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PRODUCTIVE CHARACTERISTICS OF PIGS OF DIFFERENT ORIGIN

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Scientific and industrial research was carried out at the industrial pig farm. The efficiency of industrial crossbreeding of Large White pigs with Landrace and Pietrain meat breeds has been clarified. The reproductive capacity of sows after crossing with boars of different breeds, growth and development and fattening qualities of piglets of different genotypes were studied in a comparative aspect.

Six experimental groups of pigs were formed for the experiment: Group I - purebred Large White breed, Group II - Landrace breed and Group III - Pietrain breed. Groups IV and V included crossbreeds IV - ½ Large White × ½ Landrace and V - ½ Large White × ½ Pietrain, respectively. Group VI is represented by three-breed hybrid animals: ¼ Large White × ¼ Landrace × ½ Pietrain. Such a scheme is due to obtaining crossbreds with high growth energy and good meat qualities.

According to the indicators of growth and development, crossbred piglets had better dynamics during the entire growing period. At the end of fattening, the animals of Groups IV and VI exceeded their purebred contemporaries of the Large White breed in terms of reaching a body weight of 100 kg 10 and 8 days faster.

The best slaughter yield had pigs of Group VI - ¼ Large White × ¼ Landrace × ½ Pietrain. A high indicator had also animals of Group IV - ½ Large White × ½ Landrace.

In general, crossbred pigs obtained from different combinations of breeds ½ Large White × ½ Landrace and ¼ Large White × ¼ Landrace × ½ Pietrain exceeded their peers of purebred origin in terms of reproductive capacity and indicators of growth and development of piglets.

During the research, it was also found that the half-carcass length was better in crossbreeds of the Landrace breed. Landraces also had a positive effect on the index of spigot thickness. The area of the "muscle eye" and the mass of the rear third of the half-carcass were significantly influenced by the Pietrain breed.

Key words: pigs, Large White, Landrace, Pietrain, crossing, crossbreds, heterosis, productivity.

ПРОДУКТИВНІ ОСОБЛИВОСТІ СВИНЕЙ РІЗНОГО ПОХОДЖЕННЯ

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Науково-виробничі дослідження проводились в умовах промислового свинопідприємства. З'ясована ефективність промислового схрещування свиней великої білої породи з плідниками зарубіжних м'ясних порід ландрас і п'єтрен. Дослідженні в порівняльному аспекті відтворювальна здатність свиноматок за поєднання з плідниками різних порід, ріст і розвиток та відгодівельні якості молодняку різних генотипів.

Для досліду сформували шість дослідних груп свиней: І група – чистопородна велика біла порода, ІІ група - порода ландрас і ІІІ група – порода п'єтрен. Групи IV і V включали помісей відповідно IV - ½ велика біла × ½ ландрас і V – ½ велика біла × ½ п'єтрен. VI група представлена трипородними помісними тваринами ¼ велика біла × ¼ ландрас × ½ п'єтрен. Така схема зумовлена отриманням помісних тварин з високою енергією росту та добрими м'ясними якостями.

За показниками росту і розвитку помісні підсвинки мали кращу динаміку впродовж усього періоду вирощування. У кінці відгодівлі тварини IV і VI груп перевищували чистопородних ровесників великої білої породи за показником досягнення живої маси 100 кг на 10 і 8 діб швидше.

Найкращим забійним виходом характеризувалися підсвинки VI групи – ¼ велика біла × ¼ ландрас × ½ п'єтрен. Високий показник був також у тварин IV групи – ½ велика біла × ½ ландрас.

У цілому помісні свині, які отримані за різних поєднань порід ½ велика біла × ½ ландрас та ¼ велика біла × ¼ ландрас × ½ п'єтрен перевищували своїх ровесників чистопородного походження за відтворювальною здатністю та показниками росту і розвитку молодняку.

В процесі досліджень також з'ясовано, що довжина напівтуші була кращою у помісей породи ландрас. Ландраси також позитивно вплинули на показник товщини шпигу. На площу «м'язового вічка» та масу задньої третини напівтуші суттєвий вплив мала порода п'єтрен.

Ключові слова: *свині, велика біла, ландрас, п'єтрен, схрещування, помісі, гетерозис, продуктивність.*

Introduction. The successful development of the pig farming is based on the use of various highly productive breeds. In modern technological conditions of domestic pork farming, animals of foreign origin are increasingly used (Barkar E.V. et al., 2019). However, practical experience shows that pig farming can be effective using both domestic and foreign pigs in various combinations. Multiple scientific works testify to the efficiency of such combinations, when a high effect of heterosis is ensured (Susol R. et al., 2020; Khalak V. et al., 2019; Tsereniuk O. M. et al., 2020). The mentioned publications emphasize the improvement of growth, development and meat productivity of fattening animals under the conditions of crossbreeding of pigs of domestic breeds with foreign ones. The researchers recommend combining sows of the Large White breed with boars of the Landrace, Duroc and Pietrain breeds.

The issue of improving the reproductive capabilities of sows by crossing them with boars of other breeds is covered in the scientific works of Garmatyk K. et al., (2020); Khramkova O. M., (2019); Korenieva Zh. et al., (2021). The researchers note that sows of the Large White breed crossing with boars of meat breeds increases their multifertility, newborn piglet weight, sow milk yield and pre-weaning preservation of piglets.

Some scientists studied the dependence of the reproductive abilities of sows on technological factors (Martyniuk I. M. et al., 2019; Povod M. H. et al., 2022). In the studies, the frequency of insemination, the duration of the suckling period, and the type of feeding of piglets were studied.

The influence of crossbreeding on the quality of meat and fat productivity was also studied by a number of researchers, who covered it in both general and detailed aspects in their scientific publications. Such questions are covered in the works of Bankovska, I. B. et al., (2020); Khalak V.I. et al., (2021).

In addition to genetic determinants, the productivity of pigs is influenced by feeding and housing factors. The influence of enzymes on the meat quality of pigs was studied by Khalak V.I. et al., (2020).

Kalinchyk M.V. et al., (2018) focus on determining pig feeding standards in global practice. Technological elements, including types of feeders, are an important element of the preservation and productivity of animals (Lykhach, A. et al., 2017). Researchers note the advantage of modern technologies in order to improve the level of productivity of pigs (Susol, R. et al., 2021).

Working out the issue of comparative characteristics of pigs of different origin, it is worth referring to the works of Berezovskyi M. D. (2016, 2019), who focuses on the fattening and meat qualities of pigs of the Large White breed, as the basic maternal form for crossing and hybridization. The issue of the productivity of Pietrain pigs is covered in the publications of Kirovycha A. et al., (2023).

Totsii O. (2021) reveals the productive features of Pietrains using different breeding methods.

Considering the productivity of pigs of different breeds and their crossing in order to use the effect of heterosis, it is worth referring to the works of Khvatov M.A. (2012); Susol R.L. et al., (2020).

All biological aspects of increasing the productive properties of pigs are determined by market requirements. Thus, Kopytets N.H. (2018) shows the current state and development trend of the pork market in Ukraine. Similar issues are highlighted by Lavruk O.V. & Lavruk N.A. (2020); Prymuk, O. R. et al., (2019).

In conclusion, it should be outlined that the study of the productive characteristics of pigs of various origins is carried out on a wide range of issues, taking into account market requirements, the use of modern pork production technologies, various feed factors, breeding achievements and economic feasibility. However, research of economic conditions, genetic trends, and other factors is still relevant. Further experimental works on the study of the efficiency of crossing pigs of different origin in order to obtain high fattening indicators of productivity and quality of meat and fat products provide new scientific information in the disclosure of the specified problem.

The purpose of our work was to find out reproductive features and indicators of growth, development and formation of meat productivity of Large White, Landrace and Pietrain pigs in a comparative aspect at the industrial pig farms. The efficiency of industrial crossing of the Large White breed with boars of Landrace and Pietrain breeds was studied.

Research materials and methods. Scientific and industrial research was carried out in 2019-2021 with the support of "Feedlife" LLC at the "Krasnopilsky" LLC in the Sumy oblast.

The study of reproductive abilities of animals of different genotypes was conducted on the stock of six experimental groups of sows. The groups were formed according to the principle of peers by origin, age, body weight, number of seven heads each (Table 1). Fertilization was carried out by breeding boars of the Large White, Landrace and Pietrain breeds.

Table 1

Methodical scheme of scientific and economic research

Group	Parent stock*				Young stock	
	Sows		Boars			
	genotype	n	genotype	n	genotype	n
I	LW	7	LW	2	LW	82
II	L	7	L	2	L	76
III	P	7	P	2	P	70
IV	LW	7	L	2	½ LW ×½ L	83
V	LW	7	P	2	½ LW ×½ P	77
VI	½ LW × ½ L	7	P	2	¼ LW ×¼ L × ½ P	85

** Conventional designations: LW - Large White breed of pigs; L - Landrace breed; P - Pietrain breed; ½ LW × ½ L – crossbred sows of Large White and Landrace, ½ LW × ½ L and ½ LW × ½ P – two-breed crossbred piglets; ¼ LW ×¼ L × ½ P – three-breed crossbred piglets.*

To study the dynamics of growth, development and fattening qualities of piglets of different origins, six groups of 14 heads of each genotype were formed. Two gilts and two piglets were selected from each sow.

Pig housing and feeding conditions were identical for all groups. The type of feeding is a concentrate. Concentrates used were pre-starter, starter, grower and finisher developed by "Feedlife" LLC

Recipes of compound feed for young pigs are given in Table 2.

Table 2

Compound feed recipes for young animals, %

Components	On growing	On fattening	
		I stage	II stage
Wheat	26	38	42
Barley	24	20	18
Corn	25	27	30
Concentrate	starter 25	grower 15	finisher 10

Weaning of piglets was at the age of 28 days. Rearing of piglets was carried out up to 90 days old in groups of 28 heads per pigpen.

Fattening lasted: I phase 91-140 days, II phase over 141 days until reaching a body weight of 115 kg.

Body weight of young animals was determined at the age of two, four, six and eight months individually for each head. Linear body measurements were taken at the age of four and eight months.

The study of slaughtering qualities was carried out at the Sumy Meat Processing Plant. 10 heads from each group of animals were subjected to control slaughter. Five carcasses each were subject to complete collapse.

The obtained results were calculated by the method of variational statistics.

Research results. Adhering to all the technological requirements of feeding and housing the parent herd of pigs under the conditions of purebred breeding of Large White, Landrace and Pietrain pigs, and their crossbreeding according to the research scheme, the following indicators of reproductive abilities of sows were obtained (Table 3).

Table 3

Reproductive abilities of sows of different genotypes, M ± m

Group	Multifertility, heads	Newborn piglet weight, kg	Sow milk yield, litter weight on the 21st day, kg	Pre-weaning preservation, %
I	11.7 ± 0.41	1.27 ± 0.014	64.1 ± 0.88	89
II	10.9 ± 0.43	1.30 ± 0.064	62.0 ± 0.94	85
III	9.9 ± 0.38	1.29 ± 0.063	58.9 ± 0.79	86
IV	11.9 ± 0.47	1.36 ± 0.049	65.4 ± 1.12	87
V	11.0 ± 0.51	1.33 ± 0.056	63.8 ± 1.17	86
VI	12.1 ± 0.45	1.35 ± 0.058	65.9 ± 1.21	89

Based on the results of the research, it was established that the domestic Large White breed of pigs had better reproductive qualities compared to the Landrace and Pietrain breeds. Thus, in terms of multifertility, the advantage of the Large White breed over the Landrace breed was 7.3%, and over the Pietrain breed was 18.2% ($p \leq 0.01$). In terms of newborn piglet weight, the Large White breed was slightly inferior to Landrace and Pietrain.

The milk yield indicator generally characterizes the reproductive qualities of sows The analysis of the results shows that the productivity of sows is a breed determinant. However, the breeding method is a significant factor that affects the resulting trait. Crossbreeding has a positive effect on indicators of multifertility, newborn piglet weight and pre-weaning preservation of piglets.

Therefore, when sows of the Large White breed were crossbred with boars of the Landrace breed, multifertility increased by 1.7%, and newborn piglet weight – by 7.1% compared to purebred breeding of the parent breed. Crossbreeding of the Large White with the Pietrain breed only contributed to an increase in newborn piglet weight. The most effective one was the crossbreeding of crossbred sows ½ Large White × ½ Landrace with the Pietrain breed. Their multifertility exceeded the group of purebred Large White breed by 3.4% ($p \leq 0.01$), and newborn piglet weight by 6.3% ($p \leq 0.05$).

In general, it can be stated that the combination of sows of the Large White breed with breeders of meat breeds Landrace and Pietrain contributes to the increase of their reproductive qualities in terms of multifertility, newborn piglet weight and milk yield. Considering mentioned above, it should be outlined that the domestic gene pool

of Large White pigs is highly productive and effective after crossbreeding with other breeds of foreign origin.

Growth and development indicators of young pigs are an important criterion for comparing animals of different origins. The dynamics of body weight of piglets in different age is shown in Table 4.

Table 4

Dynamics of body weight of young pigs on growing and fattening, M ± m

Group	n	Body weight at age, kg			
		2-month	4-month	6-month	8-month
I	14	17.5 ± 0.23	43.3 ± 0.38	74.0 ± 0.41	114.1 ± 0.66
II	14	16.9 ± 0.26	42.5 ± 0.41	72.2 ± 0.50	112.4 ± 0.55
III	14	16.2 ± 0.25	41.1 ± 0.39	71.4 ± 0.47	113.0 ± 0.64
IV	14	17.7 ± 0.27	44.4 ± 0.33	73.9 ± 0.44	116.0 ± 0.67
V	14	17.9 ± 0.31	43.1 ± 0.37	73.7 ± 0.41	114.9 ± 0.59
VI	14	18.0 ± 0.29	45.0 ± 0.42	74.6 ± 0.49	115.8 ± 0.74

The analysis of the obtained results shows that the most stable and high indicators of body weight growth were characterized by crossbreeds of Large White breeds and various crossbreds, namely: ½ Large White × ½ Landrace, ½ Large White × ½ Pietrain, ¼ Large White × ¼ Landrace × ½ Pietrain Thus, at the age of two months, crossbred piglets of Group IV exceeded purebred peers of the Large White breed by 1.4% in body weight, and crossbreds of Groups V and VI, respectively, by 2.3% and 2.9%. At the age of four months, the piglets of Group VI had the best indicators in terms of body weight, whose advantage over the animals of Group I was 3.9%. In subsequent age periods, the trend in favor of crossbreds was preserved. In the final period of fattening, the superiority of crossbreds over purebreds in terms of body weight is clearly observed. Accordingly, at the age of eight months, piglets of Group IV exceeded purebred peers of the Large White breed by 1.7%, Landrace breed by 3.2%, and Pietrain breed by 2.7% in terms of body weight. A similar trend of superiority of crossbreeds over purebreds was observed among the herds of Groups V and VI. However, in the comparative aspect, the reliability criteria of differences between groups were unlikely ($p \geq 0.05$). Therefore, the advantages of some groups of piglets over others are tendentious.

Linear growth indicators are shown in Table 5.

Linear growth parameters were generally satisfactory and met target breed standards. However, for crossbreds, better developed heart girth and body length were more typical

Table 5

Indicators of linear growth of young pigs, M ± m

Group	Body height, cm	Body length, cm	Heart girth, cm	Cannon girth, cm
	4 months			
I	47.1 ± 0.18	84.3 ± 0.27	80.0 ± 0.37	13.4 ± 0.07
II	46.3 ± 0.21	85.1 ± 0.31	77.4 ± 0.33	13.1 ± 0.06
III	45.9 ± 0.19	83.9 ± 0.27	73.9 ± 0.32	13.2 ± 0.05
IV	48.4 ± 0.24	86.1 ± 0.26	81.3 ± 0.34	13.7 ± 0.09
V	48.3 ± 0.23	85.0 ± 0.25	80.1 ± 0.27	13.5 ± 0.08
VI	49.3 ± 0.22	88.1 ± 0.32	81.2 ± 0.29	13.8 ± 0.08
	6 months			
I	59.4 ± 0.26	108.2 ± 0.43	102.4 ± 0.34	15.2 ± 0.08
II	60.3 ± 0.21	119.1 ± 0.37	99.7 ± 0.41	14.9 ± 0.09
III	58.4 ± 0.19	110.1 ± 0.36	100.5 ± 0.31	14.7 ± 0.07
IV	60.3 ± 0.22	118.4 ± 0.29	102.8 ± 0.33	15.1 ± 0.09
V	60.0 ± 0.27	116.0 ± 0.33	101.7 ± 0.29	15.0 ± 0.11
VI	61.2 ± 0.25	119.9 ± 0.28	103.1 ± 0.19	15.3 ± 0.07

Having a high energy of growth, pigs of Large White breed and animals of crossbred genotypes reached a marketable body weight of 100 kg a little earlier than pigs of foreign origin Landrace and Pietrain. Phenotypic features of pigs of different origins are illustrated in Fig. 1.

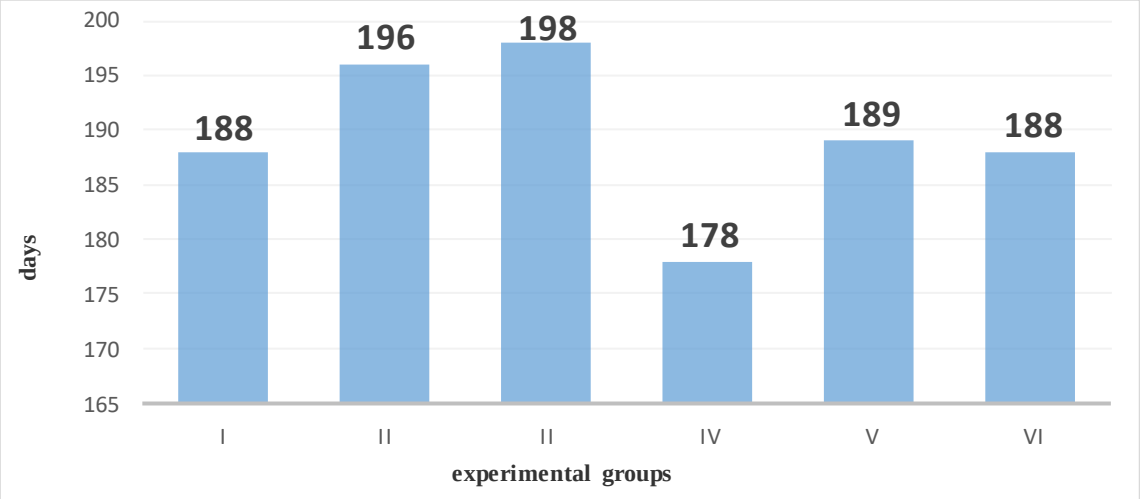

Fig. 1. **Age at which pigs reach body weight of 100 kg, days**

It was established that pigs of the Large White breed reached marketable weight 4.25% faster than pigs of the Landrace breed and 5.32% faster than the Pietrain breed, or by 8 and 10 days, respectively.

Crossbreds of ½ Large White × ½ Landrace, which reached body weight of 100 kg in 178 days, were especially different in terms of growth rate, which is 10 days faster than purebred pigs of the Large White breed.

The feeding qualities of experimental piglets are shown in Table 6.

Table 6

Feeding qualities of piglets of different origin, M ± m

Group	Body weight at the beginning of fattening	Average daily gain in fattening	Feed consumption per 1 kg of growth, kg
I	30.4 ± 0.19	710.2 ± 4.89	4.22 ± 0.02
II	29.7 ± 0.22	663.2 ± 5.32	4.38 ± 0.02
III	28.7 ± 0.27	660.2 ± 4.29	4.49 ± 0.03
IV	31.1 ± 0.31	782.9 ± 5.11[б]	3.98 ± 0.04[в]
V	30.5 ± 0.28	685.0 ± 5.28	4. 32 ± 0.02
VI	31.5 ± 0.24[а]	699.0 ± 5.15	4. 11 ± 0.03

a – p<0.001 (regarding Groups II and III); b- p<0.01 (regarding Groups II; III) and p<0.05 (regarding Groups V and VI).

The results of fattening show that piglets of the Large White breed showed high average daily gains, which were 7.1% and 7.6% ($p \leq 0.001$) higher than of piglets of the Landrace and Pietrain breeds. However, in terms of growth, the best ones were crossbreds of Group IV - ½ Large White × ½ Landrace, which exceeded purebred peers of the Large White breed (Group I) by 10.2% ($p \leq 0.001$). Indicators of feed consumption per unit of growth varied accordingly. The difference between Groups IV and I was also highly reliable ($p \leq 0.001$).

Purebred piglets on fattening paid better for feed in gain indicator than purebreds of Landrace and Pietrain meat breeds. The feed saving was 3.7% in relation to the Landrace breed and 6.1% in relation to the Pietrain breed. But crossbreds had a tendency of better feed consumption per unit of gain in relation to purebreds of Large White. The pigs of Group IV were especially different.

The greatest absolute gain per 100 kg of feed was obtained in the group of crossbreed pigs ½ Large White × ½ Landrace (Fig. 2). Crossbreeds ¼ Large White × ¼ Landrace × ½ Pietrain and purebreds of the Large White breed also have typically high indicators of absolute gain per unit of feed. Crossbreeds ½ Large White × ½ Pietrain and purebred Landraces and Pietrains were inferior to piglets of Groups I, IV and VI in terms of this indicator.

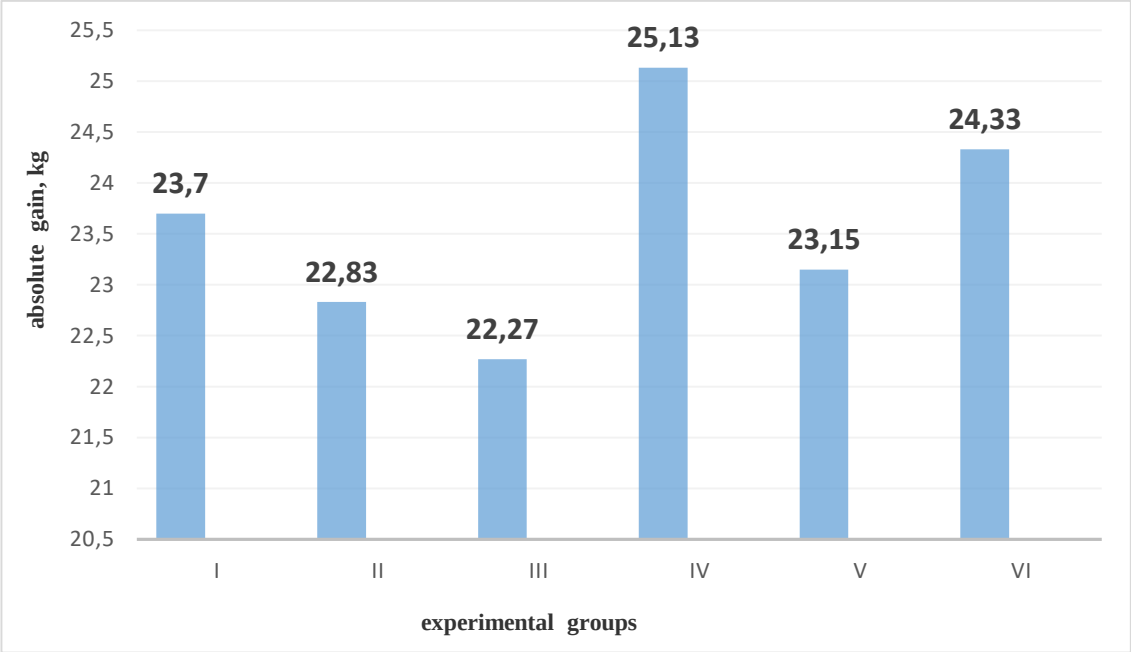

Fig. 2. **Diagram of absolute gain per 100 kg of feed**

The typical differences of pigs of different origins are the indicators of pig slaughter and meat and fat productivity. The slaughter yield of pigs of different genotypes is presented in Fig. 3.

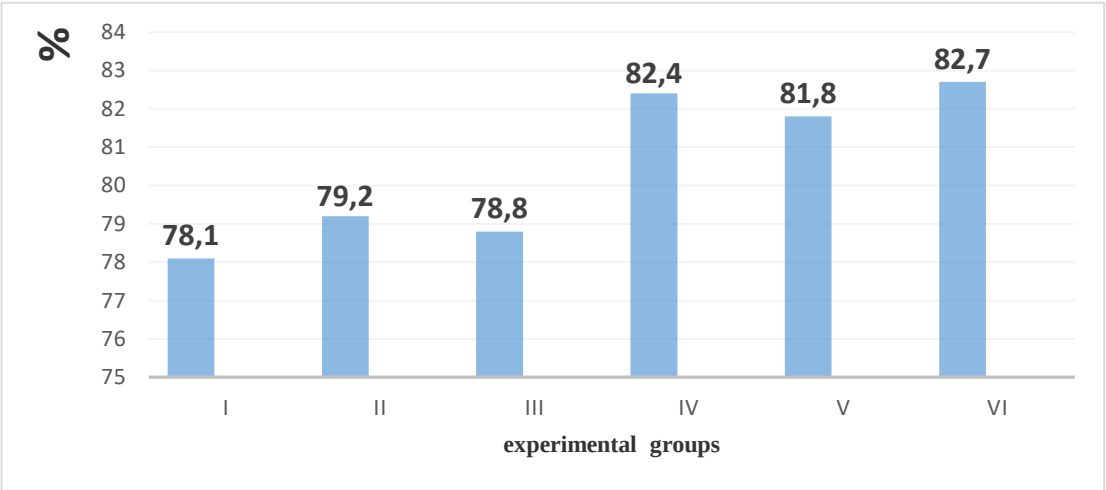

Fig. 3. **Indicators of slaughter yield of pigs of different origin**

The materials presented in Fig. 2 show that the carcasses of crossbreds of Large White and Landrace breeds slightly exceeded other genotypes in terms of slaughter yield. In particular, piglets of Group VI and Group IV, which had a high "blood share" of the Landrace breed, were the best in terms of slaughter yield. The slaughter yield of these groups was 5.9% and 5.5% higher than that of pigs of the Large White breed.

Meat and fat indicators are an important characteristic of pigs of various origins. The linear parameters of animal carcasses of various origins are given in Table 7.

Table 7

Indicators of meat and fat productivity of pigs of different genotypes, M ± m

Group	Slaughter indicators			
	half-carcass length, cm	thickness of lard, mm	area of "muscle eye", cm^2	weight of the rear third of the carcass, kg
I	91.8 ± 1.02	28.1 ± 0.11	32.7 ± 0.89	11.2 ± 0.38
II	96.7 ± 1.08	25.4 ± 0.09	31.9 ± 0.42	12.5 ± 0.44
III	92.5 ± 0.97	26.7 ± 0.12	37.8 ± 0.92	13.3 ± 0.51
IV	97.2 ± 1.22	24.4 ± 0.17	34.4 ± 1.01	13.2 ± 0.81
V	95.8 ± 1.33	25.5 ± 0.13	38.9 ± 0.87	14.1 ± 0.77
VI	97.4 ± 1.28	24.9 ± 0.15	39.1 ± 0.99	14.7 ± 0.69

Analyzing Table 7, it is worth noting that the Landrace breed is characterized by a significantly longer half-carcass compared to animals of Large White and Pietrain breeds. However, this breed is characterized by a smaller thickness of lard. Crossbreds of the Landrace bloodline inherited its inherent characteristics and, crossbred with the Large White and Pietrain, provided good parameters of slaughter indicators.

Summarizing our own research results, it is worth pointing out that similar data were obtained and published by a number of other researchers in their works.

Our results give grounds for asserting that the domestic Large White breed as well as breeds of foreign origin Landrace and Pietrain, which have undergone long-term acclimatization and adaptation to the natural conditions of Ukraine and local technologies, have certain breed characteristics, but are well crossbred in industrial crossbreeding systems, provide significant effect of heterosis, characterized by high productive qualities.

Discussion. The obtained results of studies on the productivity of pigs of different origins and the efficiency of their crossbreeding in industrial schemes for pork production at pig farms have results similar to other works. Thus, Berezovskyi M. D. (2016, 2019); Barkar, E. V. et al., (2019); Khalak, V., (2019) outlined the expediency of using Large White breed as a basic parent in industrial crossbreeding schemes. In this context, our results also correlate with the results obtained by these scientists.

Considering the above results of the conducted research, breed specific features of the formation of pig productivity can be clearly traced. Pigs of the Large White breed had better indicators of body weight than pigs of the Landrace and Pietrain breeds. Similar features of the productivity of pigs of different genotypes are described in the studies of such scientists as Korenieva, Zh. et al., (2021); Susol R. et al., (2020); Tsereniuk O. M. et al., (2020). These and other similar works confirm our conclusions regarding the breed characteristics of productivity forming.

In the conducted studies, it was found out that breeding boars of meat breeds – Landrace and Pietrain – significantly influenced the indicators of growth energy, development, slaughter and meat and fat qualities of young crossbreds.

Similar conclusions were obtained in the studies of Dudka E. I., (2019); Tatsii, O., (2021); Kirovych N. et al., (2023) and a number of others.

In the work, there is a statement about the distinctive features of the linear growth of young pigs of different genotypes. A more elongated body structure of Landrace pigs and crossbreeds ½ Landrace × ½ Large White is outlined. This feature is men-

tioned in the publications of Garmatyk K. et al., (2020); Susol R. et al., (2020); Susol R. et al., (2021);

In general, crossbreeding contributes to higher indicators of growth, development and fattening qualities of crossbreds, which is explained by the effect of heterosis. In our study, emphasis is put on the effect of heterosis due to crossbreeding of sows of the Large White breed with boars of Landrace and Pietrain meat breeds. Khvatova M.A. (2012); Tsereniuk O. M. et al., (2020) outline the effect of heterosis in industrial crossing schemes.

Therefore, the results of our research, obtained in the specific conditions of the production technology, tend to coincide with the data of other researchers who conducted experiments to study the productivity of pigs under different breeding schemes.

Conclusions.

1. The use of the domestic Large White breed of pigs in modern conditions of pork production is efficient both in purebred breeding and in systems of industrial crossing with Landrace and Pietrain meat breeds.

2. Crossbreds have high indicators of growth energy, are characterized by good slaughter and meat and fat qualities. The best crossbreds were ½ Large White × ½ Landrace and ¼ Large White × ¼ Landrace × ½ Pietrain.

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