2024 SCIENCELINE

Online Journal of Animal and Feed Research

Volume 14, Issue 4: 225-233; July 30, 2024

ISSN 2228-7701

DOI: https://dx.doi.org/10.51227/ojafr.2024.27

THE EFFICIENCY OF PIGS FROM DIFFERENT GENETIC ORIGINS UNDER INDUSTRIAL CONDITIONS IN UKRAINE

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Supporting Information

RESEARCH ARTICLE
PII: S222877012400027-14
Received: April 18, 2024
Revised: June 19, 2024
Accepted: July 15, 2024

ABSTRACT: The study investigated the dependence of the fattening qualities of pigs and the economic efficiency of their breeding on their genetic origin. Two groups of 28 sows of Danish and Canadian origin inseminated with semen from Durok boars served as research material. A control group consisted of F_1 sows of the Landrace and Large White Danish breeds inseminated with semen from Danish Durok boars. The group II, on the other hand, consisted of F_1 sows of similar breeds from Canadian selection inseminated with semen from Canadian Durok boars. The studies focused on the efficiency of the sows' reproductive function, the growth intensity of the hybrid piglets and the efficiency and profitability of their rearing and fattening. Methods of analogue pairs and statistical data analysis were used. It was found that piglets of Canadian origin had a 7.5% higher average head weight during the weaning period, which contributed to a 7.5% higher market value and at the same time to a 6.7% higher income from rearing a piglet during this period and to a 3% higher profitability of its rearing compared to analogues of Danish origin. It was shown that animals of Danish origin had a 9.6% higher gross growth of the piglet litter during the fattening period, which gave them a 7.6% higher weight at the end of the fattening period and contributed to a 7% higher cost price for this period, a 7.6% higher market value and a 10.1% higher feedlot income and a 0.77% better feedlot profitability compared to Canadian-bred counterparts. We recommend the use of sows of Danish origin if the farm intends to sell weaned piglets, in the industrial farms. If the farm intends to sell full-grown or (fattened) slaughter pigs, it is advisable to use pigs of Canadian origin.

Keywords: Breeding, Farm costs, Income, Market value, Piglet growth.

Abbreviations: LW_d is a large white breed of Danish origin; L_d is a Landrace breed of Danish origin; LW_k is a Large White breed of Canadian origin; L_k is a Landrace breed of Canadian origin; D_d is a Durok breed of Danish origin; D_k is a breed of Durok of Canadian origin, EUR is official currency of 20 EU countries, kg is kilogram.

INTRODUCTION

Pig farming is an important branch of agriculture, as it can quickly supply a large part of the population with high-quality products (Kim et al., 2024). The production and quality of pork is influenced by many factors, including animal breed characteristics, breeding methods, housing conditions, microclimatic parameters, veterinary measures, feeding technology, biosecurity measures and others (Cornelison et al., 2018; Li, 2020; Smith et al., 2021; Van Mierlo et al., 2021). To achieve efficient production, it is necessary not only to use modern equipment and good animal care in the pig complex, but also to successfully combine the reproductive and productive characteristics of pigs of different genotypes and the characteristics of different animal breeding methods (Knox, 2014; Khramkova, 2019).

The basis of the production process of pork production in all farms with a closed cycle is the reproduction of the pig herd (Maes et al., 2020). Pig breeding farms pay particular attention to the use of breeding methods that enable the most effective utilisation of the biological characteristics of the pig carcass, which subsequently determine the productivity level of the animals (Kanis et al., 2004). It is possible to implement such an approach in the conditions of an industrial pig farm by achieving the effect of heterosis through the use of hybridisation or industrial crossbreeding. According to (Vargovic et al., 2022) hybridisation represents the highest level of industrial crossbreeding, provided that specifically selected parental and maternal forms of animals are used in the breeding process, which are able to stably and with high probability transmit their best productive qualities to their offspring.

The existence of alternative opinions on the effectiveness of using different parental components leads to the existence of different hybridisation systems based on the use of sows of different combinations: Large White × Landrace, Landrace × Large White, Large White × Welsh, Welsh × Large White, Welsh × Landrace, Landrace × Welsh, etc. (Tsereniuk, 2011; Harmatiuk, 2022). It should be noted that today in Ukraine there is no unified opinion on the use of

Citation: Voloshynov V, Povod M, Mykhalko O, Verbelchuk T, Verbelchuk S, Koberniuk V, Lavryniuk O, and Shcherbatiuk N (2024). The efficiency of pigs from different genetic origins under industrial conditions in Ukraine. *Online J. Anim. Feed Res.*, 14(4): 225-233. DOI: https://dx.doi.org/10.51227/ojafr.2024.27

terminal (terminal) boars, since the main terminal parental forms that are widely used are Durok, Pietren, Alba, Optimus, Maxter, Maxgrow and others (Pundyk, 2023).

It should be noted that the process of pedigree breeding in pig breeding requires the use of previously created and subsequently genetically developed and improved genotypes of pigs based on the evaluation of their breeding value separately for different breeds and types that differ in high growth intensity (Khakhula and Svynous, 2017). Even today, the breeding process includes the use of the best breed types and lines in industrial pig farms as well as targeted selection for traits such as stress resistance and high resistance of animals to many diseases (Guy et al., 2012). It is worth noting that the experience of using foreign-bred pigs shows that imported breeds have certain problems, because in production conditions an important requirement of animal breeding is violated - separate production use, as well as appropriate conditions of keeping and feeding, which negatively affects the productivity of animals, resource intensity and economic efficiency of the industry (Ibatullin, 2017).

Therefore, the biological characteristics of the pig carcass determine the quantitative and qualitative characteristics of the company's production activity, both from a zootechnical and economic point of view. The rational use of different pig breeds is one of the ways to increase animal productivity and strengthen the profitability of the industry (Matache, 2016; Ibatullin et al., 2019). Danish genetics is the most represented in Ukraine, as its potential is very high. The Danish Landrace is one of the parent breeds in the Danish crossbreeding programme. Due to the fact that this breed is characterized by exceptional fertility, high reproductive and good slaughter characteristics, it is used as a dam line for the production of an F1 hybrid pig, which is known worldwide for its economic indicators in the production of fattening pigs (Bergman et al., 2019; Bublyk, 2023).

The Danish F1 hybrid pig is the result of crossing the Danish Landrace with the Danish Yorkshire, which provides the most ideal production basis for producing commercial pigs in terms of economic yield and production efficiency. All this is ensured by low feed conversion ratio, high weight gain, hyper-multifertility, good maternal traits, persistency and excellent fattening traits of the offspring of these pigs (Traspov et al., 2016). The Danish Durok is a terminal boar in the breeding program of Danish Genetics. Duroc is known for its high gains, low feed conversion, high yields, and good meat quality. This is why the Duroc is the obvious choice for the parent line in the insemination of hybrid gilts for the production of commercial pigs because this cross achieves ideal production results (Cilla et al., 2006; Illing 2018). Pigs of Danish origin are quite competitive in Ukraine and account for about 40% of the breeding stock among all industrial pork producers in our country (Mahfuz et al., 2022).

Recently, however, pigs of other genetic origin have become increasingly popular on the Ukrainian market, among which animals of Canadian genetics, obtained by 100% heterosis and breed complementarity, stand out. Pigs of Canadian origin are focused on productivity, fast growth, fattening efficiency and high final results (Simon, 2023) In the breeding of pigs of Canadian origin, purebred Landrace, Yorkshire and Duroc pigs are used as genetic material, which ensures the homogeneity of the herd through crossbreeding. As a result, purebred Canadian Duroc terminal pigs dominate in independent studies on growth rate, feed conversion and carcass characteristics, resulting in the production of darker pork with greater marbling and higher pH (Khakhula, 2020).

Thanks to the long-term breeding program for Canadian pigs (Kennedyl et al., 2023; Statistics Canada, 2023), pigs of Canadian origin today have a higher feed intake than most other genotypes and better feed conversion, which at the same time enables them to cope with stress factors thanks to a good appetite, which has a positive effect on growth and thus on the profits of pig farms (Grossi et al., 2017).

Therefore, considering the constant competition between the used genotypes of pigs of foreign origin among pork producers in Ukraine and the different approaches to their breeding, which have a significant economic impact on the efficiency of pig farms, further research in this area of the pig industry remains relevant.

The purpose of the work was to establish the economic efficiency of obtaining, rearing and fattening pigs of Danish and Canadian origin in conditions of intensive pork production in the southern region of Ukraine.

MATERIALS AND METHODS

Biological material

The study was conducted at Agro Novoraiske LLC in the Kherson region of Ukraine. The subject of the study was the productive characteristics and fattening indicators of pigs (weight of 1 pig at the end of fattening; absolute growth of one pig at fattening; weight of a nest of pigs at the end of fattening; gross gain of a nest of piglets during the fattening period) derived from crossbred sows of different genetic origin. For the studies in 2023, two groups of sows of Danish and Canadian origin, 28 animals each, were formed according to the experimental design (Table 1) using the method of analogous pairs according to generally accepted methods (Ladyka et al., 2023).

The first group, which was considered the control, included F_1 sows derived from animals of the Danish Landrace and Great White breeds and inseminated with semen from Danish Duroc boars. The second group, defined as the experimental group, included F_1 analogues derived from pigs of similar breeds but Canadian selection to be inseminated with the semen of Canadian Duroc boars.

Table 1 - Scheme of the experiment.

Indicators	Group I	Group II
Number of sows in the group, head	28	28
Fertility of sows	(♀LWd × ♂Ld)	(♀LWк × ♂Lк)
Number of boars, head	3	3
A breed of boars	Dd	Dк
Genotype of piglets	(♀LWd × ♂Ld) × Dd	(♀LWк × ♂Lк) × Dк
Average age at weaning of piglets, days	28	
Method of feeding suckling piglets	Dry starters from the 14th day	
The method of keeping piglets for growing	Floor-pen on a solid lattice floor, in groups of 25 heads	
The method of feeding piglets for growing	Dry full-rational granulated fodder	
Average age of piglets at the beginning of fattening, days	79	
The method of keeping pigs for fattening	Floor-pen on a partially latticed concrete floor, in groups of 25 heads	
Method of feeding pigs	Dry full-ration loose fodder	
The average age of pigs at the end of the experiment, days	175	

Feeding and rearing conditions

The sows were kept in individual pens on a partially slatted floor during the resting and rearing periods. The sows in the experimental groups were inseminated vaginally according to the experimental plan using disposable catheters from the company "MS Schippers" (Netherlands) with freshly diluted boar semen, which were located in the farm's artificial insemination station. After insemination, all test sows were kept in the same individual pens in which the insemination was carried out until the 28th day after insemination of the main sow group. On the 29th day after insemination, all animals in the experimental groups underwent ultrasound diagnostics to determine the presence of fertility. They were then regrouped according to the results obtained and moved to a room for sows with proven fertility, where they were kept until the 112th day after insemination.

All experimental sows were moved to the farrowing room when they had reached 110-112 days of gestation. The sows in this workshop were housed individually, restrained, in 1.8 × 2.5 m pens on a fully slatted floor. To create a local microclimate for the piglets, each pen is equipped with a mat for contact heating of the piglets and an infrared lamp above it. The sows were fed in all physiological periods with fully rationed, balanced feed mixtures according to suitable recipes that corresponded to the recommendations of the feed suppliers and the condition of the animals. Feeding of the piglets was started from the 14th day of life with a pre-starter mixed feed distributed in the automatic feeder attached to the rear of the farrowing pen.

Upon completion of the suckling period, two groups of piglets, each consisting of 250 heads from the sows of the I and II groups, were formed using the group-analog method according to the methodology of (Ladyka et al., 2023). For this purpose, all healthy and well-developed piglets from each experimental group were sorted by sex and weighed separately, gilts and boars. Then, the average weight of the animals in each group was determined. Each experimental piglet was individually weighed, tagged with a numbered ear tag of the corresponding color (green for the group I and red for the group II), and marked on its back with a marker indicating its weight in grams. Piglets with weights closest to the group's average weight were selected for the both groups. After forming the groups of 250 heads each and determining the average actual weight for the group, the average weight was corrected by replacing pigs of different weights but the same sex within each group until the actual group weight matched the calculated group weight. In this composition, except for animals that were withdrawn, the groups of pigs remained throughout the entire growing period and were subsequently housed in pens of 25 heads during the fattening period. Piglets of both groups were weighed individually when they were transferred from the breeder to the rearing shop, where they were kept in identical pens of 25 heads each, on a fully latticed floor at the rate of 0.35 m^2 of the pen area per head.

Ventilation in the room was negative pressure due to exhaust wall fans located on one side of the room and inflow aerodynamic valves located on the other side of the room, from the side of the gallery. The piglets were fed with full-rational balanced pelleted feed.

All technological, veterinary and preventive measures for piglets of both groups were carried out according to the same protocol. Feed consumption by piglets was recorded daily by weighing it when it was loaded into the hoppers of self-feeders, and the number, weight, and reasons for dropping animals from the experiment were taken into account. At the end of rearing, the piglets of the experimental groups were weighed individually during the transfer from rearing to fattening and, based on the results of this weighing, two groups of pigs of different genetic origin were formed according to the research scheme, by the analogue group method according to the methodology (Ladyka et al., 2023). In the fattening house, the animals of both experimental groups were kept in identical pens with 25 animals each on a partially barred concrete floor at a ratio of 0.75 m^2 of pen area per animal.

The rooms were ventilated via roof fans and supply air valves located on both sides of the rooms. Manure was removed in all stalls by a periodically operating vacuum gravity system. The pigs were fed with fully rational, balanced bulk feed in a multi-phase mode. The conditions of feeding, watering, maintenance, care and prevention of the animals in the experiment took place in accordance with the European legislation on the protection of animals and their comfort (Council Directive, 2010).

Statistical analysis

The trial investigated the dependence of the reproductive performance of sows of Danish and Canadian origin, the growth intensity from weaning to slaughter of their hybrid offspring, the efficiency and profitability of rearing and fattening a nest of their piglets. The experimental data were processed by the method of variation statistics using computer equipment and the software packages MS Excel 2016 and Statistisa V.5.5 (Kramarenko et al., 2019).

RESULTS AND DISCUSSION

Based on the results of studies on the dependence of the reproductive and fattening qualities of pigs on their genetic origin, an assessment of the efficiency of rearing and fattening a litter of piglets from sows of Danish and Canadian origin was carried out. Since the sows of both experimental groups were selected according to the method of analogy groups, the costs of keeping them until the beginning of farrowing were the same. However, due to the different fertility of the sows, the cost of a piglet at birth was not the same (Table 2).

Table 2 - The efficiency of raising suckling piglets of different genetic origin

Indicators	Group I	Group II
The average cost of keeping one sow during farrowing, EUR	119,78	119.78
Multifertility, pigs	15.1±0.31**	13.4±0.24
Cost of one piglet at birth, EUR	7.93	8.94
The cost of keeping a sow during the suckling period, EUR	30.19	30.19
The cost of a nest of piglets at weaning, EUR	149.97	149.97
Number of piglets at weaning, pigs	13.3±0.29**	12.1±0.21
Cost of one piglet at weaning, EUR	11.28	12.39
Average weight of one piglet at weaning, kg	6.7±0.19	7.2±0.14*
Cost of 1 kg of live weight of piglets at weaning, EUR	1.68	1.72
Cost of 1 kg of live weight gain of piglets before weaning, EUR	2.08	2.14
Weight of the nest of piglets at weaning, kg	89.1±2.34	87.1±2.11
Market value without VAT of 1 kg of piglets at weaning, EUR	6.81	6.81
Market value of one piglet at weaning, EUR	45.62	49.03
Market value of a nest of piglets at weaning, EUR	606.73	593.11
Income from rearing the first piglet, EUR	34.35	36.63
Profitability of raising one piglet,%	7.25	7.04
Income from obtaining and growing a nest of piglets, EUR	456.76	443.14
Profitability of growing a nest of piglets, EUR	7.25	7.04

*: P <0.05; **: P <0.01.

The cost of a piglet at birth for sows of Danish origin, which had 1.7 piglets' higher fertility, was therefore 1.00 EUR lower than for sows of Canadian origin. Since the cost of keeping a sow during lactation was the same for both groups, the cost of a nest of piglets at weaning was also the same for both groups at the end of lactation. However, taking into account the fact that the number of piglets at weaning was 1.2 higher in the nests of the sows in the group I, the cost of a piglet at the end of lactation was 1.11 EUR lower than in the group II. The piglets in the group II grew more intensively during the post-weaning period and ended up with a 0.5 kg higher live weight, but due to the higher cost per piglet, the cost per 1 kg of growth was 0.052 EUR higher for the animals in the group II, and the cost per 1 kg of live weight of the piglets weaned at this time was 0.038 EUR higher than for the animals in the group I. With the same market price per 1 kg live weight of weaned piglets, the costs for a piglet nest differed due to the different weights in the I and II groups.

Due to the 2.0 kg higher live weight of the piglet nest when weaned from animals of Danish origin, the cost of the piglet nest was 13.61 EUR higher than for the animals of Canadian origin. At the same time, the market value of a piglet was 3.40 EUR higher than that of an animal from Canada due to the higher live weight at weaning.

The income from raising one piglet in the weaning period was 2.28 EUR higher in the group II, while the income from raising a nest of piglets before weaning was already 13.61 EUR higher in animals of the group I, which caused a 9.08% improvement in profitability of raising one piglet and their nest as a whole.

The animals in the group II had a 7.5% higher average weight of a piglet after weaning, which contributed to a 7.5% higher market value at weaning, a 6.7% higher income from rearing a piglet during this period and a 3.0% higher profitability of rearing compared to the animals in the group I. At the same time, they had 12.7% higher costs for a piglet at birth, 9.9% higher costs for a piglet at weaning, 2.3% higher costs for 1 kg live weight of piglets at weaning, 2.5% higher costs for 1 kg live weight of piglets before weaning, but a 2.2% lower market value of a piglet litter in this period, a 3.0% lower income from obtaining and rearing a piglet litter and a 3% worse profitability of this process.

The different orientation of the efficiency of rearing a piglet nest and a piglet was also evident in the rearing of animals of Danish and Canadian origin (Table 3). There were 250 piglets in group I and 250 in group II. Since there were 1.07 fewer piglets at the beginning of rearing in the nests of piglets of the group II, but during the period of rearing due to higher growth intensity, they had a greater absolute gain of 1.68 kg, which caused a higher weight of each animal of this group by 2.18 kg at the end of this period. At the same time, due to the smaller number of piglets in the nest in this group, they had 2.47 kg less gross growth of the piglet nest at the end of rearing, and 3.71 kg of its weight at that time. This resulted in a 0.058 EUR lower cost of 1 kg of live weight at the end of rearing in this group, a 0.080 EUR lower cost of 1 kg of weight gain for this period, a 3.30 EUR higher cost of rearing one piglet, and a 6.65 EUR its market value, 3.35 EUR more income from raising one pig, and 3.41% better profitability of its raising.

Table 3 - The efficiency of raising piglets of different genetic origins

Indicators	Group I	Group II
The number of piglets in the nest at the end of rearing, pigs	12.93	11.86
Absolute growth of piglets during the rearing period, kg	21.0±0.53	22.6±0.42**
Weight of 1 head of piglets at the end of growing, kg	27.7±0.57	29.8±0.44**
Weight of the nest of piglets at the end of rearing, kg	8.51	8.43
Gross growth of the nest of piglets at the end of rearing, kg	6.45	6.39
The cost of a nest of piglets at the beginning of rearing, EUR	149.97	149.97
The cost of a nest of piglets at the end of rearing, EUR	824.82	795.73
The cost of one pig at the end of growing, EUR	63.80	67.09
Cost of 1 kg of live weight at the end of growing, EUR	2.31	2.25
Cost of 1 kg of weight gain at the end of growing, EUR	3.04	2.96
The cost of 1 kg of live weight of a pig without VAT, EUR	3.05	3.05
The cost of one pig at the end of growing, EUR	84.30	90.95
Income from growing one piglet, EUR	20.50	23.86
Profitability of raising one piglet, %	0.77	0.85
The cost of a nest of piglets at the end of rearing, EUR	1089.80	1078.70
Income from growing a nest of piglets, EUR	264.98	282.97
Profitability of growing a nest of piglets,%	0.77	0.85

**: P <0.01.

At the same time, in the calculation of the nest of piglets in this group, the cost price of the nest of piglets at the end of rearing was recorded to be 29.08 EUR lower, its market value by 11.29 EUR at that time, but the income from its rearing was higher by 17.78 EUR and better by 3.41% profitability of this process.

Thus, during rearing, a 2.6% lower cost of 1 kg of weight gain, a 2.5% lower cost of 1 kg of live weight for this period, and a 5.2% higher cost of rearing one piglet was recorded in hybrid piglets of Canadian origin at the end of rearing and by 7.9% of its market value at the end of the period, 16.3% higher income from rearing one pig, and 3.41% better profitability of its rearing. Whereas Canadian-bred piglets had a 3.5% lower end-of-rearing nest cost, a 1.0% lower market value at that time, but a 6.7% higher rearing income and a 3.41 % profitability of growing.

A slightly different situation was observed when pigs of both genetic lines were fattened. There were 250 piglets in group I and 250 in group II. At the time of fattening, pigs of Danish origin had 0.95 more heads in the nest than pigs from Canadian breeding. At the same time, in contrast to the growth period, the growth intensity of the animals of Canadian origin proved to be lower during fattening compared to the animals of Danish origin, so that they had 1.95 kg less absolute weight gain and at the end of fattening their mass was almost balanced. At the same time, the gross growth of the piglet nest during the fattening period was 111.57 kg higher in the animals of the control group, which resulted in a 115% higher gross growth of the piglet nest during the fattening period, which resulted in a 114.99 EUR higher cost price, a 153.70 EUR higher market value at that time, a 38.70 EUR higher fattening income and a 0.77% higher profitability of fattening compared to the animals of Canadian origin.

When calculating these indicators per animal, it was found that the pigs in the experimental group had a 0.64 EUR higher price per animal and a 0.006 EUR higher price per 1 kg of live weight at the end of fattening, while at the same time the market value at the end of fattening was 0.19 EUR lower, the fattening income was 0.84 EUR lower and the profitability was 0.77% lower (Table 4).

Table 4 - Efficiency of fattening piglets of different genetic origin

Indicators	Group I	Group II
The number of piglets in the nest after fattening, pigs	12.71	11.76
Weight of 1 head at the end of fattening, kg	119.1±1.76	119.0±1.39
Absolute growth of one head at fattening, kg	90.8±1.72	88.9±1.32
Weight of the nest of pigs at the end of fattening, kg	36.06	33.32
Gross growth of a litter of piglets during the fattening period, kg	27.55	24.13
Cost of 1 kg of live weight of pigs after fattening, EUR	1.08	1.09
The cost of a nest of pigs at the end of fattening, EUR	1635.16	1520.17
Cost of 1 head upon completion of fattening, EUR	128.63	129.27
The price without VAT of 1 kg of live weight of fattening pigs, EUR	1.33	1.33
Cost of one head without VAT at the end of fattening, EUR	158.85	158.66
Price without VAT of a nest of pigs at the end of fattening, EUR	2019.37	1865.67
Income from fattening a nest of piglets, EUR	384.20	345.50
Income from fattening one pig, EUR	1269,37	1234,01
Profitability of fattening one pig, %	23,50	22,73
Profitability of fattening a nest of piglets, %	23,50	22,73

Animals of Danish origin showed a 9.6 % higher gross growth of the piglet litter during the fattening period, which gave them a 7.6 % higher weight at the end of fattening and led to a 7.0 % higher cost price at that time, a 7.6 % higher market value and contributed to a 10.1 % higher feedlot income and a 0.77 % better feedlot profitability compared to Canadian-bred peers.

At the same time, the cost price for 1 head at the end of fattening was 0.5 % higher for Canadian-bred animals, the cost price for 1 kg live weight at that time was 0.6 % higher, the market value for 1 head at the end of fattening was 0.1 % lower, the income from their fattening was 2.8 % lower and the profitability of fattening was 0.77 % lower.

In our work, we confirmed the effectiveness of using breed-line hybridization with specialized genotypes of foreign selection in modern industrial production conditions (Harmatiuk, 2022; Khramkova, 2019; Mahfuz et al., 2022; Matache, 2016; Tsereniuk, 2011). Additionally, our conclusions regarding the higher prolificacy of Danish sows were consistent with reports (Bergman et al., 2019; Vargovic et al., 2022; Bublyk, 2023) on the high prolificacy of Danish sows. According to their data, the average number of piglets weaned from Danish-origin sows was 13.5-14.0 piglets per litter, while in our studies, this figure was 13.3 heads, which is significantly higher than that of Canadian-origin animals and aligns with the conclusions of Traspov et al. (2016) about the European origin of these pigs. Our findings also confirm the reports (Illing, 2018; Matache, 2016; Vasylevych, 2021) on the high efficiency of breeding Danish pigs in Ukraine and Europe, as the profitability of piglet production in our experiment was 9.1% higher using Danish-origin pigs compared to Canadian ones, contradicting Simon (2023) who claims significant competition from Canadian-origin pigs in the Ukrainian pork market. Simultaneously, our research supports the view (Kennedyl et al., 1996; Cilla et al., 2006; Smith et al., 2021) on the high genetic potential of Canadian-origin pigs, as in our studies, pigs imported from Canada had a 7.6% higher weight at the end of the growing period, resulting in better fattening profitability compared to their Danish counterparts, which is confirmed by Grossi et al. (2017) but contradicts Bublyk (2023), who asserts higher production efficiency with Danish-origin pigs. Overall, the comparison of pork production efficiency using pigs of different genetic origins should be continued with a larger population.

CONCLUSION

It was found that piglets of Canadian origin had a higher average weight during the weaning phase by 7.5%, higher market value by 7.5%, higher revenue per piglet raised by 6.7%, and higher profitability of raising by 3.0% compared to Danish-origin piglets. However, they had higher costs per piglet at birth and weaning by 12.7%, the cost per kilogram of live weight at weaning by 9.9%, lower market value of the piglet nest by 2.2%, and lower income by 3.0% and profitability of obtaining and raising the nest by 3.0% compared to Danish-origin counterparts.

During the growing period, hybrid piglets of Canadian origin had a lower cost per kilogram of live weight by 2.6%, higher growing costs per piglet by 5.2%, higher market value by 7.9%, higher revenue per piglet raised by 16.3%, and better growing profitability by 3.41%. It was shown that Danish-origin animals had a higher gross gain of the piglet nest during the fattening period by 9.6%, higher weight at the end of fattening by 7.6%, higher cost per kilogram of live weight by 7.0%, higher market value by 7.6%, higher revenue from fattening by 10.1%, and better fattening profitability by 0.77% compared to Canadian-origin counterparts. At the same time, there was practically no difference in the cost per head and per kilogram of live weight, and the market value per head at the end of fattening. However, Canadian-origin animals showed lower income from fattening per head by 2.8% and lower fattening profitability by 0.77%.

On the basis of the conducted research, it can be proposed to use pigs of Danish origin in the conditions of industrial pig complexes of Ukraine instead of analogues that come from Canada, which will increase the efficiency of pork production.

DECLARATIONS

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Data availability
The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

Ethical considerations:
All operations and manipulation with pigs during the study were humane and did not cause animal suffering. Any treatment of pigs was respectively with the provisions of European legislation in the field of humane treatment of animals (Council Directive 86/609/EEC, 1986). The methodology of the experiment was agreed and checked by Bioethical Commissions of Sumy National Agrarian University, Sumy region, Ukraine (ethical approval number VT-24-0322-03).

Authors' contribution
O. Mykhalko contributed on data analysis and the write up of the manuscript and M. Povod conducted research; T. Verbelchuk assisted in data collecting; S. Verbelchuk reviewed the work critically. V. Voloshynov collected data and interpreted the results; V. Koberniuk compiled the manuscript. O. Lavryniuk and N. Shcherbatiuk contributed to the preparation and correction of the text. All authors read and approved the final paper for publication.

Acknowledgements
We would like to thank the director of LLC "NVP "Globinsky Pig Complex" (Poltava region, Ukraine) Kremez Mykola for his assistance in organizing and conducting the experiment.

Competing interests
The authors have not declared any conflict of interests.

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