Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 24, Issue 3, 2024
PRINT ISSN 2284-7995, E-ISSN 2285-3952

EFFECTIVENESS OF REARING AND FATTENING OF LOW-WEIGHT PIGLETS DUE TO CHANGES IN THEIR FEEDING SYSTEMS

Igor MOISEI[1], Mykola POVOD[1], Oleksandr MYKHALKO[1], Mykola POVOZNIKOV[2], Bogdan GUTYJ[3], Yulia IEVSTAFIIEVA[4], Vita BUCHKOVSKA[4]

[1]Sumy National Agrarian University, Department of Feed Technology and Animal Feeding, 160, H. Kondratiiev St., Sumy, Ukraine, Phones: +38(066)0913555, +38(066)2871386, +38(099)5488087, E-mails: Straus22051979@gmail.com, nic.pov@ukr.net, snau.cz@ukr.net
[2]National University of Bioresources and Nature Management of Ukraine, Department of horse breeding and beekeeping, Heroyiv Oborony st., 15, Kyiv, Ukraine, Phone: +38(067)3840875, E-mail: povoznikov@i.ua
[3]Stepan Gzhytskyi National University of Veterinary Medicine and Biotechnologies, Department of Pharmacology and Toxicology Employment, Pekarska Street, 50 Lviv, Ukraine, Phone: +38(068)1362054, E-mail: bvh@ukr.net
[4]Podillia State University, Department of Feed Technology and Animal Feeding,12, Shevchenko Str., Kamianets-Podilskyi, Khmelnytskyi
region, Ukraine, Phones: +380671197661, +3808550089, E-mail: pp.nika22@ukr.net, vbutschk@ukr.net

Corresponding author: snau.cz@ukr.net

Abstract

The article contains the results of a study on the conservation, growth dynamics from birth to slaughter and economic efficiency of growing and fattening pigs depending on their live weight at birth and different feeding systems during the production cycle. It was found that piglets with a birth weight of just under one kilogram at weaning at 21 days of life had 30.3 % lower average and absolute gains, 29.4 % less live weight at this time and 4.5 % poorer maintenance in the post-weaning period compared to piglets whose live weight at birth was at the level of the line standard. During the suckling period, the weight difference between the animals at the beginning and end of the suckling period increased by 3.5 % in favor of the heavy piglets. During the rearing period and in the previous suckling period, animals with a lower birth weight had a 2.9 % worse preservation, grew 13.8 % slower and had a 13.8 % worse absolute weight at the end of rearing and at this time had a 17.7 % lower live weight and a 16.2 % worse feed conversion ratio at the same daily consumption, compared to animals born with a normal live weight. With the same costs for piglets with different birth weights and in the weaning phase, the difference according to this indicator is 8.4% in the rearing phase, 16.7% in the fattening phase and 13.2% for the entire production cycle in favor of the animals with normal birth weights. At the same time, these animals have a 3.2 % lower sales value, which leads to a 22.3 % lower income and a 31.4 % lower profitability of rearing and fattening a pig.

Key words**:** *piglet, pig, conservation, growth, conversion to coma, cost, income, profitability*

INTRODUCTION

Intensive genetic selection for hyperproductive traits over the last thirty years has focused mainly on improving reproductive qualities and has led to a constant increase in the number of piglets at birth [17, 20]. With the emergence of the latest generation of hyperproductive sows bred in Northern Europe and represented by the genetics companies Topigs Norsvin 70 or DanBred [7], the pig industry has now entered a new phase. Grace to this progress, commercial pig farms around the world can see litters of up to 20 piglets per sow [18, 19, 21]. However, the first disadvantage of selecting for a large offspring is not only a decrease in the average weight of piglets at birth, but also an increase in the weight variability of piglets in the nest [23], leading to an unevenness of the group by weight. In previous studies on the effects of multiple fertility and nest orientation on the productive and reproductive traits of sows, a dependency between two traits was found: Multiple fertility and high fertility. The higher the fertility, the lower the fertility and

vice versa [14]. With the increase in multiple fertility, the proportion of little piglets in large nests were growing, as does the frequency of piglets with intrauterine developmental delay [24]. In addition, the majority of piglets with low weight at birth and intrauterine growth retardation can adverse impacts on the structure of organs and growth after birth and later feed efficiency [3]. Other scientists also point out that one of the characteristics of perennial animals is the uneven development of their offspring. In each nest with unequal weights of piglets, there are usually animals of different sexes, with high, medium and low live weights and correspondingly different growth energy, whose development varies over the course of rearing. These differences in development in turn determine the later fattening, meat productivity or reproductive capacity of the animals [15].

Growth retardation in newborn piglets can lead to increased labour and equipment costs in the post-weaning period. Unfortunately, the negative effects can be long-lasting and lead to financial losses at the end of fattening and slaughter if the pigs have poor slaughter characteristics [17, 37].

In addition, heterogeneous groups of commercial pigs cause further problems of an economic nature: a significant difference in weight within a group forces the farm to overstock some of the animals in the feed store, which ultimately reduces the indicator "number of kilogrammes of pork grown per m^2". It can also prevent the application of the "empty-busy" principle [34]. The weight of piglets at birth determines the subsequent growth rate of piglets during the suckling period, which was confirmed by regression analysis [13].

The development of piglets in the first days after birth shows an uneven change in the weight of each individual. Inconsistency of the initial weight with the recommended or set as a norm over time is manifested by a noticeable deviation at weaning [35]. This is due to the so-called "amplification effect". According to some studies, a weight difference of 0.73 kg at birth can increase to 4.73 kg by the end of the weaning period, and a difference of 1.1 kg in weaning weight can turn into 3.8 kg at 138 days of age [8]. It is important to note that the weight difference between piglets born to the same group of sows in the same period can be significant. For example, between the 5% of the lightest piglets at weaning (less than 3 kg) and the 5% of the heaviest weaners (over 9 kg), it can be up to 6 kg. The difference in weight at birth and weaning affects the growth rate and has a significant impact on piglet survival. In general, the mortality rate of low weight piglets (less than 3 kg at weaning) is 33% between 0 and 138 days (and 25% before the transition to fattening), while the mortality rate of heavier piglets (over 9 kg) is almost 0% [2]. So there are two main reasons why pig farmers should aim for maximum homogeneity of nests and groups of piglets by mass. The more homogeneous the piglets are at the time of birth and weaning, the more homogeneous groups of animals will reach slaughter. The lower the proportion of underweight piglets, the higher the preservation of the animals in the group [5]. The existing studies showed that animals reared in levelled nests had higher indicators of average daily growth and preservation of piglets at the time of weaning. The data obtained indicate that the orientation of the nest has a great influence on the growth energy indicators of young pigs [25]. The highest growth rates were observed in pigs that came from homogeneous groups of animals with lower live weights at birth and showed compensatory growth compared to pigs with higher initial weights at birth that were kept in mixed groups [32]. However, the theory of the effect of compensatory growth in low weight piglets has been questioned as there are reports that piglets with a low birth weight (less than 1 kg) lose the ability to grow compensatory growth if the growth rate during suckling was below the average level [39]. A similar opinion on the dependence of piglets' growth intensity on the homogeneity of the nest in terms of mass was also expressed by other scientists [12]. Contrary to what was said, conclusions about the lack of a positive effect of nest uniformity by mass on the growth indicators of pigs were found in other published works. In particular, it has been reported that dividing pigs into groups of equal weight does not increase the overall performance of the herd [22, 38]. In

particular, it was found [4] that dividing piglets into groups of equal weight at weaning had no effect on the intensity of their growth.

The treatment of low birth weight piglets is becoming a common practice worldwide. The main compensatory measures aimed at increasing the efficiency of using low birth weight piglets are the use of step sows [30], extending the suckling period [27], dividing the herd into groups of equal weight [25], the use of special super prestarter feed mixtures before weaning [26] and others.

It is currently estimated that 15% of piglets weigh less than 1 kg at birth. Their survival and weight gain is a real challenge.

However, today's pig feed manufacturers are exploring new strategies to support the vitality of low weight piglets [36].

Adding a highly bioavailable source of zinc to the diet can reduce intestinal inflammation and increase growth performance of underweight piglets after weaning [11, 31].

Given the high mortality rate and slow growth, effective herd management practices need to be combined with appropriate feeding strategies [1]. Since lightweight piglets consume only a minimal amount of feed, it is very important that every gram has the optimal nutrient composition and density. Among these nutrients, trace elements play an important role in tissue and organ development, as well as in strengthening immune function, maintaining gut integrity, and minimizing inflammation [9, 29]. In addition, in order to improve the adaptability of the gastrointestinal tract of young pigs with a low initial growth weight at birth, pork producers are switching to the use of liquid feed for rearing instead of traditional dry feed mixtures, which allows implementing a strategy of soft adaptation and reducing the stress of piglets after weaning [28, 33].

The use of variable feeding methods in rearing and fattening pigs that had low and normal birth weight showed that in light weight animals, lower growth intensity, less feed consumption, worse feed conversion and higher fat content in the carcass than in counterparts born heavier [10].

Thus, taking into account the increasing influence of selection on high fertility of sows, which, as a result, It leads to bigger litters and more piglets born with low weights, further study of adaptation strategies and effective use of such piglets remains relevant.

MATERIALS AND METHODS

The experiment is dedicated to the study of the fattening indicators of pigs before slaughter, derived from sows of the cross of large white and landrace breeds and boars of the synthetic line PIC-337. The research was carried out in the Limited Liability Company "Scientific Production Enterprise "Globinsky Pig Complex" of the Poltava region, Ukraine.

The experiment was achieved on July 20, 2023 on commodity number 2 in the village Obiznivka, Poltava region, Ukraine. During the farrowing of a weekly technological group of sows, piglets were weighed individually in two adjacent sections of the farrowing shop in the amount of 120 pigs. During weighing, the mass of the animals was recorded on their backs and in the accounting table with a special marker. Upon completion of the weighing, the parameters of the mass of the control and experimental groups closest to those specified by the method were determined (Table 1).

Experimental piglets were included in 2 groups with a live weight of 1.4 kg and 1.0 kg, four hundred and fifty animals each. Ranking and selection of piglets into groups was carried out on the basis of individual weighing and tagging with clips of different colors and indicating the weight on the back. The animals in the control group received red clips, the animals in the experimental group blue clips.

During the suckling period, the piglets in both test groups were kept in two separate farrowing areas, each with 60 animals in individual pens measuring 1.8 m x 2.5 m. The maintenance of the microclimate in the farrowing rooms was supported by the negative pressure ventilation system of the company Big Dutchman.

Heating mats were used to maintain an optimal microclimate in the piglets' resting area, and infrared lamps were also used during the first week of the piglets' lives.

Table 1. Scheme of the experiment

Indicators	A group of pigs	
	Group I	**Group I**
Breed and consanguinity of the mother	(♀L×♂LW)	(♀L×♂LW)
Genetic line of boars	PIC-337	PIC-337
Genotype of piglets	♀ (L×LW)×♂ PIC-337	♀ (L×LW)×♂ PIC-337
Initial number of piglets, pigs	450	450
Initial age of piglets, days	1	1
Technology of feeding before weaning	liquid milk substitute	liquid milk substitute
Initial weight of piglets, kg	1.4	1.0
Duration of suckling period in piglets, days	21	21
Duration of growing, days	50	50
System of holding piglets during rearing	floor-loom, 150 pigs per pen on a partially latticed floor	floor-loom, 150 pigs per pen on a partially latticed floor
Piglet feeding system during rearing	dry feeding system from Hog Slat self-builders with granular pre-starter and starter compound feed	dry feeding system from Hog Slat self-builders with granular pre-starter and starter compound feed
Age of piglets at the end of rearing, days	71	71
The system of holding pigs during fattening	floor-loom, 50 pigs per pen on a partially solid lattice floor	floor-loom, 50 pigs per pen on a partially solid lattice floor
Pig feeding system during fattening	liquid feeding system using the Megamix feed kitchen of the Austrian company Schauer with grower and finishing compound feeds	liquid feeding system using the Megamix feed kitchen of the Austrian company Schauer with grower and finishing compound feeds
Age of pigs at the time of removal from fattening, days	180	180

LW is a large white breed; L is a landrace breed;
Source: own calculations.

The sows were fed an unlimited amount of complete compound feed, balanced in terms of the most important nutritional components, in a suitable composition using coma feeders from the American company Hog Slat, to which the feed was fed three times a day via a chain disc conveyor. From the second day of life, the piglets were fed Opticare Milk liquid milk replacer via stationary automatic feeders located at the rear of the pen, which was prepared on the farm using the Cullina Mix Pro feed kitchen in accordance with the recipe and feeding curve. The sows were fed using automatic nipple feeders located near the feeders at the front of the pen and the piglets were fed using automatic bowl feeders which were placed in the back of the pen near the feeder with liquid milk substitute.

The manure was removed from the site using a vacuum gravity system with periodic action.

At the end of the piglets' suckling period of 21 days of life, all shorn animals were weighed individually and additionally marked with tags of the appropriate colour with numbers similar to those of the clamps and taken to the rearing station no. 2 in the village Babichivka, Poltava region, Ukraine and housed in 3 looms with 150 animals each. The piglets of both control groups were kept in pens during rearing on a partially slotted floor with a standard area of 0.35 m^2 per animal. Each pen was equipped with a recovery area for piglets with parts. Solid floor with heating 16.3 m^2. The maintenance of microclimatic parameters in the rooms where the experimental animals were kept was carried out with the help of negative pressure geothermal ventilation equipped with Big Dutchman devices. During the rearing phase, the experimental piglets were fed dry mixed feed using self-feeders from the American company Hog Slat. The dry feed was transported to the feeders using a chain and disc conveyor and weighed for each test group using a torsion scale. From the first day after weaning until the piglets reached a weight of 9 kg, the animals in both test groups were given the first pre-starter of the 0-9 kg formula, which they were fed in the last week

of the weaning period. At the same time, during the first five days of rearing, the piglets in both test groups received warm, moist compound feed mixtures at a ratio of 3 kg water to 1 kg compound feed five times a day in parallel with unlimited access to the self-breeders. After the piglets of the corresponding group had reached an average weight of 9 kg, feeding of the second pre-starter feed of formulation 9-12 was started, using the same distribution system for feeding. When the average weight of the corresponding group reached 12 kg, they were switched to the feeding of starter compound feed of formula 12-25, which was fed before the piglets of both groups were transferred to fattening. The experimental piglets were watered with automatic cup drinkers and the faeces were removed with a periodic vacuum gravity system.

On the 72nd day of life, after being weighed individually, the experimental piglets were transferred to fattening farm no. 4 near the village Hrynky, Poltava region, Ukraine. Here they were housed in group pens with an area of 36 m^2 on a fully barred floor with 50 animals each. The room was ventilated with a Big Dutchman negative pressure valve system.

Manure removal with a periodic vacuum gravity system.

The feed was prepared, transported and distributed using equipment from the Swiss company Schauer's feed kitchen, 10-12 times per day, with a feeding front of 0.18 m per 1 experimental animal. The consistency of the feed was produced by adding 1 kg of dry pulp to three parts of water. The feed was calculated using the feed kitchen software in the form of dry feed with a moisture content of 14%.

When the test animals were transferred from rearing to finishing at the age of 122 days, their group weight was determined.

When the animals in each experimental group had reached a weight of almost 130 kg, they were weighed individually and sent to slaughter. Throughout the research period, all veterinary and technological procedures were the same for the animals in the two controlled groups and were carried out according to a fixed protocol. The conditions of feeding, watering, maintenance, care and prevention of animals in the experiment were carried out in accordance with the EU legislation on animal welfare [6].

Throughout the experiment, the number of piglets that died or were eliminated due to a technological defect, their weight and the date of elimination were recorded. The weighing data were used to analyse the growth intensity and survival of the piglets. Feed utilisation was calculated on the basis of feed cost accounting. Based on feed accounting, its average daily consumption was calculated, and taking into account their share in the operating cost, this cost was calculated for rearing and fattening one pig of pigs and the profitability of rearing standard and low-weight piglets.

For a comprehensive evaluation of the fattening qualities of experimental pigs, the index of fattening qualities was calculated according to the formula [16]:

$$I=A^2/(B\times C) \quad (1)$$

where:

A – gross weight gain during the fattening period, kg; B – the number of days of fattening; C – feed consumption per 1 kg of growth.

The system of manure removal, watering, air conditioning and air heating in the rooms were identical for animals of all experimental groups.

Microsoft Office Excel 2016 was used for data analysis. Indicators were considered significantly different when the significance levels corresponded to $p<0.05$, $p<0.01$ and $p<0.001$.

RESULTS AND DISCUSSIONS

We can observe (Table 2) the different intensity of growth in piglets, the cause of which we believe is the unequal initial weight of the animals. It was found that piglets with a 0.36 kg lower initial birth weight were likely to have lower average daily gains during rearing by 81 g ($p<0.001$) compared to standard weight animals. In our opinion, this is due to the fact that piglets with a lower weight are usually born later and retain fewer mammary glands. The absolute growth of piglets in the weaning period decreased by 1.66 kg ($p<0.001$), and, as a result, their weight decreased by 2.02 kg

(p<0.001) during this period. In our opinion, this was caused by the lower intensity of growth of the specified animals. The indicator of live weight of born piglets was higher in the herd of the experimental group by 25.9% at the beginning and by 29.4% at the end of the suckling period. It is known that piglets born with a lower live weight usually have a poorer health status and are less adapted to the conditions of the external environment, which causes an increased proportion of their offspring in the post-weaning period.

Table 2. Growth and survival of piglets with different initial weights in the weaning period

Indicators	Group I	Group I
The number of piglets at the beginning of the experiment, pigs	450	450
Piglets weight at birth, kg	1.39±0.0027***	1.03±0.0036
Piglets age at weaning, days	20.4	20.4
Piglets average weight oat weaning, kg	6.87±0.076***	4.85±0.111
Absolute growth of suckling piglets, kg	5.48±0.069***	3.82±0.012
Average daily growth of suckling piglets,	269±10.3***	187±14.8
Piglets preservation, %	93.6	89.1

*** – p <0.001.
Source: own calculations.

In our studies, piglets with a standard live weight had a 4.5% better survival rate during the subsystem period compared to piglets with a low weight.

Piglets with a birth weight of just under one kilogram had 30.3% lower average daily and absolute gains, 29.4% less live weight at this time and 4.5% poorer maintenance in the 21st post-weaning period compared to piglets whose live weight at birth was at the level of the line standard. In the weaning period, the difference in the weight of animals at the beginning and at the end of the weaning period increased by 3.5% in favor of heavier piglets.

Heavier piglets showed a 3.5% increase in weight during the suckling period compared to their counterparts from the control group. Piglets that had a low initial weight in the weaning period also lagged behind their peers in terms of this indicator during rearing (Table 3). Livestock of group I prevailed over analogs from group II in terms of average daily growth by 57 g (p<0.001), absolute growth by 2.92 kg (p<0.001), initial live weight at the beginning of growing by 2.02 kg (p< 0.001), the indicator of live weight at the end of growing by 4.94 kg (p<0.001). As in the previous technology period, the survival rate of piglets born with a weight of just under one kilogram was 2.9% worse than that of animals with a standard live weight.

Table 4. Feeding qualities of pigs

Indicators	Group I	Group I
The initial number of pigs, pigs	411	401
The number of days of pig life from birth to the beginning of fattening, days	71.5	71.5
Number of fattening days, days	27.98±0.365***	23.04±0.571
Number of pigs before slaughter, pigs	103	112
The initial number of pigs, pigs	401	386
Saving of pigs during fattening, %	97.5	96.3
Age at which weight is 120 kg, days	159.9	172.2
Age at removal from fattening, days	174.5	183.5
Weight of pigs when removed from fattening, kg	135.2±1.07**	130.8±1.14
Weight of pigs at 180 days of life, kg	140.5	127.2
Absolute gain in fattening, kg	107.2±1.07	107.8±1.12
Average daily gains in fattening, g	1,041±15.3***	963±19.7
Average daily feed consumption in fattening, kg	2.72	2.76
Feed conversion at fattening, kg	2.61	2.87
Index of fattening qualities, points	42.8	36.1

** – p <0.01; *** – p <0.001.
Source: own calculations.

Animals with a lower initial weight at birth reached a weight of 120 kg 12.3 days earlier and at the age of 180 before slaughter weighed 13.3 kg more compared to counterparts that were heavier at birth.

In contrast to the growth period, the average amount of feed consumed per day during the fattening phase was 0.05 kg lower in animals with a lower birth weight, and due to their significantly lower growth intensity, feed utilisation during fattening was 0.26 kg lower. Pigs of the II group, which were heavier at birth, demonstrated a 6.6-point higher value of the complex index of fattening qualities compared to peers from the I group.

For example, piglets with a 0.36 kg lower birth weight during fattening had a 7.5% lower growth rate, an 8.7% longer fattening period and a 3.2% lower weaning weight when they consumed 1.7% less feed and utilised 10.0% less feed, reached a marketable weight of 120 kg 7.7% later and had a 9.4% lower weight at 180 days of age and differed by 15.5% from animals that had a standard weight at birth.

Piglets with a lower birth weight had lower growth rates throughout their lives. As can be seen from the diagram in Fig. 1, the weight difference in the pigs increased with age. It was 0.36 kg at birth, 2.02 kg at weaning, 4.94 kg at the transition to fattening, 5.8 kg at 120 days of age and 13.3 kg at 180 days of age. This means that a relative reduction in the difference in live weight was observed in piglets with a low birth weight due to compensatory growth in the following stages of life.

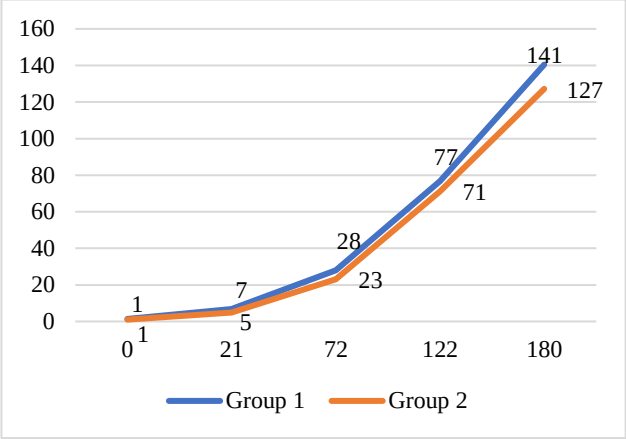

Fig. 1. Dynamics of the average weight of one piglet from birth to 180 days, kg
Source: Own determination.

That is, in relative units, the difference in live weight between piglets with a standard live weight at birth and piglets with a low weight at birth was 29.4%, at weaning it remained at the same level, during the transition to fattening it decreased to 17.7%, after reaching the age of 120 days it decreased to 8.2% and at the age of 180 days it was 9.4%.

When analyzing the growth intensity, conservation and feed payment of piglets with different live weights at birth over the entire period of their lives, we found that piglets with low birth weights had a 9.0 days longer duration of this cycle, while we found 59.4 g ($p<0.001$) lower average daily weight gain, 4.0 kg ($p<0.01$) lower absolute weight gain, 7.6 worse piglet survival from birth to slaughter, 0.07 kg less feed consumption during rearing and fattening and 0.12 kg worse utilization (Table 5).

Table 5. Growth and preservation of piglets with different weights at birth in the period of life

Indicators	Group I	Group I
Duration of the production cycle from birth to slaughter, days	174.5	183.5
Preservation of piglets for the entire production cycle,%	88.9	81.3
Absolute growth over the entire period of life, kg	134.0±1.14**	130.0±1.16
Average daily growth for the entire period of life, g	767±10.3***	707±14.2
Average daily feed consumption during the period of rearing and fattening, kg	2.03	2.10
Conversion of fodder for growing and fattening, kg	2.43	2.71
Duration of the production cycle from birth to slaughter, days	174.5	183.5

** – p <0.01; *** – p <0.001.
Source: own calculations.

When analyzing the profitability of rearing piglets with different birth weights, it was found that if the costs of rearing these piglets at birth were the same as the costs of rearing

them in the weaning period, there was a difference in the costs of rearing and fattening these animals in the subsequent periods of the production cycle.

As can be seen from Table 6, the operating costs for rearing low-weight piglets are 1.42 EUR higher than for analogous piglets with a standard weight at birth due to lower growth intensity and poorer feed conversion efficiency, while the difference in operating costs for fattening already amounts to 11.11 EUR. Operational expenses at the end of fattening amounted to 94.74 EUR in group I and 107.24 EUR in group II. The sale price of piglets in the control group was 176.33 EUR, which is due to a higher live weight of animals. On the other hand, the piglets of the research group were lighter, so their price was lower and amounted to 182 EUR.

Table 6. Growth and preservation of piglets with different weights at birth in the period of life

Indicators	Group I	Group I
Operating cost of one piglet at birth, EUR	9.43	9.43
Operating cost of rearing one piglet until weaning, EUR	1.63	1.63
Operational cost of raising one piglet, EUR	16.97	18.40
Operational cost of fattening 1 pig, EUR	66.69	77.80
Operational cost of obtaining and raising and fattening 1 pig, EUR	94.72	107.25
The cost of 1 pig without VAT upon completion of fattening, EUR	176.33	170.66
Income from raising and fattening 1 pig, EUR	81.62	63.40
Profitability of raising and fattening 1 pig, EUR	2.16	1.48

Source: own calculations.

Due to the lower cost price and higher sales value, the income from the sale of an animal in the control group was EUR 0.45 higher than that of the experimental group, and the profitability of rearing piglets with normal live weight was 27.05% better than the profitability of rearing piglets with low weight.

With the same costs for piglets with different birth and weaning weights, the difference according to this indicator is therefore 8.4% in the rearing phase, 16.7% in the fattening phase and 13.2% for the entire production cycle in favour of the animals with normal birth weight. At the same time, these animals have a 3.2% lower sales value, which leads to a 22.3% lower income and a 31.4% lower profitability of rearing and fattening a pig.

The results we obtained confirm the observations [3] on the influence of the weight of piglets at birth on the intensity of postnatal growth and the efficiency of their further fattening. In addition, our study confirmed the findings [34] that a significant difference in the weight of piglets caused by their unevenness at birth and subsequent growth forces producers to keep some of the animals on the fattening farm for too long. In our study, such a delay was found to be 9 days. In addition, the results of our research were consistent with the findings [13] that the growth rate of piglets from birth to weaning is determined by their birth weight. In our trials, piglets that weighed 25.9% less at birth increased this shortfall to 29.4% before weaning. Our results confirmed the report [35] stating that the weight loss of piglets at an early age increases over time in the later stages of the production cycle. In our experiment, a weight difference of 0.32 kg at birth resulted in a deficit of 4.94 kg at the end of rearing and 13.3 kg at 180 days of age, which partly agrees with the data [8], according to which the weight difference in weanlings is 1, 1 kg can translate into 3.8 kg at 138 days of age, but it contradicts the conclusions of [32] regarding the compensatory growth of low weight piglets in the later periods of the production cycle and partially confirms the conclusions of [39] and [12] about the lack of compensatory growth in low birth weight piglets. In our research we also found no confirmation of the opinion [25] that the division of animals into groups of equal weight increases the growth intensity of piglets in the later periods of the production cycle, and on the contrary, the conclusions [4] were confirmed that the division of piglets at

weaning into groups of equal weight has no effect on their growth intensity.

In addition, our research partially confirmed the report [2] of a significant difference in survival of piglets with different birth weights, with our trials showing that the survival of low weight piglets was 7.6% worse than that of normal birth weight piglets. However, in contrast to the indicators reported [2] for the survival rate of low-weight piglets in the pre-weaning group (67%) and in the rearing group (75%), we found slightly better values for this indicator for the technological groups reported, namely 89.1% for low-weight piglets in the suckling group and 94.7% for low-weight piglets in the rearing group.

Our research confirmed the findings [17, 37] on the negative effects of lower piglet weight at birth leading to financial losses at the end of fattening and slaughter.

In our experiment, the piglets with low weight at the end of fattening had a 13.2% higher cost per animal, a 3.2% lower sales value, a 4.1% lower profit from the sale of a fattened animal and a 27% lower profitability of breeding and fattening. We consider it necessary to continue this research and apply other innovative methods for rearing low-weight semi-pigs.

CONCLUSIONS

It was found that piglets with low birth weight at weaning had significantly lower average daily and absolute gains, lower live weight and poorer conservation than their counterparts whose live weight at birth was at the level of the line standard. During the suckling period, the weight difference between the animals at the beginning and end of the suckling period increased by 3.5% in favor of the heavier piglets.

It has been shown that animals with a lower weight at birth had poorer preservation during the rearing period, grew more slowly and had a significantly lower live weight and poorer feed conversion ratio before weaning than their counterparts born with a normal live weight.

It was proven that lower birth weight in pigs is the cause of a decrease in slaughter weight, increases feed consumption per 1 kg of gain, increases the duration of fattening up to a weight of 120 kg, reduces fattening productivity at the age of 180 days and, as a result, reduces indicators of a complex index of fattening qualities.

It was found that the difference in live weight between animals with different live weights at birth decreased as the animals aged.

Better costs were found in the growing period, in fattening and for the entire production cycle in favor of animals with a normal weight at birth. They had a higher sales value, a higher income and a better profitability in the rearing and fattening of one pig.

REFERENCES

[1]Alexopoulos, J. G., Lines, D. S., Hallett, S., Plush, K. J., 2018, A Review of Success Factors for Piglet Fostering in Lactation. Animals : an open access journal from MDPI, Vol. 8(3): 38. https://doi.org/10.3390/ani8030038

[2]Blavi, L., Solà-Oriol, D., Llonch, P., López-Vergé, S., Martín-Orúe, S., Pérez, J. F., 2021, Management and Feeding Strategiesin Early Life to increase PigletPerformance and Welfare around Weaning: a Review. Animals, Vol. 11: 302. https://doi.org/10.3390/ani11020302

[3]Bortolozzo, F. P., Zanin, G. P., Ulguim, R. D. R., Mellagi, A. P. G., 2023, Managing Reproduction in Hyperprolific Sow Herds. Animals : an open access journal from MDPI, Vol. 13(11): 1842. https://doi.org/10.3390/ani13111842

[4]Camara, L., Berrocoso, J. D., Fuentetaja, A., López-Bote, C. J., de Blas, C., Mateos, G. G., 2016, Regrouping of pigs by body weight at weaning does not affect growth performance, carcass quality or uniformity at slaughter of heavy weight pigs. J. Anim. Sci., Vol. 87: 134– https://doi.org/142. 10.1111/asj.12404

[5]Charneca, R., Freitas, A., Nunes, J., Le Dividich, J., 2023, Effects of the Mean Weight of Uniform Litters on Sows and Offspring Performance. Animals: an open access journal from MDPI, Vol. 13(19): 3100. https://doi.org/10.3390/ani13193100

[6]Council Directive 2010/63/EU of 22 September 2010 on the protection of animals used for scientific purposes. Official Journal of the European Union. L 276. 2010, 33–79. https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:276:0033:0079:en:PDF, Accessed on 14.02.2024.

[7]Danish Pig Research Centre, 2000, Combination of Key Figures of Production Performance in Danish Swine Herds between 2000 and 2020 [in Danish: Landsgennemsnit for Produktitivet i Svineproduktionen Fra 2000 Til 2020] SEGES, Danish Pig Research Centre (DPRC); Copenhagen, Denmark. https://pigresearchcentre.dk/ Accessed on 14.02.2024.

[8]Faktory vplyvu na odnoridnist hnizd [Factors affecting the homogeneity of nests]. PigUA.Info. [in

Ukrainian] https://pigua.info/uk/post/faktori-vplivu-na-odnoridnist-gnizd-uk, Accessed on 14.02.2024.
[9]Farmer, C., Edwards, S. A., 2022, Review: Improving the performance of neonatal piglets, Animal, Vol. 16(2): 100350. https://doi.org/10.1016/j.animal.2021.100350.
[10]Hawe, S. J., Scollan, N., Gordon, A., Muns, R., Magowan, E., 2020, Impact of feeding low and average birthweight pigs on a weight basis post-weaning on growth performance and body composition, Livestock Science, Vol. 241: 104233. https://doi.org/10.1016/j.livsci.2020.104233.
[11]Holen, J. P., Urriola, P. E., Schwartz, M., Jang, J. C., Shurson, G. C., Johnston, L. J., 2020, Effects of supplementing late-gestation sow diets with zinc on preweaning mortality of pigs under commercial rearing conditions. Translational animal science, Vol. 4(2): txaa010. https://doi.org/10.1093/tas/txaa010
[12]Huting, A. M. S., Almond, K., Wellock, I., Kyriazakis, I., 2017, What is good for small piglets might not be good for big piglets: The consequences of cross-fostering and creep feed provision on performance to slaughter. Journal of animal science, Vol. 95(11): 4926–4944. https://doi.org/10.2527/jas2017.1889
[13]Jankowiak, H., Balogh, P., Cebulska, A., Vaclavkova, E., Bocian, M., Reszka, P., 2020, Impact of piglet birth weight on later rearing performance. Veterinární medicína, Vol. 65(11): 473–479. https://doi.org/10.17221/117/2020-VETMED
[14]Kalynychenko, H. I., Kalynychenko, I. T., Masliuk, A. M., 2002, Otsinka reproduktyvnykh yakostei svynomatok ukrainskoi miasnoi porody v umovakh uchhospu «Soniachne» [Assessment of reproductive qualities of sows of the Ukrainian meat breed in the conditions of the "Sonyachne" state farm]. Visnyk ahrarnoi nauky Prychornomoria [Bulletin of Agrarian Science of the Black Sea Coast], Vol. 2(16): 214–217. [in Ukrainian] https://scholar.google.com/scholar?cluster=3115126948995489883&hl=en&oi=scholarr, Accessed on 14.02.2024.
[15]Kalynychenko, H. I., Oryshchenko, A. O., 2022, Growth and development of piglets depending on nest alignment and distribution by sex. Proceedings of the 10th International Scientific and Practical Conference «Challenges in Science of Nowadays» (November 16-18, 2022). Washington, USA. Agrotechnologies and agricultural industry, Vol. 132: 388–392. https://archive.interconf.center/index.php/conference-proceeding/article/download/1673/1703, Accessed on 14.02.2024.
[16]Ladyka, V. I., Khmelnychiy, L. M., Povod, M. G.. 2023, Tekhnolohiia vyrobnytstva i pererobky produktsii tvarynnytstva: pidruchnyk dlia aspirantiv [Technology of production and processing of livestock products: a textbook for graduate students]. Odesa: Oldi+, 244. [in Ukrainian] https://oldiplus.ua/tehnologiya-virobnitstva-ta-pererobki-produktsii-tvarinnitstva/ Accessed on 14.02.2024.
[17]Milligan, B. N., Fraser, D., Kramer, D. L., 2001, Birth weight variation in the domestic pig: effects on offspring survival, weight gain and suckling behaviour. Applied animal behaviour science, Vol. 73(3): 179–191. https://doi.org/10.1016/s0168-1591(01)00136-8
[18]Milligan, B. N., Dewey, C. E., de Grau, A. F., 2002, Neonatal-piglet weight variation and its relation to pre-weaning mortality and weight gain on commercial farms. Prev. Vet. Med., Vol. 56: 119–127. https://doi.org/10.1016/S0167-5877(02)00157-5.
[19]Moreira, R. H. R., Pérez Palencia, J. Y., Moita, V. H. C., Caputo, L. S. S., Saraiva, A., Andretta, I., Ferreira, R. A., de Abreu, M. L. T., 2020, Variability of piglet birth weights: A systematic review and meta-analysis. Journal of animal physiology and animal nutrition, Vol. 104(2): 657–666. https://doi.org/10.1111/jpn.13264
[20]Mykhalko, O. G., 2021, Suchasnyi stan ta shliakhy rozvytku svynarstva v sviti ta Ukraini [The current state and ways of development of pig farming in the world and in Ukraine]. Visnyk Sumskoho natsionalnoho ahrarnoho universytetu. Seriia «Tvarynnytstvo» [Bulletin of the Sumy National Agrarian University. Series «Livestock»], Vol. 3: 60–77. [in Ukrainian] https://doi.org/10.32845/bsnau.lvst.2021.3.9 Accessed on 14.02.2024.
[21]Oliviero, C., Junnikkala, S., Peltoniemi, O., 2019, The challenge of large litters on the immune system of the sow and the piglets. Reproduction in domestic animals = Zuchthygiene, Vol. 54(3): 12–21. https://doi.org/10.1111/rda.13463
[22]O'Quinn, P. R., Dritz, S. S., Goodband, R. D., Tokach, M. D., Swanson, J. C., Nelssen, J. L., Musser, R. E., 2001, Sorting growing-finishing pigs by weight fails to improve growth performance or weight variation. J. Swine Health Prod., Vol. 9: 1. https://doi.org/10.4148/2378-5977.6664
[23]Panzardi, A., Bernardi, M. L., Mellagi, A. P., Bierhals, T., Bortolozzo, F. P., Wentz, I., 2013, Newborn piglet traits associated with survival and growth performance until weaning. Preventive veterinary medicine, Vol. 110(2): 206–213. https://doi.org/10.1016/j.prevetmed.2012.11.016
[24]Peltoniemi, O., Yun, J., Björkman, S., Han, T., 2021, Coping with large litters: the management of neonatal piglets and sow reproduction. Journal of animal science and technology, Vol. 63(1): 1–15. https://doi.org/10.5187/jast.2021.e3
[25]Pelykh, V. H. ,Chernyshov, I. V., 2008, Vplyv vyrivnianosti hnizd na rist i rozvytok porosiat u pidsysnyi period [The influence of nest alignment on the growth and development of piglets during the suckling period]. Visnyk Poltavskoi derzhavnoi ahrarnoi akademii, Silske hospodarstvo. Tvarynnytstvo [Bulletin of the Poltava State Agrarian Academy, Agriculture. Animal husbandry], Vol. 4: 95–97. [in Ukrainian] http://base.dnsgb.com.ua/files/journal/Visnyk-Pdaa/Visnyk-Pdaa2008-4/VPdaa2008-4_95-97.pdf Accessed on 14.02.2024.
[26]Povod, M., Mykhalko, O., Gutyj, B., Ievstafiieva, Y., Zasukha, L., Buchkovska, V., Verbelchuk, S., Lavryniuk, O., Moisei, I., 2023a, Productivity of Sows and Efficiency of Growing Piglets by Feeding Dry and Liquid Methods. In Journal of Mountain Agriculture on the Balkans, Vol. 26(6): 1–26.

https://jmabonline.com/en/article/HiM3LLvP9yZE7H8o06fG
[27]Povod, M., Mykhalko, O., Verbelchuk, T., Gutyj, B., Borshchenko, V., Koberniuk, V., 2023b, Productivity of sows, growth of piglets and fattening qualities of pigs at different durations of the suckling period. Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol. 23(1): 649–459. https://managementjournal.usamv.ro/pdf/vol.23_1/volume_23_1_2023.pdf, Accessed on 14.02.2024.
[28]Povod, M. G., Tishchenko, O., Mykhalko, O. G., Verbelchuk, T. V., Verbelchuk, S. P., Sherbyna, O. V., Kalynychenko, H. I., 2022, Intensyvnist rostu ta vidhodivelni yakosti svynei pry zmini sposobiv hodivli v period vidtvorennia ta vidhodivli [Growth intensity and fattening qualities of pigs during changes in feeding types during reproduction and fattening]. Naukovyi visnyk Lvivskoho natsionalnoho universytetu veterynarnoi medytsyny ta biotekhnolohii. Seriia: Ahrarni nauky [Scientific Messenger of Lviv National University of Veterinary Medicine and Biotechnologies. Series: Agricultural sciences], Vol. 24(96): 50–60. [in Ukrainian] https://doi.org/10.32718/nvlvet–a9607 Accessed on 14.02.2024.
[29]Riddersholm, K. V., Bahnsen, I., Bruun, T. S., de Knegt, L. V., Amdi, C., 2021, Identifying Risk Factors for Low Piglet Birth Weight, High Within-Litter Variation and Occurrence of Intrauterine Growth-Restricted Piglets in Hyperprolific Sows. Animals: an open access journal from MDPI, Vol. 11(9): 2731. https://doi.org/10.3390/ani11092731
[30]Smith, D. C., 2023, Black Greek Step Shows. In: Ojaide, T. (eds) African Battle Traditions of Insult. African Histories and Modernities. Palgrave Macmillan, Cham. https://doi.org/10.1007/978-3-031-15617-5_8
[31]Schokker, D., Kar, S. K., Willems, E., 2023, Dietary supplementation of zinc oxide modulates intestinal functionality during the post-weaning period in clinically healthy piglets. J Animal Sci Biotechnol., Vol. 14: 122. https://doi.org/10.1186/s40104-023-00925-1
[32]Susol, R. L., 2014, Vzaiemozviazok pokaznyka velykoplidnosti ta produktyvnosti svynei velykoi biloi porody odeskoi populiatsii [The relationship between the indicator of large fertility and the productivity of pigs of the large white breed of the Odesa population]. Naukovo-tekhnichnyi biuleten IT NAAN [Scientific and technical bulletin IT NAAS], Vol. 112: 143–150. [in Ukrainian] http://www.irbis-nbuv.gov.ua/cgi-bin/irbis_nbuv/cgiirbis_64.exe?C21COM=2&I21DBN=UJRN&P21DBN=UJRN&IMAGE_FILE_DOWNLOAD=1&Image_file_name=PDF/Ntb_2014_112_25.pdf Accessed on 14.02.2024.
[33]Tishchenko, O., Povod, M., Gutyj, B., Verbelchuk, T., Verbelchuk, S., Koberniuk, V., Maistrenko, O., 2023, Efektyvnist riznykh system ridkoi hodivli porosiat na doroshchuvanni v umovakh promyslovoi tekhnolohii [Effectiveness of different systems of liquid feeding of piglets in the conditions of industrial technology]. NV LNU veterynarnoi medytsyny ta biotekhnolohii. Seriia: Silskohospodarski nauky [National University of Veterinary Medicine and Biotechnology. Series: Agricultural Sciences], Vol. 25(98): 185–193. [in Ukrainian] https://doi.org/10.32718/nvlvet–a9830 Accessed on 14.02.2024.
[34]Tucker, B. S., Craig, J. R., Morrison, R. S., Smits, R. J., Kirkwood, R. N., 2021, Piglet Viability: A Review of Identification and Pre-Weaning Management Strategies. Animals: an open access journal from MDPI, Vol. 11(10): 2902. https://doi.org/10.3390/ani11102902
[35]Vande Pol, K. D., Bautista, R. O., Harper, H., Shull, C. M., Brown, C. B., Ellis, M., 2021, Effect of within-litter birth weight variation after cross-fostering on piglet preweaning growth and mortality. Translational animal science, Vol. 5(3): txab039. https://doi.org/10.1093/tas/txab039
[36]Ward, S. A., Kirkwood, R. N., Plush, K. J., 2020, Are Larger Litters a Concern for Piglet Survival or an Effectively Manageable Trait?. Animals: an open access journal from MDPI, Vol. 10(2): 309. https://doi.org/10.3390/ani10020309
[37]Wolf J., Žáková E., 2008, Groeneveld E. Within-litter variation of birth weight in hyperprolific Czech Large White sows and its relation to litter size traits, stillborn piglets and losses until weaning. Livest. Sci., Vol. 115: 195–205. https://doi.org/10.1016/j.livsci.2007.07.009.
[38]Wolter, B. F., Ellis, M., Curtis, S. E., Parr, E., Webel, D. M., 2002, Effects of feeder-trough space and variation in body weight within a pen of pigs on performance in a wean-to-finish production system. J. Anim. Sci., Vol. 80: 2241–2246. https://doi.org/10.2527/2002.8092241x
[39]Zeng, Z. K., Urriola, P. E., Dunkelberger, J. R., Eggert, J. M., Vogelzang, R., Shurson, G. C., Johnston, L. J., 2019, Implications of early-life indicators for survival rate, subsequent growth performance, and carcass characteristics of commercial pigs. Journal of animal science, Vol. 97(8): 3313–3325. https://doi.org/10.1093/jas/skz223