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THE EFFICIENCY OF RAISING HYBRID PIGLETS OF ENGLISH ORIGIN IN A TWO-PHASE METHOD WITH DIFFERENT DURATIONS

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Abstract

In the article, the efficiency of two-phase rearing of piglets was compared with a change in the feeding system from dry to liquid feeding for different periods of the phases of this production cycle. It was discovered that animals reared in a one-phase system with dry feed had the lowest daily feed intake on average. In contrast, those in a two-phase system, with the second phase involving liquid feed for 9 days, showed a 14.8% increase in average daily consumption. This figure rose to 20.3% with an 18-day duration of the liquid feeding phase and further to 32.4% with a 27-day duration, compared to animals in the single-phase system. It was found that when the piglets were fed liquid feed for 18%, 35% and 53% of the total rearing period in the second rearing phase, their live weight increased by 3.4%, 7.9% and 12.2%, respectively, at the transition to fattening with analogues with single-phase top-up and 100% dry power supply system. The highest income was achieved in animals reared in two phases with a phase duration of 27 days on liquid feed, which was 6.2 % higher than in animals reared in one phase on dry feed, and 16.0 % higher in two-phase rearing with a second phase duration of 9 days and 7.3% higher than in two-phase rearing with a second phase duration of 18 days.

Key words**:** *piglet, rearing, gain, feed conversion, feed cost, market price, income, profitability*

INTRODUCTION

Pig farming is the most productive branch of animal husbandry in many countries. An important factor in this is the implementation of rational and balanced feeding practices. This includes not only formulating rations correctly and establishing an effective feed base but also utilizing modern and highly efficient systems and technologies [7]. Studying the aspects of pig feeding allows you to significantly increase its productivity, in particular, to accelerate the growth of young animals in rearing, due to scientifically balanced rations in terms of energy intensity and the amount of nutrients and biologically active substances, taking into account the physiological needs of animals [25].

In today's economic conditions in Ukraine, both modern industrial complexes and small farms use different approaches to feeding weaned piglets [10]. However, no matter what technology is used in pork production, piglet feeding is one of the most responsible technological processes, the results of which affect the final economic indicators of large and small pig farms. Proper feeding and care of growing piglets for optimal performance from birth to slaughter is a major goal of pork producers [23]. The efficiency of pig feeding

depends on many factors, including the type of feed [12] and the way it is prepared [13], its composition [19] and the management of the growth phase, which takes into account the physiological development of young animals and their readiness to consume and process concentrates [18, 22]. Piglet rearing is a very important period in pork production, as it is during this time that immunity is intensively developed, which is crucial for the further health and productivity of the animals [16]. The ability to maximise productivity results during rearing has a direct impact on the results of pig fattening: herd maintenance, average daily gain, feed conversion and the quality of pig carcasses at slaughter. Therefore, the rational organisation of post-weaning feeding requires great attention and a balanced approach [15, 17].

Weaning is indeed a crucial phase in piglet rearing. It marks the transition from a milk-based diet to solid feed and is a critical period for piglets' growth and development. Proper weaning practices are essential to ensure the health and well-being of piglets and to set them up for successful growth and productivity [1, 30]. In the growth phase up to a weight of 30 kg, producers endeavour to meet the animal's nutritional and energy requirements, paying particular attention to minimising costs. The biggest problems in feeding piglets during rearing occur during the transition from pre-starter to starter feed [8]. The transition to starter feed should take place when the piglet's weight is at least 12 kg. The economy of the pre-starter leads to significant economic losses due to the further extension of the fattening period of pigs [9].

It has been experimentally proven that within 3-4 days after weaning, piglets consume a smaller amount of feed, which is only necessary to maintain vital activity, and that nutrients are distributed during this period not for growth, but to compensate for stress conditions. In the first two days, the piglets use up the reserves of subcutaneous fat that they have built up during the lactation period. And in the third case, they gradually adapt to the new conditions and usually eat to their heart's content. In many cases this leads to diarrhoea. For this reason, post-weaning feeding management is crucial [4, 34].

The generally accepted order of feeding piglets in rearing is to use the feed they received in the last days before weaning until they reach a weight of 9 kg in the next 14 days [24]. In the subsequent stage, for piglets weighing between 9 and 15 kg, the blend should include no more than 15% soybean meal and 3–4% fishmeal or another protein source that is easily digestible, with the exclusion of rapeseed and sunflower seeds. As the piglets progress to the second phase of growth, reaching a weight range of 15 to 30 kg, their diet should consist of a maximum of 22% soybean meal and ideally 1% fishmeal or potato protein. During this period, other protein sources such as sunflower, rapeseed, and peas can be introduced [21, 28, 31].

Also important is the type of feeding and its change when the piglets move from the weaning group to the rearing group and when the piglets move within the rearing group [20, 29]. In particular, there are reports that you can save up to 10–12 of feed by switching the feeding of pigs from dry compound feed to liquid feed. Feed conversion with such feeding reaches 1:2.8, and growth during the fattening period is 800–900 g/day [3].

Three phases of pig breeding are described in the production cycle of the pig industry [6]. Similarly, foreign authors and genetic pig breeding companies [32] also distinguish three main phases of the technology commonly used in industrial pig farms. In phase I, piglets are reared from birth to weaning. Phase II comprises the phase in which the piglets are reared from weaning to transfer to the fattening area. And the III phase lasts from transfer to fattening until the moment of sending fattened pigs to slaughter [33].

At the same time, there are different types of piglet housing in the growth phase, which provide for different lengths of stay for the pigs in the same room. The duration of the stay of animals in the conditions of a group pens in a particular room of the farm depends on the production characteristics of the pig complex, the specifics of the equipment for transportation, feed distribution and feeding, on the size of the group pens and the possibility

of changing their size, as well as on the area of the room itself. Australian pork producers report that piglets remain in one room for 9–10 weeks in the first rearing phase. They are then moved to more spacious group pens in another room, where they remain for the next 15–16 weeks [26].

In general, there are two types of rearing technologies: in the first, rearing takes place on one farm; in the second, it is divided into two separate rearing phases on different farms. The first approach involves placing weaned piglets in group pens weekly post-weaning, without mixing different age groups. This method guarantees uniformity in the animals' origins and cuts production costs by eliminating the need for extra piglet transportation. However, it often leads to more pigs per unit area and limited space availability. In the second option for rearing young animals, the piglets are initially reared on a farm until they reach a weight that limits their further effective care and feeding in the pens, without changing their size or configuration. The pigs are then transported to another farm, where group pens allow larger animals to be housed and provide them with sufficient space, and automatic feeders can provide a sufficient feed front per animal [32, 33]. The management of piglet housing in the rearing group thus depends on various factors that determine the length of time young animals remain in one production area and affect the need to move them to another, which can also influence the intensity of animal growth [11, 27]. Fixed housing is usually associated with less free space per animal and the housing of pigs in smaller groups in small group pens, which can reduce their growth rates compared to piglets moved to larger pens in a different space [35, 36]. In contrast, other studies point out that the number of piglets in the rearing group has no influence on the intensity of their growth, but that the survival rate decreases with a decrease in the area of the group pen [5].

The study of the dependence of the indicators of piglet growth intensity on the duration of stay in one or different rearing rooms will make it possible to find a better way to increase it, including the economic results of different approaches during this period.

The aim of this work is therefore to study the duration of rearing of piglets with constant and variable stay in the same room of the farm.

MATERIALS AND METHODS

In order to achieve the set objective, 4 groups of 3,000 animals each were formed at farm No. 1 of LLC "NVP "Globinsky Pig Complex", Poltava Region, Ukraine, using the peer group method. At the time of weaning, all piglets had the same age and weight. They came from crossbred sows of the Great White and Landrace breeds, which were inseminated with boar semen of the synthetic line PIC-337. During weaning, all the piglets studied were fed a dry mix for newborns Superior Neonatal (0–9) and continued to be fed this feed after weaning until they reached a weight of 9 kg. The piglets were subsequently transitioned to the pre-starter feed, 9–12 brand, from the same manufacturer. This feed was provided until the piglets in this group reached a weight of 12 kg. Following this, they were switched to the starter feed, 12–25 formula, from the Cargill brand. This feed was given until the pigs were ready for the fattening stage.

After weaning the piglets of all groups, they were transferred to the rearing station of breeder No. 1, where they were housed in pens for 50 piglets each, with a fully barred floor and an average area of 0.33 m^2 per animal, equipped with incubators to automatically maintain the local microclimate in the piglets' recovery area. All animals were fed dry, fully rationed compound feed from self-fertiliser in the first rearing phase, with a feeding front of 2.5 cm per piglet. Automatic drinkers in the amount of 8 units were set up for feeding the piglets, and waste was managed using a periodic vacuum gravity system. These housing conditions remained consistent for the control group of piglets throughout the rearing period. In contrast, the piglets in the second, third, and fourth experimental groups were moved to pig complex no. 4 on the 42nd, 33rd, and 24th day, respectively, after the first rearing phase ended. They were kept under conditions identical to those of the control group but were fed liquid feed mixtures in the second rearing phase. These mixtures had a

ratio of 2.8 parts water to 1 part feed and were provided at a feeding front of 0.08 m per pig, using the same feed as the control group.

During the trial, all aspects of feeding conditions, animal husbandry and other zoological and veterinary procedures were carried out in accordance with EU and Ukrainian regulations for pig husbandry.

Data on the health status, excretions, reason and weight of the excreted animals were recorded throughout the experiment.

For regular monitoring of growth intensity in all experimental groups, two control pens with 50 animals each were selected according to the principle of analogue groups. After aligning the control pen's weight to the group average, all animals were individually weighed and marked. Additionally, these piglets were individually weighed when they were placed at the feeding trough. The average daily feed intake and feed conversion, piglet survival rate, and the weight of the animals at the transition to another rearing phase in the experimental groups were calculated based on group weighing. The biometric indicators for the control pens were determined using individual weighing data. Experimental results were calculated, using personal computers and application programs in the MS Excel.

RESULTS AND DISCUSSIONS

The results presented in Table 1 show that the growth intensity of the piglets and, consequently, their weight in the different rearing phases depends on the phased nature of the process and the duration of these phases. Thus, the average live weight of the piglets at the beginning of rearing was approximately the same in all groups. However, at the end of the first growth phase, the weight of the animals was different due to the different duration of these phases and the different intensity of growth during this time. While the difference in the live weight of the piglets at the end of the first rearing phase between the analogues of the I and the II experimental group was already 3.50 kg, it was 6.60 kg in the III experimental group and already 11.80 kg in the IV. At the end of piglet rearing, the live weight of the pigs in the I group was 23.35 kg, while the piglets in the II group, which were fed liquid feed for 18% of the entire rearing period in the II rearing period, had a live weight 0.80 kg or 3.4% higher than the I group at the transition to fattening. The animals in the III group, in which the second rearing phase with liquid feed accounted for 35% of the total rearing period, had a live weight that was 1.85 kg or 7.9% higher than the pigs in the I group at the finish of this phase ($p \leq 0.001$).

At the same time, the live weight of the piglets in the IV experimental group, which was reared in the second rearing phase, which accounted for 53% of the total rearing period, was 2.85 kg or 2.85% ($p \leq 0.001$) higher than that of the control analogues.

Table 1. Productivity of piglets in the first phase of rearing

Indicators	Group I	Group II	Group III	Group IV
The initial piglet count at the start of the experiment, pigs	3,171	2,974	3,089	3,150
The average weight of a single piglet at the beginning of the trial, in kilograms	5.57±0.113	5.57±0.129	5.60±0.093	5.52±0.073
The average weight of piglets at the start of the second phase of rearing, in kilograms	23.35	19.85	16.75	11.55
The average live weight of a single piglet at the end of the rearing period, in kilograms	23.35±0.267	24.15±0.311	25.20±0.294***	26.20±0.354***

*** – P <0.001.

Source: own calculations.

When the piglets were fed a liquid ration for 18%, 35% and 53% of the total rearing period in the second rearing phase, their live weight increased by 3.4%, 7.9% and 12.2% respectively at the transition to fattening compared to the analogous systems with

single-phase supplementation and 100% dry feed supply.

The average daily feed consumption in the first rearing phase depended significantly on the duration of this phase for a group of piglets and, accordingly, on the increase in the live weight of the piglets during this phase. As depicted in Figure 1, it is evident that pigs in Group II, where the initial phase was 9 days shorter than in Group I, consumed approximately 0.03 kg less feed. Conversely, pigs in Group III, with a first growth phase 18 days shorter, consumed an average of 0.18 kg less feed per day compared to Group I. Meanwhile, piglets in Group IV, with a first growth phase 27 days shorter, consumed 0.19 kg less feed than those in Group I. Taking into account that the piglets had a greater mass in the second rearing phase than in the first phase, they consumed relatively more feed. And the shorter the second growth phase, the older the pigs were at this time. As can be clearly from the diagram, the pigs in the II and III groups consumed almost the same amount of feed (1.03–1.06 kg) during the second growth phase, while the apigs in the IV group gained an average of 0.04–0.07 kg less per day. Despite the same duration of the entire growth phase, feed consumption was higher in the animals that spent most of the growth phase on the liquid feeding system. Thus, the animals of the I group consumed the least amount of feed, 0.52 kg, while their counterparts from the second group had an average daily consumption of 0.08 kg, the third by 0.11 kg, and the fourth by 0.17 kg compared to the control counterparts.

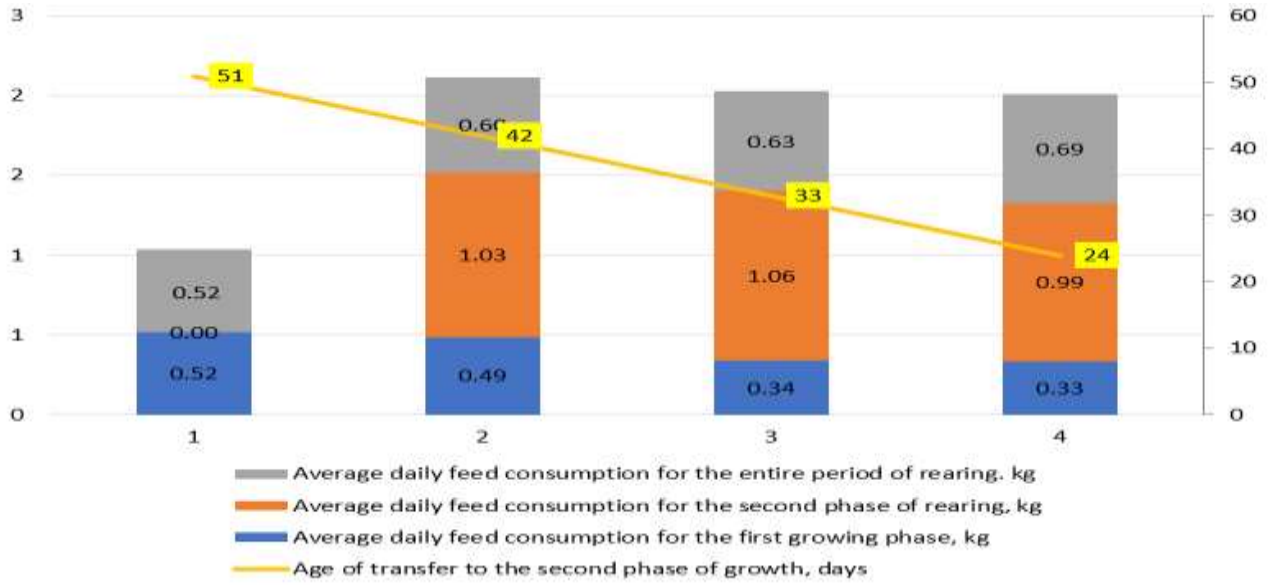

Fig. 1. Average daily feed consumption during different phases of rearing
Source: own calculations.

The absolute increase in the first growth phase also depended more strongly on the duration of these phases (Fig. 2). For instance, pigs in Group I, with a first rearing phase lasting 51 days, achieved an absolute gain of 17.78 kg. In contrast, pigs in Group II, where the rearing phase was 9.00 days shorter, had an absolute gain 6.54 kg less than their Group I counterparts. Similarly, piglets in Group III, with a first rearing phase lasting 33 days, had an absolute gain 11.73 kg less than those in Group I.

Absolute growth also depended on the duration of the second phase. Pigs of group III, in which the growth phase lasted 9 days longer than in group II, had an absolute gain of 4.16 kg more than animals of group II. In contrast, pigs in group IV, where the second phase lasted 18 days longer than in group II, showed an absolute gain of 10.36 kg.

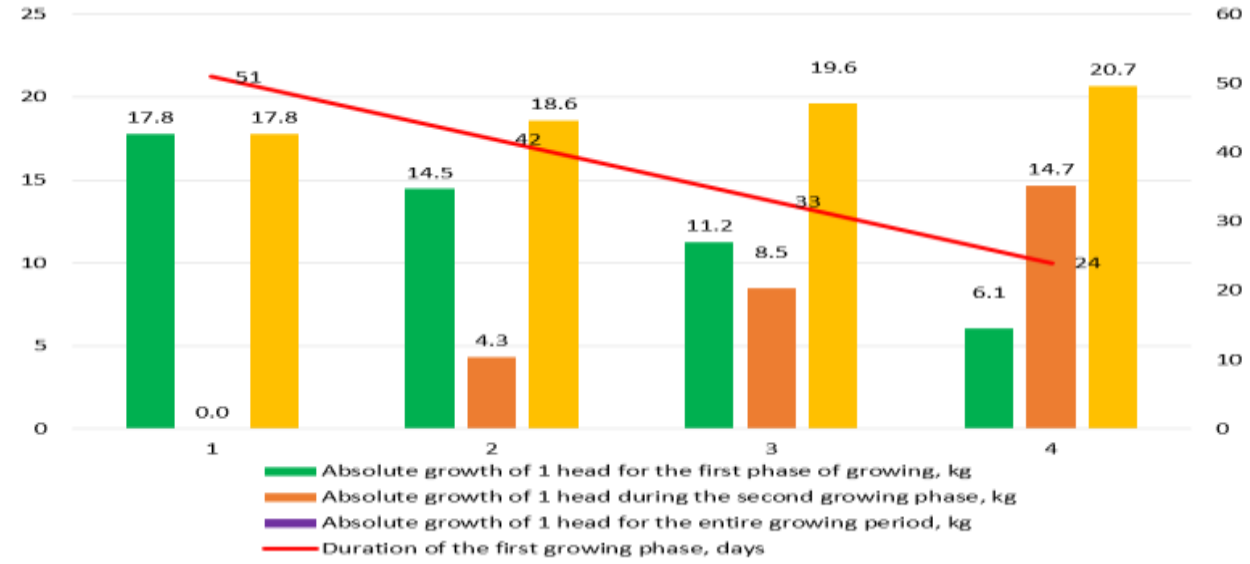

Fig. 2. Absolute growth during different phases of growth
Source: own calculations.

With the same duration of the entire growth period, the absolute gain during this time is defined by the different growth intensity caused by the unequal duration of the feeding methods during the first and second phase. The absolute growth of the pigs in the I group, which were reared on dry feed for the entire period, was 0.80 kg, 1.82 kg and 2.90 kg lower than that of the animals in groups 2, 3 and 4, which were partly reared on liquid feed.

Given the same duration of the entire growth period, the difference in the consumption of an animal is due to the different average daily consumption in each of the groups (Fig. 3). For example, the pigs in the I group, in which the daily consumption was 0.52 kg, ate 26.55 kg of feed during the entire rearing period. Pigs in Group II, with a daily feed consumption of 0.60 kg, consumed a total of 30.47 kg of feed. In Group III, where feed consumption was 0.63 kg, 31.95 kg was allocated for the growth of one pig. For Group IV, with the highest feed consumption (0.69 kg), 35.16 kg was used for the growth of one pig.

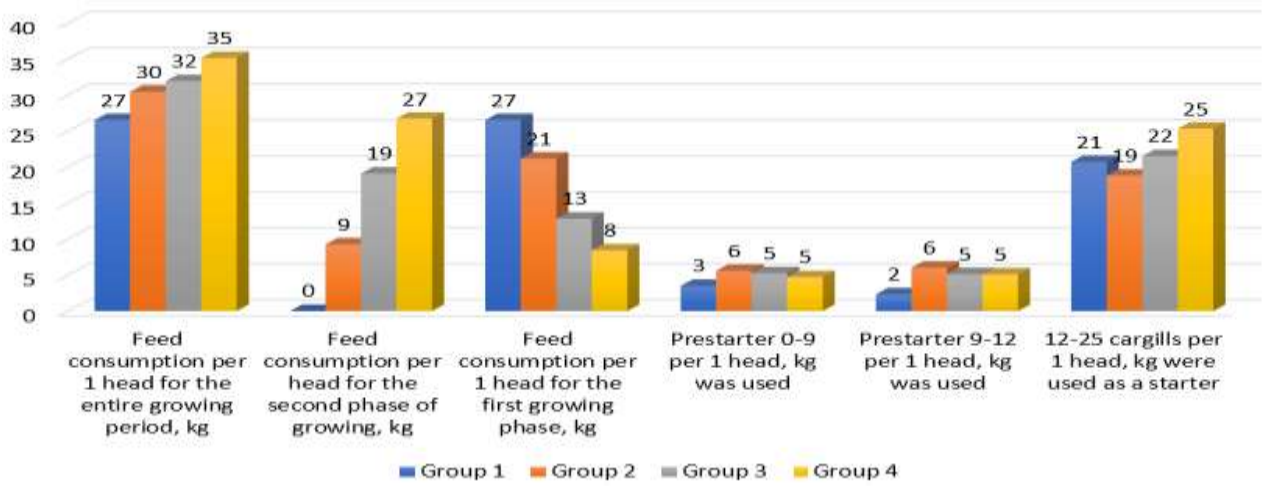

Fig. 3. Feed consumption of different recipes during different phases of growing
Source: own calculations.

The amount of feed consumed and its cost, which depended on the use of different compound feed formulations, also caused different feed costs for rearing an animal and a growth unit during this period, which in turn affected the cost of the entire rearing process and the cost of a pig after its completion. As shown in Table 2, the phasing of watering

affected the feed consumption of the animals and their cost per animal. The piglets in the I group were characterised by the lowest feed costs when they were fed dry feed and did not move during rearing. An amount of 2.61 EUR less was spent on the training of one pig from this group than the analogues of the second group, 3.07 EUR less than the third group, and 3.52 EUR less than the fourth group, which were transferred to another division and changing the way of feeding. In the two-phase method of rearing with a change in the feeding system, the costs per kilogramme of growth were also higher. The costs were 0.11 EUR higher for Group II pigs, 0.1 EUR higher for Group III pigs, and 0.08 EUR higher for Group IV pigs compared to Group I pigs, which were fed in a single phase with a consistent feeding method.

Considering that the proportion of feed in the total operating costs for growth was nearly identical across all groups, this influenced the variation in rearing costs per animal. Therefore, the operating costs for rearing Group I pigs were 14.12 EUR. This cost was 3.17 EUR higher for Group II pigs, 3.66 EUR higher for Group III piglets, and the difference was 3.66 EUR for Group IV pigs. Also considering that the cost price of one piglet at the time of placement for rearing was equal, the same difference remained between the cost of one pig after finishing rearing.

Table 2. Feed consumption of different recipes during different phases of growing

Indicators	Group I	Group II	Group III	Group IV
Feed costs per head during rearing, EUR	10.88	13.49	13.95	14.40
Operating costs for 1 piglet, EUR	13.43	16.66	17.22	17.78
Cost of the 1st piglet upon completion of rearing, EUR	23.18	26.41	26.97	27.53
Market value without VAT of the 1st piglet upon completion of rearing, EUR	43.78	45.28	47.25	49.13
Profit from raising the 1st piglet, EUR	20.61	18.88	20.28	21.60
Profitability of growing the 1st piglet, EUR	2.22	1.79	1.88	1.96
Feed cost of 1 kg of gain, EUR	0.61	0.73	0.71	0.70

Source: own calculations.

The varying final live weights of the piglets, despite the consistent price per kilogram of live weight during this period, led to a considerable disparity in the market value of an animal at the end of the experiment. In this scenario, the cost was also the lowest among the animals in the control group, who were outperformed in this regard by 1.5 EUR compared to the second group, 3.46 EUR compared to the third group, and 5.34 EUR compared to the fourth group. The variation in the market value of a piglet at the end of the rearing period, coupled with different cost levels, resulted in varying income amounts from rearing a piglet by the end of this period. Thus, the highest income from rearing a piglet was obtained from animals in the IV group, which totalled 21.14 EUR. Meanwhile, the cost difference was 1.23 EUR for the first group, 2.91 EUR for the second group, and 1.43 EUR for the third group compared to the fourth group. These discrepancies in costs and market values at the end of rearing led to differing levels of profitability in this stage of the production process. Hence, the pigs in Group I, raised under dry feeding conditions and a single-phase system, showed the highest profitability at 83.39%, which was 15.97% higher than that of Group II, 11.82% higher than Group III, and 7.80% higher than Group IV.

Therefore, in a 2-phase rearing system with a transition from dry to liquid feeding, piglets exhibited 4.5–16.3% higher absolute gains, leading to a 3.4–12.2% increase in live weight at the end of the rearing period and a consequent 2.4–12.2% higher market value for the piglets. However, this approach also resulted in 14.8–32.4% higher feed costs due to increased average daily feed consumption, a 9.4–14.1% less efficient feed conversion ratio, and a 24.1–32.4% higher cost of feed consumed during the rearing period. This

translated to 22.5–29.1% higher operating costs for rearing an animal, 13.8–18.7% higher costs per kilogram of growth, and 13.3–17.2% higher costs per piglet at the end of the period. Consequently, the profitability of rearing one animal per period decreased by 7.80–15.97% compared to animals fed a single-phase diet with dry feed. With regard to the amount of income from the rearing of a pig during the 72 days of life, no clear regularity was found between animals with single-phase growth and two-phase growth with different durations of the phases. The highest income was obtained in biphasic rearing animals with a phase duration of 27 days on liquid feed, which was 6.2% higher than in monophasic rearing animals on dry feed, and by 16 in biphasic rearing with a second phase duration of 9 days and by 7.3% compared to biphasic rearing with a second phase duration of 18 days.

Our data on the higher growth intensity of piglets in biphasic rearing, where the animals were moved back and forth between two farms, compared to piglets kept in the same room without movement, are consistent with the results [35] related to the growth of animals transferred to larger pens in different farms. However, the expression of the growth intensity indicator we found contradicted the results describing a lack of dependence of the growth rate of piglet live weight on the size of the group pens and the density of animals in it, indicating the inappropriateness of additional production space and moving piglets between farms of different sizes [5].

In addition, our results differed from reports [2] which indicated that pigs kept unchanged on a farm in pens with an initially large area performed better in terms of weight gain than pigs transferred from pens with a smaller area to another farm in group pens with a larger area. that matched the age and weight of the experimental animals but did not provide additional space.

Housing pigs for rearing with two-phase fattening also led to an increase in the amount of feed consumed and a deterioration in feed conversion efficiency, as noted in the paper [35]. However, our findings contradicted the results reported in [14], which suggested that moving piglets to larger pens and maintaining a consistent number of piglets per feeder did not impact feed consumption. However, the feed conversion ratio deteriorated at higher stocking densities, a characteristic of single-phase piglet rearing.

Additionally, piglets that remained on the same farm from weaning to transfer to fattening exhibited a decreased survival rate attributed to limited space and higher piglet density per pen, aligning with the findings of the study mentioned [5].

CONCLUSIONS

It was found that animals reared under a single-phase system with dry feeding exhibited the lowest average daily feed consumption, while those under a two-phase system with liquid feeding showed a reduction in this indicator by 14.8–32.4% compared to those under single-phase rearing.

When piglets were fed a liquid diet in the second phase of rearing, their weight at the transition to fattening increased by 3.4–12.2% compared to counterparts reared with a single-phase and 100% dry feeding system.

The study demonstrated that piglets under two-phase rearing experienced higher absolute gains, leading to increased live weights at the end of rearing and consequently a higher market value.

Higher feed costs during the growth period, poorer conversion rates, increased cost of consumed feed per period, higher operational costs per pig, higher cost per kilogram of growth, higher cost per piglet, and lower profitability compared to animals reared under a single-phase system with dry feeding were observed.

It has been proven that no clear regularity has been established in terms of the level of income from growing one pig during 72 days of life between animals with one-phase rearing and two-phase rearing with different durations of phases.

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