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Sow and piglet productivity improvement in the farrowing department using milk substitutes

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Abstract. Modern pork production technology requires more piglets from sows to ensure the industry's profitability. The physiological reserve of sows' milk production at multiplicity above 14-18 piglets is often insufficient, which requires a constant search for ways to solve the problem of "hyperfertile sows". The study aims to investigate the effectiveness of using milk replacers from different manufacturers in sow nests under conditions of multiple farrowings on the productivity and behaviour of suckling piglets and sow conditions. The experiment was conducted in 2023, with 36 sow nests in the farrowing shop and 513 suckling piglets. Nests with a litter of 13 or more were selected and three groups were formed. In the control group, piglets were raised without additional feeding with milk replacers. The group II piglets were fed with Alternative Milk Junior as a source of additional nutrition from 10 days of age until weaning. Piglets of group III received a Commercial Analogue of milk replacer. Group II was characterised by a higher survival rate – of 93.03% and, a higher live weight – of 7.84 kg, which led to higher values of average daily weight gain – 222.47 g. The nests of the II and III experimental groups (consuming milk replacer) were more aligned, which significantly outperformed the analogues of the control groups by 31.2% and 14.7%. Piglets of group II were in a calmer state and therefore spent the most time on rest – 60%, in contrast to animals of the control group – 50% and group II – 58%. Additional

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nutrition of piglets in the nests of “hyperfertile sows” reduces the load on sows during lactation allows to obtain animals in factory condition and reduces the number of unprofitable days. The practical significance of the experiment is to determine an effective milk replacer as a source of supplementary nutrition for suckling piglets in the nests of “hyperfertile” sows

Keywords: pigs; technology; suckling period; feed additive; live weight; gain; safety; behaviour; sow condition

Introduction

The maintenance and feeding of suckling sows and suckling piglets are the main and most important technological process in the reproduction of pig stock in farms of different sizes and management systems. The issue of increasing the productivity of these technological groups of pigs is currently being addressed by breeding and genetic, technological solutions, by improving feeding technology with the use of functional feeds, etc. (Baxter *et al.*, 2020). Today, scientists and practitioners have made significant progress in increasing sow fertility. Nowadays, 14-20 piglets born and 13-18 live piglets per nest are not uncommon. However, this creates new challenges, complicating animal management (Nicolaisen *et al.*, 2019; Lykhach *et al.*, 2023).

Milk substitutes in pig production are not a new concept. Almost every farm has experience in their use, as there is a demand for this product because it is necessary to quickly solve the problem of milk deficiency in sows for various reasons. And there is no need to look for a faster way – just dissolve the powder in warm water. Indeed, in recent years, the use of these products has become an increasingly traditional practice both on foreign and domestic farms, when more than 30 piglets are often weaned from a sow per year. Therefore, these substitutes in the technological process can be used not permanently, but only when the sow does not produce enough milk; and as a permanent element of the structural approach in conditions when sow litters are becoming more and more fertile (Maximizing the genetic..., 2023).

P.J. Maas *et al.* (2023), producers are now able to obtain numerous farrows thanks to scientific advances in genetic companies, modern and better housing conditions, strong constitution and animal resistance, and improved feeding technology and management models. However, the process of increasing sow milk production is less progressive. Consequently, with additional piglets in the nest, the amount of milk consumed by one animal decreases. This has led to increased attention from producers to milk substitutes as a means of solving this relatively new problem. Given the trend towards multiple genetics, more and more pork producers are turning to milk replacers. Such technological solutions help to minimise the stress on piglets from moving them between farrowing units.

G. Yordanova *et al.* (2021) due to increasing sow fertility, the number of piglets with low birth weights (0.85-1.05 kg) in the nest is increasing. Therefore, producers are looking for ways to preserve and feed weak piglets until weaning. Milk powder substitutes produced by the industry need to be dissolved to a consistency of 10-15% to obtain a more liquid solution. As a rule, one kilogram of liquid milk replacer has a nutritional value equivalent to 0.5-0.75 kg of sow milk. Given the high milk consumption potential of piglets, this concentration does not slow down their growth and development. The closer the characteristics of the substitute are to natural milk, the higher the piglets' productivity. However, the price of such a product will be correspondingly high (Blavi *et al.*, 2021).

Piglets' digestive system is more adapted to digesting dairy products. Therefore, dairy ingredients such as skimmed milk, whey, buttermilk, lactose, and their derivatives should be the quality basis. In addition, a good substitute should contain easily digestible lipids, sucrose, possible flavour enhancers, vitamins, trace elements, organic acids and, if necessary, the necessary veterinary drugs. Also, vegetable proteins after the purification procedure (soy concentrate, potato and pea protein, wheat gluten, etc.) can be used as partial substitutes, but only in small proportions. They reduce the price of the product, but also the quality. Lecithin is commonly used as an emulsifier. Milk replacers used in the modern technological process contain immunoglobulins, as milk is rich in these functional proteins that support the health of suckling piglets. There are three main sources of immunoglobulins for milk replacers: dried bovine colostrum (high cost), dried animal plasma (high cost and banned in some countries) and egg immunoglobulins (for specific diseases in piglets) (Thomson & Friendship, 2019; Kobek-Kjeldager *et al.*, 2021). Milk replacers that do not contain immunoglobulins only provide nutrition for piglets but do not provide protection. Therefore, such products (milk replacers) can only compensate for 50% of the functions of natural sow milk (Return of milk..., 2023).

Thus, genetic improvements can increase the profits of pig producers, but without proper management and conditions for rearing sows and suckling piglets, genetics alone is irrelevant. L. Blavi *et al.* (2021) clearly states that the use of milk replacers in pig production allows for reducing the percentage of deaths of weak piglets under sows (large farrowings in gilts, problems with lack of milk in sows with mastitis-metritis-agalactia syndrome, low birth weight of piglets, and other problems); increase the number of business piglets per sow per year due to additionally fed piglets; obtain weight-even nests at weaning, which is crucial in industrial pig production, with fluctuations

in sow milk production; stimulates rapid live weight gain in piglets from the first weeks, which is important at early weaning (21-24 days); weak piglets gain maximum weight and form a stable immune system by introducing immunoglobulins into the product, as well as form a complete intestinal microflora by introducing probiotics.

Thus, the study aimed to investigate the effectiveness of the use of different milk replacers in the nests of suckling sows under conditions of multiple farrowing on productivity, safety and behavioural indicators of suckling piglets and sow conditions under industrial technology.

Materials and Methods

As part of the experiment, which took place in 2023, 36 nests of suckling sows in the farrowing room with 513 suckling piglets (breed: Large White × Landrace × Maxter terminal line) kept at the farm of the private enterprise “Victoria” in the Mykolaiv region were studied. Experimental studies were conducted in the farrowing shop, where the conditions of keeping experimental animals complied with VNTP-APC – 02.05 “Pig enterprises (complexes, farms, small farms)” and recommendations of genetic companies on keeping (2005). Animals of the experimental groups were kept in identical premises with boxed separation according to the design and set of equipment of AgroDana LLC (Ukraine). In each group, during the suckling period, piglets were kept in individual pens on a fully lattice floor, measuring 2.4×1.8 m, with the sow fixed in the centre of the pen. A combination of local heating sources was used as a source of local heating for the experimental animals: an infrared incandescent lamp, an electric heating mat and a brooder (Tsarenko *et al.*, 2004). The experiment started from the moment of the farrowing of sows and ended with the weaning of piglets. The duration of the suckling period was 28 days. According to the analysis of the index of fertility of the main sows in the context of two farrowing cycles, the

average value of this index was determined – 13.56 goals per farrowing.

Accordingly, sow nests with a litter of 13 or more were selected for the experiment and three experimental groups were formed according to the experimental scheme (Table 1). In the farrowing shop, sows of all groups were provided with free-range feeding (except for farrowing day – 1.0 kg/head) and used compound feed “Lactating sows”. The nutritional value of the diet provided is as follows: per kilogram of product weight, it contains 163.9 g of crude protein and provides metabolic energy in the amount of 2990.4 Kcal. The farrowing

shop used pre-starter feed from Tsekhav LLC, Ukraine, in the form of pellets from homemade cows, which was provided from day 7 to day 28. The nutritional value of this feed is 185.0 g of crude protein and 325.0 Kcal of metabolic energy per kilogram. The main diet for lactating sows in the experimental groups was a compound feed of our production, which included a protein, mineral and vitamin supplement from Tsekhav LLC (Ukraine). The composition of the main diet “Lactating sows” included 40.0% wheat, 40.0% barley and 20.0% protein, mineral and vitamin supplement “Tsekhavit Sow Concentrate Lactation”.

Table 1. Experimental design for the use of milk substitutes during the suckling period (28 days)

No.	Group	Amount, heads		Number of piglets at birth, heads	Milk replacer usage conditions	Period, days
		sows	piglets			
I	control	12	170	14.17	“Lactating sows” feed	0-28
					pre-starter feed for suckling piglets	7-28
II	experimental	12	172	14.33	“Lactating sows” feed	0-28
					pre-starter feed for suckling piglets	7-28
					“Alternative Milk Junior” milk replacer	10-28
III	experimental	12	171	14.25	“Lactating sows” feed	0-28
					pre-starter feed for suckling piglets	7-28
					“Commercial Alternative” milk replacer	10-28

Source: compiled by the author

An algorithm for the preparation and use of milk replacers in groups of experimental animals was developed: 1 kg of milk replacer powder was added to a container for preparation of 5.5 litres of warm water (45-50°C), then stirred constantly until completely dissolved. The mixture was fed immediately after preparation at a solution temperature of 38-40°C (piglet body temperature). The temperature of the mixture was monitored using a thermometer. In the case of atypical reactions from piglets, feeding of the substitute was immediately stopped and the electrolyte solution was given for 12-24 hours. When using a milk replacer, all feeders were washed in warm water with detergent. The piglets had constant access to water.

The dishes from which the milk replacer was fed were located in the machine near the piglet drinkers. The frequency of milk replacer feeding was 6-8 times per day to feed weak and numerous nests. After 15 days of life, the substitute could be given in the required amount. The milk replacer was fed to the experimental groups using a conventional feeder starting from day 5 of life (Fig. 1). Composition of the product “Alternative Milk Junior” (Technical Specifications of Ukraine 15.7-35756835-001:2011): whey, milk-fat concentrate, skimmed milk powder, dextrose, soy concentrate, wheat gluten, salt, acidifier, lysine, methionine, a mixture of organic trace elements, vitamin and mineral premix, probiotic, flavouring, sweetener. Nutritional

content of Alternative Milk Junior (%) according to the manufacturer: crude protein – 21.5; crude fat – 16; crude fibre up to 0.5; lysine – 1.8; lactose – 40. Vitamin content (IU; mg/kg):

vitamin A – 55,000; vitamin D – 4,500; vitamin E – 80; vitamin C – 120; vitamin B₁ – 18; vitamin B₂ – 23; vitamin B₆ – 10; vitamin B₁₂ – 45; selenium – 0.3.

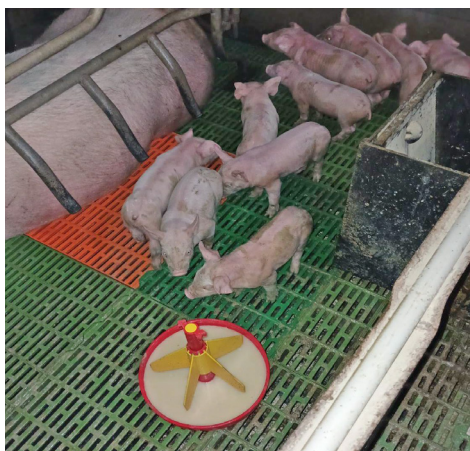


Figure 1. Example of feeding a milk replacer

Source: compiled by the author

Ingredients of the Commercial Analogue milk replacer product: skimmed milk powder, whey, milk and fat concentrate, soya concentrate, soya flour, vitamin and mineral mix, probiotic, flavouring, and antioxidant. Product nutritional content (%) according to the manufacturer: crude protein – 21; crude fat – 17; crude fibre 1.0; lysine – 1.7; lactose – 38. Vitamin content (IU; mg/kg): vitamin A – 55,000; vitamin D – 4,500; vitamin E – 80; vitamin C – 120; vitamin B₁ – 16; vitamin B₂ – 10; vitamin B₆ – 8; vitamin B₁₂ – 40; selenium – 0.3. To ensure optimal microclimate parameters, ventilation in each farrowing box was provided by an exhaust axial fan and an aerodynamic inlet valve, which operated by creating negative pressure in the room. Manure was removed from the room using a traditional vacuum and gravity system. The frequency of emptying the baths under the slatted floor was 10-14 days. Sows were fed from nipple drinkers and suckling piglets from cup drinkers were placed 7 cm above the floor. All veterinary procedures were

identical in both the experimental and control groups, according to the scheme adopted on the farm. The conditions of feeding, watering, housing, care and prevention of animals in the experiment were by European legislation on animal welfare and comfort (Council Directive 91/630/EU, 2008/120/EU, 2008; Council Directive 98/58/EU, 2008; Council Directive 2010/63/EU, 2010).

The productive traits of suckling piglets of these groups (Table 1) were studied by the following traits: number of piglets at birth (heads), live weight of each piglet at birth and weaning (28 days) (kg), number of piglets in the nest at weaning (heads), average daily growth of suckling piglets (g), safety (%) and nest alignment at weaning (Ibatulin & Zhukorskyi, 2017). The indicator of piglet nest alignment at weaning was calculated using the formula (Kovalenko, 2009):

$$NA = 0.625 \times M - (10 - P1) \times (10 - 1.875 \times P2), (1)$$

where M – weight of the nest at weaning, kg; $P1$ – number of piglets at weaning, heads; $P2$ –

number of piglets that lag behind the average nest weight by 3 kg or more.

The behaviour of suckling piglets was monitored during the study period to determine the time spent on rest, movement, and feed intake according to generally accepted methods in pig production. The condition of sows in different technological groups was assessed based on measurements of the thickness of the back fat at point P2, located 65 mm to the left and down from the midline of the back at the level of the head of the last rib. Measurements of rind thickness were carried out before farrowing and on the day of weaning using a Renco ultrasound scanner (Ladyka & Khmelnychiy, 2023). After the end of the suckling period, the proportion of sows that entered heat and were inseminated within 7 days was determined (%). In the experimental groups, the daily consumption of feed and milk replacer was monitored by the group and the data were recorded in the experimental table. Deviations in the health of the animals and the veterinary care provided to them were also recorded daily in each group. The date and reason for the animals' withdrawal from the experimental groups and the weight of the

animals that withdrew were recorded. The obtained results of the scientific and economic experiment were processed according to the generally accepted methods of variation statistics using computer equipment and application software packages *MS Excel* 2000 and *Statistica* V. 5.5 (Kramarenko *et al.*, 2019).

Results and Discussion

Improving the breeding qualities of sows is usually associated with an increase in sow fertility. Today, the achievements of geneticists and breeders in this area are quite advanced and average 14-18 gilts per farrowing. The main aspects of solving the problem of “hyperfertile” sows are to preserve the maximum number of animals before weaning, obtain high piglet growth energy, and keep the sow in factory condition and high milk yield. It should be noted that without the use of milk replacers, the planned high productivity of modern sow and suckling pig genotypes cannot be achieved (Ivanov *et al.*, 2009). The productivity and safety of suckling piglets depending on the use of milk replacers in the suckling period are presented in Table 2.

Table 2. Productivity and safety of suckling pigs, $\bar{X} \pm S_{\bar{X}}$

Parameter	Group		
	I control	II experimental	III experimental
Number of sows, heads	12	12	12
Number of piglets at birth:			
total, heads	170	172	171
per sow per farrowing, heads	14.17 ± 0.228	14.33 ± 0.219	14.25 ± 0.232
Nest weight of piglets at birth, kg	16.60 ± 0.269	16.73 ± 0.230	16.85 ± 0.253
Piglet weight at birth, kg	1.17 ± 0.008	1.17 ± 0.008	1.18 ± 0.005
Number of piglets at weaning at 28 days of age, heads	12.33 ± 0.133	13.33 ± 0.251***	12.92 ± 0.260*
Average live weight of one piglet at weaning, kg	6.80 ± 0.076	7.84 ± 0.140***	7.21 ± 0.187 ^{ab}
Live weight of a nest of piglets at weaning, kg	83.74 ± 0.574	103.89 ± 1.015***	92.12 ± 0.850*** ^c
Average daily weight gain of piglets in the suckling period, g	187.72 ± 2.393	222.47 ± 4.536***	200.97 ± 5.221*** ^b
Piglet safety, %	87.49 ± 1.030	93.03 ± 1.088**	90.54 ± 0.762**
Nest alignment at weaning, points	67.86 ± 1.305	89.20 ± 1.790***	77.84 ± 1.329*** ^c

Note: * – $p < 0.05$; ** – $p < 0.01$; *** – $p < 0.001$ (compared to animals of the control group - group I); a – $p < 0.05$; b – $p < 0.01$; c – $p < 0.001$ (compared to animals of experimental group III with analogues of experimental group II) nests at weaning, points

Source: compiled by the author

The formed experimental and control groups were similar when they were set up for the experiment. Changes in the number of piglets at weaning were noted in the nests of sows whose fertility exceeded the average for the herd in the control and experimental groups when using milk replacer in the technology of growing suckling piglets starting from 5 days of life, according to the methodological recommendations. The number of piglets at weaning in the nests of the sows of the II experimental group (treated with the "Alternative Milk Junior") was 13.33, which is 8.1% higher than the control ($p < 0.001$) and 3.2% higher than the analogues of the III experimental group (treated with the "Commercial Analogue") ($p < 0.05$). Accordingly, the growing conditions, the presence of additional factors of feeding piglets of the experimental groups along with the basic technology influenced the piglet survival rate, which was higher in the nests of sows using milk replacers, so in group II 93.03% of piglets were preserved, in group III – 90.54%, which is higher than in the control group by 5.54 and 3.05% ($p < 0.01$), respectively. Similar experimental data were obtained by researchers L. Brossard *et al.* (2017), who found that the use of additional sources of piglet nutrition makes it possible to increase the safety performance by 0.8-1.5% on average per farrowing cycle. The presented recommendations allow for saving high-cost feed and investments in the industry at the level of 5-12% over the period of the full production cycle.

As such, the weight of piglets at weaning (28 days) can reach 9-10 kg. In reality, not all farms can reach 7-7.5 kg. Although the genetic potential has not yet been fully realised, the results have improved thanks to quality management in the farrowing house. The live weight of piglets at weaning is one of the main production indicators on a pig farm. The higher the piglets' weaning weight, the faster the pigs will reach a slaughter weight of 110 kg. It is necessary to use the high growth energy of piglets at

the initial stages of development as efficiently as possible in order not to lose their early maturity potential, the previous studies conducted by P. Nevrla *et al.* (2017) are consistent with the data obtained in the current study, namely, increased birth weight led to an increase in daily body weight gain from birth to weaning (28 days), as well as from birth to slaughter by 10-18% ($p < 0.05$, $p < 0.01$). High daily weight gain (250 g; 685; 998 g) allowed pigs to reach slaughter weight a month earlier and obtain a higher yield of lean meat ($52.74 \pm 2.82\%$).

The use of milk replacers from different manufacturers in both cases had a positive effect on the development and growth of piglets, namely, gilts of group II had a higher weaning weight of 7.84 kg, which was 15.3% higher than the control ($p < 0.001$). Animals of the same group, when using the product of the animal feeding supplement "Alternative Milk Junior", in contrast to the product "Commercial Analogue", exceeded the peers of the third group by 8.04% ($p < 0.01$). An increase in the number of piglets in the nests of the II and III experimental groups and their live weight at the time of weaning led to higher values of the weight of the piglet nest at weaning. The highest value of this indicator was characterised by the representatives of the II experimental group – 103.89 kg, which significantly exceeded the analogues of the control group and the III experimental group by 20.15 and 11.77 kg ($p < 0.001$), respectively. Similar studies were obtained by S. Sugiharto *et al.* (2015) on suckling piglets as a result of feeding milk replacers. Namely, in piglet nests where cow whey was additionally used, an increase in piglet live weight at weaning at the age of 28 days by 0.36-1.12 kg ($p < 0.01$), nest weight by 12-16% ($p < 0.05$), and safety at the time of weaning from the sow within 1.1-2.3% was noted. In piglets of the experimental groups receiving high-quality milk replacers during the suckling period, 6% fewer cases of gastrointestinal diseases were observed.

When many piglets are born (more than 13-14 piglets), the proper growth and development of the piglets are hampered. The sow does not have enough milk in her body, especially at the end of the lactation period when the piglet's nutritional needs increase significantly. If certain technological measures are not taken, the weight of the piglets will be significantly reduced when they are weaned. In such groups, there will be smaller piglets that lack the nutrients necessary for normal growth and development. Stunted piglets often do not achieve maximum productivity and often do not survive in the competitive feed environment of pig farms. Our research is consistent with the experimental data of E. Ambroziak and A. Rekiel (2017), who noted that the live weight of piglets at birth correlates with the subsequent growth energy of gilts. Thus, the correlation coefficients for piglets of groups I (the lightest at birth) and IV (the heaviest at birth) were found to confirm the relationship between birth weight and body weight on the 7th ($p < 0.01$), 21st ($p < 0.01$) and 56th day of age ($p < 0.05$), with a tendency to decrease the calculated relationships. In addition, in group I, piglet weight at birth correlated with daily weight gain from day 1 to day 7 ($r = +0.365$, $p < 0.01$) and from day 1 to day 56 ($r = +0.291$, $p < 0.05$). With an increase in the average live weight at birth, the safety of piglets increased and was higher in group IV compared to group I by 13.64%. Birth weight ≥ 1.60 kg provided the best growth rate and piglet survival. Thus, the position of scientists is unanimous regarding the need to support piglets in the suckling period with additional sources of nutrition (milk replacers), because in their absence, young animals are not able to achieve high and standard performance indicators.

Additional support for suckling piglets in the form of milk replacers in their diet from 14 days of age in combination with the basic technology significantly increased the average daily weight gain of young animals before weaning. The use of the milk replacer "Alternative Milk

Junior" and its innovative composition made it possible to obtain a higher average daily weight gain of piglets at weaning at 28 days (group II) – 222.47 g, which exceeded the indicator of the control group (I) by 34.75 g ($p < 0.001$), and the commercial analogue (group III) by 21.5 g ($p < 0.01$). G. Yordanova *et al.* (2021), based on the results of a study on the development of piglets using different milk replacers in the suckling period and during rearing, found significant differences in the control and experimental groups. The highest average daily weight gain for the period up to 21 days was in pigs of group II, which is higher compared to group I (by 21.88%, $p \leq 0.05$) and group III (by 28.64%, $p \leq 0.01$). Regarding the average daily weight gain at 28 days (at weaning), significant differences between the control and the experiment were proved. The piglets of the second group with the addition of a special milk replacer had a higher growth of 6.04-12.94% ($p \leq 0.05$). The results obtained are consistent with our data from the scientific and economic experiments.

A special requirement of industrial pork production technology is to obtain levelled nests at weaning because piglets with significantly different live weights from the average nest size will be worse fed and pay for feed in increments during further rearing (Tsarenko *et al.*, 2004). It was found that the nests of piglets of the II and III experimental groups (consuming milk replacer) were more aligned at weaning at 28 days, which significantly outperformed the analogues of the control group (basic technology without the use of DM) by 31.2% ($p < 0.001$) and 14.7% ($p < 0.001$), respectively. In the control group, where piglets did not receive additional nutrition in the form of milk replacers, a greater number of piglets lagging in growth was observed because, after 18-21 days, sow milk production and pre-starter feeding did not fully meet the growing need for nutrients in young animals. In the context of experimental groups, it was noted that the young animals receiving the milk replacer ZSZM "Alternative Milk

Junior" (experimental group II) were more aligned – 89.2%, which is higher than the coefficient of nest alignment at weaning of analogues of group III by 12.7% ($p < 0.001$).

During the experiment, the behaviour of suckling piglets was monitored. The piglets of the II experimental group spent more time on feed intake in the total observation period – 14%. At the same time, animals of the control group spent 12-15% more time moving compared to their counterparts of the II and III experimental groups, respectively. The time spent on rest by piglets of the control and experimental groups was also different. It was found that the piglets of the II experimental group were in a calmer state and therefore spent the most time on rest – 60%, in contrast to the animals of the control group – 50% and the II experimental group – 58%. A. Middelkoop *et al.* (2019) revealed a greater behavioural response of piglets to different feeding combinations and, as a result, an increase in the time spent on feeding. Increased feeding behaviour significantly influenced the increase in growth performance of experimental piglets, namely an increase in average daily weight gain by 12-28 g, and a 2.5% increase in survival rate. The presence of several types of feed elements of different physical conditions (liquid milk replacer, pre-starter in the form of a granule

with a diameter of 1.5-2 mm) in the farrowing machine, which were fed from feeders of different designs, provoked a significant increase in play and feeding behaviour in experimental pigs by 15-23%, and a decrease in aggression (cannibalism) by 18%. Increased feed intake by piglets during the suckling period had a positive effect on further high-fattening qualities of young pigs.

The profitability of this type of production is ensured by reducing unprofitable days in the technological process of the pig industry. Therefore, getting the sow into heat as soon as possible after weaning is crucial, as the main goal is to produce the maximum number of piglets per year. The degree of sow fatness at the end of the suckling period has a significant impact on this. After all, emaciated or thin animals give birth to a few piglets, while obese animals do not become pregnant, and if they do, they give birth to weak, non-viable offspring (Lykhach *et al.*, 2023). The thickness of the fat is an indicator of the sow's body reserves during critical periods (insemination, farrowing, weaning), the less fat she has, the less reserves she has. Sows of the experimental groups at farrowing were similar in fat thickness, the value of this indicator was in the range of 18.92-19.08 mm (Table 3), which corresponds to the normative values.

Table 3. Sow fat thickness, ($n = 12$), $\bar{X} \pm S_{\bar{x}}$

Indicator	Normative value of slicing thickness, mm	Group		
		I control	II experimental	III experimental
Thickness of farrowing fat, mm	16-20	18.92 ± 0.136	19.08 ± 0.162	19.00 ± 0.230
Thickness of farrowing fat at weaning (28 days), mm	14-16	13.00 ± 0.289	16.00 ± 0.230***	14.58 ± 0.253*** ^c
Farrowing fat thickness loss during lactation, mm	2-4	5.92 ± 0.281	3.08 ± 0.136***	4.42 ± 0.295*** ^c

Note: * – $p < 0.05$; ** – $p < 0.01$; *** – $p < 0.001$ (compared to animals of the control group - group I); a – $p < 0.05$; b – $p < 0.01$; c – $p < 0.001$ (compared to animals of experimental group III with analogues of experimental group II) nests at weaning, points

Source: compiled by the author

In numerous nests of the control group I, along with low piglet productivity (Table 2),

a significant decrease in the thickness of the sow's rind during the suckling period was noted.

Thus, at the time of weaning, the rind thickness of sows of group I was 13.0 mm and the animals were characterised by the highest loss of rind thickness during lactation – 5.92 mm. Feeding piglets with milk replacers during the period of their intensive growth made it possible to reduce the load on sows and get them in good condition at the time of weaning, as evidenced by the rind thickness of animals of group II – 16.00 mm and group III – 14.58 mm, which is 3 mm and 1.58 mm ($p < 0.001$) higher than the control, respectively. The loss of subcutaneous fat thickness during lactation in the experimental groups was lower and was within the normative range of 3.08–4.42 mm, which is consistent with studies of C. Farmer *et al.* (2017), which confirms the influence of sow condition in different physiological periods on their reproductive traits.

Experimental sows that had a rind thickness of 19.5–20.5 mm before farrowing, according to scientists, had a higher conditional milk yield by 15% and, significantly higher average daily weight gain of young animals by 10.2–16.4% ($p < 0.01$). Sows that had lower losses of rind thickness during lactation, within 3–5 mm, showed higher reproductive performance in subsequent productive cycles. The study of the duration of oestrus and the onset of complete fertilisation after weaning in sows of the II experimental group showed that in sows of this group, signs of oestrus were manifested faster, on a larger scale and more clearly. Sows came into a state of heat after weaning within 4.58 days, which was faster than in the control and III experimental groups by 3.67 and 0.84 days ($p < 0.05$), respectively.

Summing up the results of the scientific and economic experiment, it is worth noting that even sows with normal lactation according to the standard may not have enough functional teats for all piglets in the nest due to injury, disease, etc. Therefore, the best way to support sows during low lactation is to transplant and equalise the number of nests. However, this is

not always possible, either because the number of suckling sows is too low, or the piglets are too old to be transferred. In such cases, the competition for milk between piglets is intense and growth and survival rates decline rapidly unless additional sources of nutrition are provided. For this reason, milk replacer has proven to be the best solution, especially for young piglets.

Conclusions

Based on the scientific and economic experiment conducted in the conditions of a pork production enterprise using intensive technologies, it was found that in numerous piglet nests (multiplicity above 14 heads) the use of milk replacers as an additional element of suckling piglets' nutrition is practically expedient and even mandatory. In the second experimental group, where milk replacer was used to feed suckling piglets, the number of piglets at weaning was 8.1% ($p < 0.001$) higher than in the control group and 3.2% ($p < 0.05$) higher than in the experimental group III. This, accordingly, affected the piglet survival rate, which was higher in sows' nests when using milk replacers, so in group II 93.03% of piglets were preserved, in group III – 90.54%, which is higher than in the control group by 5.54 and 3.05% ($p < 0.01$), respectively.

The use of a milk replacer in the technological scheme for growing piglets of group II resulted in higher average daily weaning weights of 222.47 g at 28 days, which is 34.75 g higher than in the control group (I) ($p < 0.001$) and 21.5 g higher than in the commercial analogue (group III) ($p < 0.01$). Aligned nests of piglets at weaning are the key to high growth energy during fattening. It was established that the nests of the II and III experimental groups (consuming milk replacer) were more aligned, which significantly exceeded the analogues of the control groups by 31.2% ($p < 0.001$) and 14.7% ($p < 0.001$), respectively. In comparison of the experimental groups, it was noted that the indicators of group II were more equalised – 89.2% and exceeded those of group III by 12.7% ($p < 0.001$).

A sufficiently high level of influence on the feeding behaviour of suckling piglets was proved by additional feeding with milk replacers. Piglets of the II experimental group were found to be in a calmer state and therefore spent the most time on rest – 60%, in contrast to animals of the control group – 50% and the II experimental group – 58%. Additional feeding of piglets with milk replacers during the period of their intensive growth made it possible to reduce the load on sows and get them in good condition at the time of weaning, as evidenced by the thickness of the rind in animals of group II – 16.00 mm and group III – 14.58 mm, which is 3 mm and 1.58 mm ($p < 0.001$) higher than the control, re-

spectively. The appropriate condition of sows contributed to a faster coming into heat after weaning and, as a result, a decrease in the duration of the idle period. Prospects for further experiments are to study the effectiveness of the use of milk replacers in the technological processes of growing suckling piglets and their effect on productivity, behaviour and microbiocenosis and morphometry of the intestinal epithelium.

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Conflict of Interest

None.

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Підвищення продуктивності свиноматок та поросят в цеху опоросу за використання заміників молока

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Анотація. Сучасна технологія виробництва свинини для забезпечення прибутковості галузі вимагає отримання від свиноматок більшої кількості поросят. Фізіологічний резерв молочності свиноматок при багатоплідності вище за 14-18 поросят часто буває недостатнім, що вимагає постійного пошуку шляхів вирішення проблеми «гіперплідних маток». Мета дослідження полягала у вивченні ефективності використання заміників молока різних виробників у гніздах свиноматок за умови багаточисельних опоросів на продуктивність та показники поведінки поросят-сисунів і кондиції свиноматок. Дослід проходив у 2023 році, було досліджено 36 гнізд свиноматок в цеху опоросу і 513 голів поросят-сисунів. Були відібрані гнізда з приплодом 13 голів і більше та сформовано три групи. В контрольній групі поросята вирощувалися без додаткової підгодовівлі заміниками молока. Представники ІІ групи починаючи з 10 доби життя і до відлучення отримували в якості джерела додаткового живлення ЗМ «Альтернатива Мілк-Юніор». Поросята ІІІ групи отримували «Комерційний аналог» заміника молока. ІІ група відзначалася більшим показником збереженості – 93,03%, вищою живою масою – 7,84 кг, що обумовило і вищі значення середньодобових приростів – 222,47 г. Більш вирівняними були гнізда ІІ та ІІІ дослідних груп (споживали заміник молока), які вірогідно переважали аналогів контрольної групи на 31,2% та 14,7%. Поросята ІІ групи перебували в більш спокійному стані, а тому на відпочинок витрачали часу найбільше – 60%, на відміну від тварин контрольної групи – 50% і ІІ групи – 58%. Додаткове живлення поросят у гніздах «гіперплідних маток» знижує навантаження на свиноматок у період лактації і дозволяє отримати тварин у заводській кондиції та зменшити кількість не прибуткових днів. Практичне значення дослідження полягає у визначенні ефективного заміника молока як джерела додаткового живлення поросят-сисунів у гніздах «гіперплідних» свиноматок

Ключові слова: свині; технологія; підсисний період; кормова добавка; жива маса; приріст; збереженість; поведінка; кондиція свиноматки