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THE DEPENDENCE OF PIGLET PRODUCTIVITY ON THE METHOD OF FEED PREPARATION AND THE FEEDING OF PIGLETS

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Abstract

The article investigated the productivity of piglets and the efficiency of their rearing in relation to the type of feed preparation and the type of feeding, and the influence of these factors on growth intensity, piglet survival rate, feed costs and feed costs for rearing a piglet on farms in the Kingdom of Denmark, using data from the consultancy Svine Rådgivningen's open source evaluation analysis of DB-Tjek pig farms for 2021. It was found that preparing feed from own raw materials in the farms' capacities had no influence on the growth intensity of piglets during rearing and feed conversion during this period. At the same time, these farms had 9.15% lower costs per 1 kg of piglet growth, which contributed to a 1.05% reduction in the cost of a piglet at the end of rearing compared to farms feeding piglets exclusively with purchased feed. It was shown that the growth intensity of piglets did not depend on the feeding method, while liquid feeding contributed to a 4.99% improvement in feed conversion, resulting in a 3.03% reduction in the share of feed costs in the rearing of 1 animal. In addition, liquid feeding enabled a 0.67% reduction in the proportion of veterinary costs per animal. The feeding method was found to have a probable influence on the preservation of the piglets and the conversion of the feed during their rearing, but no significant influence on the intensity of the animals' growth and the feed costs of their rearing. At the same time, the method of feed preparation had no significant influence on any of the indicators studied.

Key words**:** *pigs rearing, feed type, feed mixtures, intensity of growth, gains*

INTRODUCTION

Complete feeding is a key tool for the efficient functioning of pig farms, which includes the development of nutritious rations based on a high-quality feed base and the use of feeding systems that intensify the process of feed intake and improve digestion in pigs [5, 25, 31, 33].

Advances in swine nutrition are increasing pig productivity by more accurately balancing rations in terms of energy and nutrient content [14]. However, pig productivity will increase even further if a rational system of feeding and feed preparation is applied for a balanced complete diet [19, 29].

Many farmers who have their own acreage and grow grain in large quantities prefer to produce feed for their own production on their farms. The advantages of on-farm production of feed mixtures are lower costs [20, 27], clear certainty of the quality of this feed, reduction of the risk of fungal, bacteriological and viral contamination of the feed, the

possibility of rapid adjustment of the composition of the feed. When using a liquid feeding system, in addition to these advantages, there is also the possibility of reducing the price of the feed, as a number of by-products are used, such as milk whey, canned corn kernels with cobs, brewer's grains and brewer's yeast, as well as other by-products from food and organic production [8, 46]. At the same time, the production of own feed mixtures requires additional investment in containers and space for storing the components of these mixtures, additional equipment for grinding and mixing the feed components and granulating them. This process, in turn, requires additional working time and appropriate qualification of the personnel preparing these feeds. Time and equipment are also required to control the quality of mixing and the chemical composition of the finished feed mixtures [7, 34]. In addition, mixers with limited dosage of the various components are usually installed in the feed kitchens of pig farms. In contrast, the equipment of specialized compound feed plants can introduce a large number of components with different dosage levels at the same time [15, 39]. Logistics and storage conditions for feed components are also improved in large specialized compound feed mills. In addition, many countries have a number of restrictions on producing feed on their own farms [13]. For example, according to information [11], in Denmark, pig farms that intend to produce feed mixes on their own farms must obtain a permit from the Danish Directorate of Crop Production, followed by feed quality control at the same level as feed mills. Therefore, pig enterprises in Denmark buy about half of their feed from specialized enterprises.

In pig farming, two feeding methods are most common: liquid and dry feeding; wet feeding is less common [12]. Dry feeding was widely used among pig farmers. Dry feeding of pigs became widespread during the industrialization of agriculture due to cheaper equipment and maintenance [30]. In addition, dry feed ensured a better hygienic condition not only of the feeding equipment but also of the whole farm, was easier to store, and was more convenient to use because it ensured free access and consumption by the animals [18, 35]. It was also reported that prolonged consumption of dry feed improved digestion of its components, which begins in the oral cavity. At the same time, the delay of individual pigs near the feeding facility led to hierarchical tensions in the group due to the longer waiting time of the other animals. In addition, studies have shown that pigs fed dry feed gained weight better than those fed liquid feed containing food industry waste [10, 22, 24].

The liquid feeding method, on the other hand, is not new, although it is less common in pig farms today. It is based either on the use of cheap waste from the food industry or on the production and preparation of a liquid feed mixture from the same ingredients as dry feed, but with prior rehydration using agricultural feed plants [4]. It is known that the method of preparation, transportation, and distribution of wet and liquid feeds is technically more complicated and more expensive to maintain [42]. In addition, liquid feeding requires additional attention and preventive measures to ensure the hygienic requirements of the feed and the condition of the equipment [9].

So one of the main advantages of liquid feeding is the possibility of using cheap waste from the food industry. Considering that 70% of the costs in pork production are related to feed, the use of cheap products in the composition of complete and balanced rations for pigs significantly reduces the cost of pork [1, 40]. In particular, it is known that the type of liquid or dry feeding used for growing pigs can have a noticeable effect not only on growth but also on feed consumption [24]. Each feeding method has its advantages and disadvantages that can increase or decrease the overall productivity of pigs [25]. Liquid feeding usually uses the same feedstuffs as dry feeding, but with additional hydration or fermentation of the ration ingredients. For post-weaning piglets, liquid feed meets their physiological needs to a greater extent than dry feed [43]. In addition, the components of liquid migration (cereal grains, dairy products) contain lactic acid bacteria, which

ferment the feed mixture, lower its pH value and thus have a preservative effect. Lactic acid prevents the multiplication of pathogenic microflora in the feed and thus improves the balance of the intestinal microorganisms of pigs [23, 36]. In addition, the effect of liquid feed on the gastrointestinal tract of pigs is known, which translates into improved secretion of gastrointestinal hormones [42]. In addition, fermentation of liquid feed has a positive effect on the fattening qualities of pigs [41], increases average daily gains [21] and reduces feed conversion [17]. Liquid feed can be more easily digestible and provide a broad spectrum of nutrients [45]. As a result, pigs fed liquid feed mixtures may have a higher growth rate in both rearing and fattening [26, 35]. Liquid feed is usually more palatable, resulting in higher consumption compared to dry feed. The pigs usually absorb the feed better when it is prepared in liquid form, resulting in a higher consumption rate compared to dry feeding [25, 26, 28], so that they reach the desired live weight faster [47]. Another positive aspect of using liquid feed in rearing is the reduction of stress in newly weaned piglets that are fed liquid feed during the initial adjustment [6].

Disadvantages of liquid feeding include: High initial investment and skilled process management personnel are required, as the risk of losses can be high if the technology is breached at any stage [8, 18, 24].

The aim of the study was to investigate the influence of the way piglets are fed during rearing and the way the feed mixtures are prepared on their productivity and rearing efficiency.

MATERIALS AND METHODS

The object of the study was the productive qualities and economic indicators of rearing hybrid piglets obtained from F_1 sows of the Danish Landrace and Danish Large White breeds inseminated with semen from Danish Durok boars under different feeding methods and methods of feed preparation in this technological group.

The subject of the study was the technological processes in the rearing of hybrid piglets on farms in the Kingdom of Denmark. The indicators of productivity and efficiency of pig rearing were studied using the data from the consultancy Svine Rådgivningen from the open sources of the rating analysis of the DB - Tjek pig farms for the year 2021.

In order to investigate the dependence of the piglets' productivity during rearing and their efficiency on the type of feed preparation before feeding, all the farms studied were divided into two groups. The first group, which was taken under control, included farms in which feed mixes for raising piglets were prepared from their own grain raw materials on the territory of enterprises at their own facilities for mixing feed components. The second group, which was an experimental group, included pig farms that were used for rearing piglets exclusively bought at feed mills.

In the second phase of the study, we analysed the dependence of piglet productivity and the efficiency of their rearing on dry and liquid feeding. For this purpose, all the farms studied were divided into two groups according to the type of feed they used during piglet rearing. The first group comprised farms that used traditional dry piglet feeding from weaning to fattening. This group of piglets was the control group. The second group (experimental) consisted of farms that used liquid feeding during piglet rearing.

In the third research phase, we investigated the influence of the method of feed preparation and the type of feeding on the leading productivity indicators using a two-factor analysis of variance.

The following performance indicators were identified for the study: survival of piglets during rearing, their average daily feed consumption and its conversion, and the absolute and average daily live weight gains of the animals. The added value of raising piglets and the share of feed and veterinary care in it are also analysed.

RESULTS AND DISCUSSIONS

The results of the study are shown in Table. 1 show that farms that used their own feed raw materials and prepared mixed feed on their

farms gave piglets with a slightly lower initial live weight to rearing, while the weight of piglets at the end of the rearing period proved to be reliably (p ≤0.01) 1.66 kg higher in this group of farms than in farms that used only purchased feed. This fact is probably (p ≤0.01) due to a 1.76 kg higher absolute growth of the animals in this group of farms, which in turn was reliably (p ≤0.01) caused by a 3.51 days longer rearing period of the piglets. At the same time, the group of farms using purchased feed was likely to have 0.53% better preservation of piglets (p ≤0.01). In this group there was also a tendency for a slight decrease in daily feed consumption and its conversion, which we believe is also related to the shorter duration of rearing.

Table 1. Productivity of piglets during rearing depends on the method of feed preparation

Indicator	The method of preparing fodder	
	The feed is made on the farm	The fodder is bought ready-made
Number of farms considered (n)	116	51
Weight of piglets at the beginning of rearing, kg	6.75±0.13	6.85±0.17
Duration of rearing, days	55.61±0.83	52.10±0.71**
Weight of piglets at the end of the rearing period, kg	32.29±0.25	30.63±0.49**
Preservation of piglets during the rearing period, %	97.5±0.16	98.03±0.096**
Absolute growth, kg	25.54±0.28	23.78±0.45**
Average daily gain, g	462.02±4.72	457.0±7.83
Average daily feed consumption, kg	0.87±0.011	0.85±0.019
Feed consumption per 1 kg gain, kg	1.71±0.015	1.70±0.022

* – P ≤0.05; ** – P ≤0.01; *** – P ≤0.001.
Source: own calculations.

The different duration of piglet rearing in the control and experimental groups of farms also led to a difference in feed consumption and costs of piglet rearing (Table 2). Thus, the cost of rearing piglets in the second group was 1.16% higher than in the first group, which in our opinion, is due to their slightly higher live weight. During the rearing period, piglets in the first group probably consumed (p ≤0.01) 3.31 kg (7.57%) more feed per head, which we believe is due to a longer rearing period and greater mass at the end of this period. But the expenditure on these feeds turned out to be somewhat lower in the group with their own preparation, which is due, to their lower cost. These factors also contributed to significantly lower feed costs by 9.15% (p ≤0.001) per 1 kg of piglet growth.

Table 2. Efficiency of raising piglets depending on the method feed preparation

Indicator	The method of preparing fodder	
	The feed is made on the farm	The fodder is bought ready-made
The cost of a piglet at the beginning of rearing, DKK	260.14±1.76	263.17±3.65
Feed consumption per animal, kg	43.71±0.61	40.40±0.84**
Feed consumption per head, DKK	109.18±1.75	110.36±1.04
Feed consumption per 1 kg growth, DKK	4.26±0.04	4.65±0.090***
The cost of rearing one animal, DKK	190.71±2.54	192.42±4.70
The cost of the piglet at the end of rearing, DKK	450.86±2.71	455.58±2.41
The share of feed in the cost of rearing a piglet, %	57.79±1.20	58.42±2.34
Veterinary costs for 1 animal, DKK	5.47±0.37	5.70±0.81
The share of veterinary losses in the cost of rearing a piglet, %	2.91±0.21	3.06±0.45

** – P ≤0.01; *** – P ≤0.001.
Source: own calculations.

Despite the longer rearing period of the piglets in the first group and their higher weight at the end of this period, the cost of rearing an animal was found to be 0.9% lower compared to the analogues in the second group, which, together with the lower cost of piglets at the beginning of rearing, resulted in a 1.05% reduction in the cost of piglets after they were reared.

The main expenses for rearing piglets are feed and veterinary care. In our research, we observed a trend towards a 0.63% lower share of feed in the costs of rearing an animal on farms that prepared the feed on their own premises. On these farms, the costs of preventive and medical measures for piglets were 4.20% lower, which naturally led to a 0.15% decrease in their share of the total costs of rearing an animal.

Thus, preparing feed from their own raw materials within the capacity of their farms had no effect on the growth intensity of piglets during rearing and feed conversion during this period. At the same time, these farms had 9.15% lower costs per 1 kg of piglet growth, which contributed to a 1.05% reduction in the cost of a piglet after the completion of rearing compared to farms that fed piglets exclusively with purchased feed.

When analyzing the dependence of piglet productivity of piglets on growing-out on the type of feed they were fed during this period (Table 3), it was found that in farms that used liquid feed, piglets were placed on growing-out with probably ($p \leq 0.05$) 0.57 kg less live weight, but were removed from rearing with probably 1.42 kg ($p \leq 0.05$) more live weight, compared to farms that used dry feed for rearing. This is probably caused ($p \leq 0.05$) due to the 3.96 days longer rearing time of the animals.

This factor also probably contributed ($p \leq 0.001$) to 2.0 kg higher absolute gains during the rearing of piglets in the experimental group. As long as there is no significant difference in growth rate between piglets with different feeding methods.

Table 3. The productivity of piglets in rearing depends on the method of feeding

Indicator	Method of feeding	
	Dry	Liquid
Number of farms considered (n)	110	57
Weight of piglets at the beginning of rearing, kg	6.85±0.11	6.28±0.26*
Duration of rearing, days	54.06±0.62	58.02±1.56*
Weight of piglets at the end of the rearing period, kg	31.62±0.24	33.04±0.54*
Preservation of piglets during the rearing period, %	97.76±0.12	96.98±0.24**
Absolute growth, kg	24.76±0.24	26.76±0.46***
Average daily growth, g	460.13±4.41	463.2±10.02
Average daily feed consumption, kg	0.79±0.01	0.76±0.02
Feed consumption per 1 kg of gain, kg	1.72±0.01	1.64±0.03*

* – P ≤0.05; ** – P ≤0.01; *** – P ≤0.001.
Source: own calculations.

A tendency to reduce daily feed consumption by 0.03 kg was observed with liquid feeding, which probably ($p \leq 0.05$) resulted in 0.08 kg better feed conversion at almost the same growth intensity. At the same time, the preservation of piglets during rearing was probably ($p \leq 0.01$) 0.78% better on farms using the dry feeding method.

With liquid feeding, the feed cost for an adult piglet was 4.05% higher (Table 4), resulting in a 3.44% increase in feed cost for head growth. We explain this by a longer growth period and correspondingly larger absolute increases in live weight during this period. In the group of farms rearing piglets with liquid feeding, the cost of 1 kg of growth was 4.99% lower ($p \leq 0.001$).

With liquid feeding, the cost of a piglet was probably ($p \leq 0.01$) 7.22% lower at the beginning of rearing due to the lower weight of piglets, while it was only 0.72% lower at the end of this period, with a higher live weight during this period. This was probably caused ($p \leq 0.001$) due to the 8.32% higher

cost of raising the animals. While the cost of 1 kg growth of piglets during rearing practically did not differ in both farm groups.

Table 4. The efficiency of raising piglets depending on the method of their feeding

Indicator	Method of feeding	
	Dry	Liquid
Feed consumption per animal, kg	42.51±0.55	44.23±0.55
Feed cost per animal during rearing, DKK	109.07±1.54	112.82±4.85
Feed cost for 1 kg of growth, DKK	4.41±0.05	4.19±0.03***
Cost of one piglet at the beginning of rearing, DKK	263.43±2.23	244.4±5.83**
Cost of pig at the end of rearing, DKK	452.68±2.00	449.4±3.32
The cost of rearing one animal, Danish kroner	189.26±2.43	205.0±3.87***
The cost of 1 kg of piglet growth during rearing, DKK	7.64	7.66
The share of feed in the cost of raising an animal, %	58.35±1.13	55.32±3.45
Veterinary costs for 1 animal, DKK	5.64±0.40	4.18±0.5
The share of veterinary costs in the cost of raising an animal, %	3.04±0.22	2.37±0.27*

* – P ≤0.05; ** – P ≤0.01; *** – P ≤0.001.
Source: own calculations.

The research showed that the cost of veterinary care of a piglet during rearing was 25.89% higher, which also caused a 0.67% higher share of these costs in the total cost of rearing in the farms with dry feeding. In this group of farms, the share of feed in the total cost of raising an animal was 5.19% higher.
Thus, the growth intensity of piglets did not depend on the type of feeding, while liquid feeding contributed to a 4.99% improvement in feed conversion, which resulted in a 3.03% reduction in the share of feed costs in raising an animal. In addition, liquid feeding reduced the proportion of veterinary costs per animal by 0.67%.

According to the calculations of the influence of the factors of feed preparation and feeding method, no probable influence of these factors on the average daily growth of piglets was found (Table 5).

Table 5. The influence of the method of feed preparation and feeding of piglets on the average daily growth

Source of variance	Sum of squares	Degrees of freedom	Middle square	F_{fact}	F_{crit} at α = 0.05	P-significance	% contribution to the factor sum of squares	% contribution to the total amount of squares
General, Cy	103,023.99	79						
Factorial, Cx	474.93	1	12413					
Method of feeding, A	82.54	1	83	0.06	3.97	0.8053	17.4%	0.1%
The method of preparing fodder, V	392.38	2	196	0.15	3.12	0.8649	82.6%	0.4%
Interaction, AB	0.00	0		0.00			0.0%	0.0%
Remainder, Cz	102,549.06	76	1349					99.5%

Source: own calculations.

While piglet survival during rearing was probably influenced by feeding method at a level of 6.1%, the absence of a probable influence of feed preparation method and its interaction on this indicator was found (Table 6). Unaccounted for factors accounted for 89.8% of the total variance.

Table 6. The influence of the method of feed preparation and feeding of piglets on the survival of growing piglets

Source of variance	Sum of squares	Degrees of freedom	Middle square	F_{fact}	F_{crit} at $\alpha = 0.05$	P-significance	% contribution to the factor sum of squares	% contribution to the total amount of squares
General, Cy	88.52	79						
Factorial, Cx	8.99	1	12,413.24					
Method of feeding, A	5.40	1	5.4	5.16	3.97	0.0260	60.1%	6.1%
The method of preparing fodder, V	3.59	2	1.8	1.72	3.12	0.1867	39.9%	4.1%
Interaction, AB	0.00	0		0.00			0.0%	0.0%
Remainder, Cz	79.53	76	1.0					89.8%

Source: own calculations.

The method of feeding piglets during rearing also probably had a 6.5% influence on feed conversion, with 91.9% influenced by factors not considered (Table 7). In contrast, the method of feed preparation and its interaction with the feeding method probably had no influence on feed conversion during rearing.

Table 7. The influence of the method of feed preparation and the feeding of piglets on feed conversion ratio

Source of variance	Sum of squares	Degrees of freedom	Middle square	F_{fact}	F_{crit} at $\alpha = 0.05$	P-significance	% contribution to the factor sum of squares	% contribution to the total amount of squares
General, Cy	1.00	79						
Factorial, Cx	0.08	1	12,413.24					
Method of feeding, A	0.07	1	0.0651	5.37	3.97	0.0232	80.7%	6.5%
The method of preparing fodder, V	0.02	2	0.0078	0.64	3.12	0.5293	19.3%	1.6%
Interaction, AB	0.00	0		0.00			0.0%	0.0%
Remainder, Cz	0.92	76	0.0121					91.9%

Source: own calculations.

The feed cost of one piglet was not significantly influenced by the method of preparation of feed and the method of their feeding (Table 8). Thus, the feeding method had a probable influence on the preservation of piglets and feed conversion during piglet rearing and had no significant effect on the growth intensity of the animals and the feed cost of their rearing. At the same time, the method of feed preparation had no significant influence on any of the studied indicators.

According to reports [2, 30], the lifelong productivity of young pigs, i.e. growth and development of animals, occurs due to the complex interaction of the hereditary basis of the organism with specific environmental conditions and is an important background for the realization of the genetic potential of animal productivity.

In this regard, the share of feeding in the influencing factors is 60-70%, genotype - 20-25%, and microclimate and maintenance - 15-20%. However, we could not confirm such a high influence of the feeding method on the productivity of the young animals during rearing. In our study, the feeding factor had a less significant effect, namely: 6.1% on the survival rate of piglets, which is more consistent with reports [30], where it was 1.5%.

Table 8. The influence of the method of preparation of fodder and feeding of piglets on the cost of rearing one head of piglets

Source of variance	Sum of squares	Degrees of freedom	Middle square	F_{fact}	F_{crit} at α = 0.05	P-significance	% contribution to the factor sum of squares	% contribution to the total amount of squares
General, Cy	13,675.55	79						
Factorial, Cx	297.99	1						
Method of feeding, A	123.01	1	123.0	0.70	3.97	0.4058	41.3%	0.9%
The method of preparing fodder, V	174.98	2	87.5	0.50	3.12	0.6103	58.7%	1.3%
Interaction, AB	0.00	0		0.00			0.0%	0.0%
Remainder, Cz	13,377.56	76	176.0					97.8%

Source: own calculations.

Also the factor of feeding method had an influence of 6.5 % on feed conversion, which is also more consistent with data [30], where it was 1.0 %. We did not find a probable dependence of the average daily growth on the influence of the feeding factor, in contrast to other data [30], where the influence of this factor was observed at a level of 12.6%.

Our results of a higher absolute growth rate in pigs fed liquid feed compared to counterparts fed dry feed were in agreement with reports [32, 35], where a probable difference in this rate was found when different feeding methods were used. However, in contrast to other scientific works [21, 25, 26, 30], which indicated higher average daily gain in pigs kept in liquid feeding systems compared to peers consuming dry feed, we found no significant difference in the mentioned indicator, similar to the results of other researchers [43]. The absence of a difference in average daily gains in our experiment also contradicts reports of a probable excess of this indicator in animals fed dry diets compared with their counterparts fed liquid diets [3, 24].

At the same time, we could not confirm the presence of a probable excess of survival in pigs fed liquid, in contrast to other authors [30, 32] who reported equal survival values for pigs fed both liquid and dry diets.

We also noted an increase in feed consumption per 1 kg of growth when pigs were fed liquid diets, similar to other researchers who also observed a deterioration of this indicator in animals fed liquid feed and an improvement in pigs fed dry feed [30, 43]. However, other work [17, 44] indicated an improvement in feed conversion in pigs fed liquid feed, which was not consistent with our result.

According to the data [38], piglets that were raised on a liquid type of feeding consumed about 12.4% more feed, which was not confirmed in our experiment, since the pigs in our experiment did not have a significant difference in this indicator. According to [16, 28], feed intake in pigs was improved by using dry granular mixes, which is similar to the results of our current study, which did not

agree with the findings [37] on improved feed intake with liquid feeding.

CONCLUSIONS

Piglet growth intensity during rearing and feed conversion during this period were not dependent on the type of feed preparation. Preparation of feed from own raw materials in own facilities allowed to reduce the cost of means per 1 kg of growth of piglets by 9.15% and the cost of a piglet after completion of rearing by 1.05%, compared to farms that fed piglets exclusively with purchased feed.

The liquid feeding method contributed to a 4.99% improvement in feed conversion, a 3.03% reduction in the share of feed costs, and a 0.67% reduction in the share of veterinary costs in the cost of raising an animal. The growth intensity of piglets did not depend on the feeding method.

Feeding method probably affected piglet preservation and feed conversion during rearing and had no effect on animal growth intensity or rearing feed costs. The method of feed preparation had no significant effect on any of the parameters studied.

REFERENCES

[1]Boumans, I.J.M.M., Schop, M., Bracke, M.B.M., de Boer, I.J.M., Gerrits, W.J.J., Bokkers, E.A. M., 2022, Feeding food losses and waste to pigs and poultry: Implications for feed quality and production. Journal of Cleaner Production, Vol. 378: 134623. https://doi.org/10.1016/j.jclepro.2022.134623

[2]Buhaievskyi, V.M., Ostapenko, O.M., Danylchuk, M.I., 2010, Vplyv seredovyshcha ta tekhnolohii utrymannia na produktyvnist svynei [The influence of the environment and housing technology on the productivity of pigs]. Naukovi pratsi [Scientific works], Vol. 132(119): 59–61. [in Ukrainian] https://lib.chmnu.edu.ua/pdf/naukpraci/ecology/2010/132-119-14.pdf , Accessed on 03.09.2023.

[3]Byrgesen, N., Madsen, J. G., Larsen, C., Kjeldsen, N. J., Cilieborg, M. S., Amdi, C., 2021, The Effect of Feeding Liquid or Dry Creep Feed on Growth Performance, Feed Disappearance, Enzyme Activity and Number of Eaters in Suckling Piglets. Animals: an open access journal from MDPI, Vol. 11(11): 3144. https://doi.org/10.3390/ani11113144

[4]Canibe, N., Jensen, B.B., 2012, Fermented liquid feed-Microbial and nutritional aspects and impact on enteric diseases in pigs. Anim. Feed Sci. Technol., Vol. 173: 17–40. https://doi.org/10.1016/j.anifeedsci.2011.12.021.

[5]Canibe, N., Højberg, O., Kongsted, H., Vodolazska, D., Lauridsen, C., Nielsen, T.S., Schönherz, A.A., 2022, Review on Preventive Measures to Reduce Post-Weaning Diarrhoea in Piglets. Animals (Basel), Vol. 12(19): 2585. doi: 10.3390/ani12192585.

[6]Chae, B.J., 2000, Impacts of wet feeding of diets on growth and carcass traits in pigs. J Appl Anim Res., Vol. 17(1): 81–96.

[7]Chudak, R.A., Poberezhets, Yu.M., Vozniuk, O.I., 2017, Efektyvnist vyroshchuvannia hibrydnykh svynei za vykorystannia kormiv riznoho vyrobnytstva [The efficiency of growing hybrid pigs using feed of different production]. Ahrarna nauka ta kharchovi tekhnolohii [Agrarian science and food technology], Vol. 5(99): 11–16. [in Ukrainian] http://repository.vsau.org/getfile.php/17028.pdf, Accessed on 03.09.2023.

[8]Cullen, J.T., Lawlor, P.G., Cormican, P., Gardiner, G.E., 2021, Microbial Quality of Liquid Feed for Pigs and Its Impact on the Porcine Gut Microbiome. Animals: an open access journal from MDPI, Vol. 11(10): 2983. https://doi.org/10.3390/ani11102983

[9]Cumby, T.R., 1986, Design requirements of liquid feeding systems for pigs: a review, Journal of Agricultural Engineering Research, Vol. 34(3): 153–172, https://doi.org/10.1016/S0021-8634(86)80015-4.

[10]da Fonseca de Oliveira, A.C., Webber, S.H., Ramayo-Caldas, Y., Dalmau, A., Costa, L.B., 2023, Hierarchy Establishment in Growing Finishing Pigs: Impacts on Behavior, Growth Performance, and Physiological Parameters. Animals: an open access journal from MDPI, Vol. 13(2): 292. https://doi.org/10.3390/ani13020292

[11]Dalgaarda, T., Halberga, N., Porterb, J.R., 2001, A model for fossil energy use in Danish agriculture used to compare organic and conventional farming. Agriculture, Ecosystems and Environment, Vol. 87(1): 51–65. https://doi.org/10.1016/S0167-8809(00)00297-8.

[12]De Lange, C.F.M., Zhu C.H., 2012, Liquid feeding corn-based diets to growing pigs: Practical considerations and use of co-products. In: Patience J.F., editor. Feed Efficiency in Swine. Wageningen Academic Publishers; Wageningen, The Netherlands: pp. 63–80.

[13]Gusev, A.Yu., Koshkina, I.G., 2022, IOP Conf. Ser.: Earth Environ. Sci., Vol. 979: 012092. https://iopscience.iop.org/article/10.1088/1755-1315/979/1/012092/pdf, Accessed on 03.09.2023.

[14]Heo, J.M., Opapeju, F.O., Pluske, J.R., Kim, J.C., Hampson, D.J., Nyachoti, C.M., 2013, Gastrointestinal health and function in weaned pigs: A review of feeding strategies to control post-weaning diarrhoea without using in-feed antimicrobial compounds. J. Anim. Physiol. Anim. Nutr., Vol. 97: 207–237.

[15]Jakobsen, M., 2018, Integrating foraging and agroforestry into organic pig production - environmental and animal benefits. PhD Dissertation. Aarhus University, Denmark.

https://orgprints.org/id/eprint/33776/7/Endelig%20afhandling_tryk_Malene_Jakobsen_20111406%20(002)X.pdf, Accessed on 03.09.2023.

[16]Jo, Y., Choi, M., Chung, W., Hong, J., Lim, J., Kim, Y., 2021, Effects of feed form and particle size on growth performance, nutrient digestibility, carcass characteristics, and gastric health in growing-finishing pigs. Anim Biosci., Vol. 34(6): 1061–1069. https://doi.org/10.5713/ab.20.0777

[17]Jones, A., Woodworth, J., 2016, Effect of Enzymatically Fermented Soybean Meal and Lactobacillus Plantarum on Nursery Pig Performance. Kans. Agric. Exp. Stn. Res. Rep., Vol. 2: 14. https://doi.org/10.4148/2378-5977.1291.

[18]Kravchenko, O.O., Holov, V.O., 2013, Porivnialna kharakterystyka sukhoho ta ridkoho sposobiv hodivli svynei [Comparative characteristics of dry and liquid methods of pig feeding]. Visnyk ahrarnoi nauky Prychornomoria [Herald of Agrarian Science of the Black Sea Region], Vol. 4(2): 116–120. [in Ukrainian] https://visnyk.mnau.edu.ua/statti/2013/n75v4r2013t2c1kravchenko.pdf, Accessed on 03.09.2023.

[19]Kulyk, M.F., Krasnoselska, M.P., Obertiukh, Yu.V., Skoromna, O.I., 2016, Intensyvnist vidhodivli svynei pry riznomu vmisti lizynu v proteini kormiv ratsionu [Intensity of fattening pigs with different content of lysine in the protein feed of the diet]. Ahrarna nauka ta kharchovi tekhnolohii. Hodivlia tvaryn ta tekhnolohiia kormiv [Agrarian science and food technology. Animal feeding and feed technology], Vol. 3 (94): 3–10. [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/anxt_2016_3_3.pdf, Accessed on 03.09.2023.

[20]Lawlor, P.G., 2021, Update on liquid feeding; Recent research findings; Proceedings of the The Society of Feed Technologists Pig Live and Virtual Conference; Belfast, UK.

[21]Lu, J., Zhang, X., Liu, Y., Cao, H., Han, Q., Xie, B., Fan, L., Li, X., Hu, J., Yang, G., 2019, Effect of Fermented Corn-Soybean Meal on Serum Immunity, the Expression of Genes Related to Gut Immunity, Gut Microbiota, and Bacterial Metabolites in Grower-Finisher Pigs. Front. Microbiol., Vol. 10: 2620. https://doi.org/10.3389/fmicb.2019.02620.

[22]Martínez-Miró, S., Tecles, F., Ramón, M., 2016, Causes, consequences and biomarkers of stress in swine: an update. BMC Vet Res., Vol. 12: 171. https://doi.org/10.1186/s12917-016-0791-8

[23]Missotten, J.A., Michiels, J., Dierick, N., Ovyn, A., Akbarian, A., Smet, S.D., 2013, Effect of fermented moist feed on performance, gut bacteria and gut histo-morphology in broilers. Br. Poult. Sci., Vol. 54: 627–634. https://doi.org/10.1080/00071668.2013.811718.

[24]Moon, J.S., Kwon, I.K., Chae, B.J., 2004, Effects of wet feeding of diets with or without food waste on growth performance and carcass characteristics in finishing pigs. Asian-Aust J Anim Sci., Vol. 17(4): 504–510.

[25]Mykhalko, O.G., 2020, Vidhodivelni yakosti svynei irlandskoho pokhodzhennia za riznoho typu hodivli [Feeding qualities of pigs of Irish origin under different types of feeding]. Visnyk Sumskoho natsionalnoho ahrarnoho universytetu. Seriia "Tvarynnytstvo" [Bulletin of the Sumy National Agrarian University. "Livestock" series], Vol. 3: 51–56. [in Ukrainian] https://doi.org/10.32845/bsnau.lvst.2020.3.9, Accessed on 03.09.2023.

[26]Mykhalko, O.G. 2022, Zalezhnist vidhodivelnykh yakostei datskykh svynei vid typu hodivli [Dependence of danish pigs fattening qualities on the type of feeding]. Visnyk Sumskoho natsionalnoho ahrarnoho universytetu. Seriia "Tvarynnytstvo" [Bulletin of the Sumy National Agrarian University. "Livestock" series], Vol. 4(47): 99–107. [in Ukrainian] https://doi.org/10.32845/bsnau.lvst.2021.4.17, Accessed on 03.09.2023.

[27]O'Meara, F.M., Gardiner, G.E., O'Doherty, J.V., Lawlor, P.G., 2020, The effect of feed form and delivery method on feed microbiology and growth performance in grow-finisher pigs. J. Anim. Sci., Vol. 98: 1–37. https://doi.org/10.1093/jas/skaa021.

[28]Nechmilov, V.M., Povod, M.H., 2018, Vidhodivelna produktyvnist svynei za riznykh terminiv doroshchuvannia ta vykorystannia sukhoho i ridkoho typiv hodivli [Feeding productivity of pigs at different periods of rearing and use of dry and liquid types of feed]. Visnyk Sumskoho natsionalnoho ahrarnoho universytetu. Seriia "Tvarynnytstvo" [Bulletin of the Sumy National Agrarian University. "Livestock" series], Vol. 7(35): 328–355. [in Ukrainian] http://repo.snau.edu.ua/bitstream/123456789/6610/1/12.pdf, Accessed on 03.09.2023.

[29]Pankieiev S.P., Nimchyn M.V., 2021, Obgruntuvannia tekhnolohii vyrobnytstva svynyny v umovakh fermerskoho hospodarstva «Dnister» khersonskoho raionu Khersonskoi oblasti [Justification of the technology of pork production in the conditions of the farm "Dniester" of the Kherson district of the Kherson region]. Tavriiskyi naukovyi visnyk [Taurian Scientific Herald], Vol. 122: 243–251. [in Ukrainian] https://doi.org/10.32851/2226-0099.2021.122.36

[30]Povod, M.G., Izhboldina, E.A., Nechmilov, V.N., Mikhalko, O.G., Zhizhka, S.V., 2018, Sezonna produktyvnist hibrydnoho molodniaku svynei za riznymy vydamy hodivli [Season productivity of young pigs hybrid by various types of feeding]. Visnyk Sumskoho natsionalnoho ahrarnoho universytetu. Seriia "Tvarynnytstvo" [Bulletin of the Sumy National Agrarian University. "Livestock" series], Vol. 2(34): 194–200. [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/Vsna_tvar_2018_2_46.pdf, Accessed on 03.09.2023.

[31]Povod, M.G., Kondratiuk, V.M., Lykhach, V.Ya., Mykhalko, O.G., Izhboldina, O.O., Povoznikov, M.G., Gutyi, B.V., 2022, Efektyvnist vykorystannia

innovatsiinykh proteinovykh komponentiv v hodivli svynei [Effectiveness of using innovative protein components in pig feeding]. Visnyk Sumskoho natsionalnoho ahrarnoho universytetu. Seriia "Tvarynnytstvo" [Bulletin of the Sumy National Agrarian University. "Livestock" series], Vol. 2(49): 24–36. [in Ukrainian] https://doi.org/10.32845/bsnau.lvst.2022.2.5

[32]Povod, M.G., Tishchenko, O., Mykhalko, O.G., Verbelchuk, T.V., Verbelchuk, S.P., Sherbyna, O.V., Kalynychenko, G.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 LNU veterynarnoi medytsyny ta biotekhnolohii. Seriia: Silskohospodarski 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 03.09.2023.

[33]Povod, M., Mykhalko, O., Povoznikov, M., Gutyj, B., Koberniuk, V., Shuplyk, V., Ievstafiieva, Y., Buchkovska, V., 2022, Efficiency of using high-protein sunflower meal instead of soybean meal in feeding of growing piglets. Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol. 22(4): 595-602. https://managementjournal.usamv.ro/pdf/vol.22_4/volume_22_4_2022.pdf, Accessed on 03.09.2023.

[34]Rauw, W.M., Rydhmer, L., Kyriazakis, I., Gilbert, H., Dekkers, J.C.M., 2020, Prospects for sustainability of pig production in relation to climate change and novel feed resources. Journal of the Science of Food and Agriculture, Vol. 100(9): 3575–3586. https://doi.org/10.1002/jsfa.10338

[35]Torres-Pitarch, A., Gardiner, G.E., Cormican, P., Rea, M., Crispie, F., O'Doherty, J.V., Cozannet, P., Ryan, T., Cullen, J., Lawlor, P.G., 2020, Effect of cereal fermentation and carbohydrase supplementation on growth, nutrient digestibility and intestinal microbiota in liquid-fed grow-finishing pigs. Sci. Rep., Vol. 10: 1–17. doi: 10.1038/s41598-020-70443-x.

[36]Van Winsen, R.J.A., 2001, Effect of fermented feed on the microbial population of the gastrointestinal tracts of pigs. Appl. Environ. Microbiol., Vol. 67: 3071–3076. https://doi.org/10.1128/AEM.67.7.3071-3076.2001.

[37]Vázquez, N.A., Barragán, H.B., Vásquez Aguilar N.C., Brenner, E.G., Dávila, F.S., Trejo, A.M., Ramírez, M.C., 2021, Effect of wet feeding of finishing pigs on production performance, carcass composition and meat quality. Rev Mex Cienc Pecu., Vol. 12(2): 370–385. https://doi.org/10.22319/rmcp.v12i2.5582

[38]Vdovichenko, Yu.V., Nechmilov, V.M., Povod, M.H., 2108, Produktyvnist porosiat za sukhoho, volohoho ta ridkoho typu hodivli na doroshchuvanni [Productivity of piglets under dry, wet and liquid type of feeding during rearing]. Visnyk Poltavskoi ahrarnoi akademii. Silske hospodarstvo. Tvarynnytstvo [Bulletin of the Poltava Agrarian Academy. Agriculture. Animal husbandry], Vol. 3: 106–109. [in Ukrainian] https://doi.org/10.31210/visnyk2018.03.15

[39]Voronetska, I.S., Sprynchuk, N.A., Kravchuk, O.O., 2018, Perspektyvy rozvytku tovarnoho kormovyrobnytstva v Ukraini [Prospects for the development of commodity fodder production in Ukraine]. Ahrosvit [Agroworld], Vol. 3: 12–18. [in Ukrainian] http://www.agrosvit.info/pdf/3_2018/4.pdf Accessed on 03.09.2023.

[40]Westendorf, M.L., Zirkle Pas, E.W., Gordon, R., 1996, Feeding Food or Table Waste to Livestock. The Professional Animal Scientist, Vol. 12(3): 129–137, https://doi.org/10.15232/S1080-7446(15)32509-2.

[41]Wiseman, M., Wey, D., de Lange, C.F., 2016, Liquid feeding fermented DDGS to weanling pigs: Improvement of growth performance with added enzymes and microbial inoculants. J. Anim. Sci., Vol. 94: 50–51. https://doi.org/10.2527/msasas2016-108.

[42]Xin, H., Wang, M., Xia, Z., Yu, B., He, J., Yu, J., Mao, X., Huang, Z., Luo, Y., Luo, J., Yan, H., Wang, H., Wang, Q., Zheng, P., Chen, D., 2021, Fermented Diet Liquid Feeding Improves Growth Performance and Intestinal Function of Pigs. Animals: an open access journal from MDPI, Vol. 11(5): 1452. https://doi.org/10.3390/ani11051452

[43]Yang, J.S., Lee, J.H., Ko, T.G., Kim, T.B., Chae, B.J., Kim, Y.Y., Han, InK., 2001, Effects of wet feeding of processed diets of performance, morphological change in the small intestine and nutrient digestibility in weaned pigs. Asian-Aust J Anim Sci., Vol. 14(9): 1308–1315.6.

[44]Zhang, S., Yoo, D.H., Ao, X., Kim, I.H., 2020, Effects of dietary probiotic, liquid feed and nutritional concentration on the growth performance, nutrient digestibility and fecal score of weaning piglets. Asian-Australasian journal of animal sciences, Vol. 33(10): 1617–1623. https://doi.org/10.5713/ajas.19.0473

[45]Zheng, L., Li, D., Li, Z., Kang, L., Jiang, Y., Liu, X., Chi, Y., Li, Y., Wang, J., 2017, Effects of Bacillus fermentation on the protein microstructure and anti-nutritional factors of soybean meal. Lett. Appl. Microbiol., Vol. 65: 520–526. https://doi.org/10.1111/lam.12806.

[46]Zijlstra, R.T., Beltranena, E., 2013, Swine convert co-products from food and biofuel industries into animal protein for food, Animal Frontiers, Vol.3(2): 48–53, https://doi.org/10.2527/af.2013-0014

[47]Zoric, M., Johansson, S.E., Wallgren, P., 2015, Behaviour of fattening pigs fed with liquid feed and dry feed. Porcine Health Managem., Vol. 1: 14. https://doi.org/10.1186/s40813-015-0009-7