

EFFICIENCY OF USING HIGH-PROTEIN SUNFLOWER MEAL INSTEAD OF SOYBEAN MEAL IN FEEDING OF GROWING PIGLETS

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Abstract

The article shows the productivity of piglets when they were fed from day 42 to day 70 of this period with sunflower meal (SP-45) instead of soybean meal (SP-48). The manuscript highlights the effectiveness of replacing soybean meal with high-protein sunflower meal in the final period of rearing pigs. It was established that this change in the diet of piglets during their rearing period contributed to a 1.0% improvement in the survival of piglets during the experiment, at the same time it led to a 7.6% decrease in daily feed consumption, which caused a 9.7% deterioration in the intensity of animal growth and as a result of a 6.8% decrease in live weight of piglets at the end of rearing and a 2.3% decrease in feed conversion. The replacement of soybean meal with high-protein sunflower meal in the structure of the starter feed made it possible to reduce its cost by 4.7%, which made it possible to reduce the cost of 1 kg of growth by 2.4%, and the cost of growing 1 head before transfer to fattening by 8.2%. At the same time, in the group of pigs consuming sunflower meal due to a decrease in their productivity and a decrease in their final weight, as a result, the market value of one piglet before transferring them to fattening decreased by 5.9% and the income per 1 reared head decreased by 1.7%. Whereas in the group of piglets that used sunflower meal instead of soybean meal in the starter feed recipe, the profitability of raising piglets was 3.89% higher.

Key words: feeding, rearing, meal, growth intensity, coma costs, cost, profitability

INTRODUCTION

Increasing demand for sustainable animal protein and increasing competition for agricultural land for food production make it necessary to search for alternative feed proteins for farm animals [15, 28]. It is known that among the main problems that affect pork production, problems with the fodder base are highlighted [19]. Feeding is one of the main technological factors which influence pig live

weight at slaughter and carcass quality [23]. An important issue for pig producers is ensuring that feed meets the animal's nutritional needs, particularly with regard to protein and the correct amino acid composition. Feeding marketable young animals with a balanced diet can be a difficult task not only because of the expensive feed, but also because pigs, as animals with a single-chambered stomach, have a noticeable

effect on growth and well-being from the composition of nutrients in their diet.

There are several options to meet the pig's requirement for 100% locally sourced organic ingredients in organic concentrate rations, but when considering practical, economic and environmental concerns, the list of such options is quite short. The list of options varies depending on the climate, with options being more limited in the northern parts of Europe than in the south. In the category of vegetable ingredients, oilseeds and in particular soybean meal of our local production is the most promising alternative to imported soybean flour. But recently, sunflower seeds have become more popular among pork producers as a widely available protein crop [7]. And the ease of processing raw materials further increases the importance of by-products of this crop as a substitute for classic soybean meal [17]. Sunflower seeds (*Helianthus annuus*) and by-product meals are important in some parts of the world as a source of high-oil protein material for livestock diets. The main areas of sunflower production in the world today are Argentina, China, Eastern Europe and the United States. Although Australia only produces relatively small amounts of sunflower meal, it remains a valuable source of protein for livestock there [10].

According to the data of foreign scientists [16], sunflower concentrate is a valuable ingredient for pigs due to its high energy concentration and low cost of processing in feed mills. Moreover, it does not contain most of the anti-nutritional factors. However, some authors [14] warn that sunflower products are less digestible than soy products. Although today this view is mixed and, in contrast to it, other authors, on the contrary, note the higher digestibility of sunflower concentrates compared to alternative feeds [27]. Studies of sunflower concentrate for fattening pigs, conducted by domestic scientists, showed that the total amino acid content in it is equivalent to soybean feed. At the same time, the content of methionine in it was 1.5 and 2.1 times higher compared to roasted soybean meal and full-fat soybean meal, respectively. Also, the content of threonine, glycine, cystine,

tryptophan, aspartic and glutamic acids in a sample of sunflower meal prevailed over the share of the same amino acids in soy products [25]. In turn, it was established that the additional introduction of only 0.5% of total protein into pig feed contributes to a 1.0% higher livestock survival and 41 g better average daily gains during the fattening period [22]. At the same time, the disadvantages of sunflower concentrates are high sulphur content and low lysine content compared to soybean meal [2]. Solvent-extracted sunflower seed meal has an average crude protein concentration of 30.7% and a high content of methionine [21].

Comprehensive studies of the advantages of sunflower concentrate revealed its versatile effect on indicators of digestibility, growth intensity and quality indicators of pig carcasses at slaughter. According to foreign researchers, the introduction of sunflower concentrate into the diet increased the fat content of fattening pig carcasses [12, 30] and accelerated the gain of live weight of piglets during rearing compared to the use of soybean concentrate [24]. In separate works, this opinion is supported by the argument that the composition of unsaturated fatty acids in sunflower meal caused an increase in the amount of adipose tissue in pigs, especially in the last month before slaughter [1]. There are reports that increasing the amount of sunflower meal in the diet of fattening pigs led to an increase in linear feed intake and to an increase in average daily gains [4]. The addition of sunflower meal to the diet affected the performance of the animals, but not the carcass characteristics. Feed conversion in pigs weighing 30 to 70 kg was improved by its addition [9]. A similar conclusion can be found in other studies, which showed that there were no differences between pigs fed sunflower meal and pigs on conventional feed, except for better values of average daily gains and daily feed consumption. The addition of meal had no significant effect on carcass characteristics [6]. Recent publications of the results of the experimental use of high-protein sunflower fodder prove its positive effect on shortening the rearing period by 1.17 days with a complete

replacement of soybean products ($p < 0.01$), a significant reduction in feed costs and the absence of a reliable effect on the slaughter quality of pig carcasses [29].

However, other researchers have reported completely opposite results, where pigs fed sunflower concentrate showed slower growth rates and a lower percentage of adipose tissue in their carcasses than their counterparts on classic soy-corn feed ($p < 0.05$) [5]. There are also known conclusions about a decrease in feed consumption by young pigs during rearing with an increase in the concentration of protein in sunflower meal, which was added instead of classic feed or in addition to it [10]. Other researchers, on the contrary, point to a significant regression effect ($P < 0.05$) on indicators of the following characteristics depending on the share of sunflower meal in the diet. Daily feed consumption, average daily gain, meat content in the carcass and its weight decreased with the increase in the proportion of sunflower meal. During the specified research period, the best results in terms of the amount of feed consumed per day were observed on diets with 20% meal, and in terms of average daily gains, the best results were on diets 5% meal. A diet with 20% sunflower meal had a negative effect on carcass weight [8]. It was also reported that sunflower meal compared to soybean meal, rapeseed meal and especially lupine had the lowest standardized digestibility in pigs ($P < 0.05$) [20].

Thus, taking into account not only the diverse, but often the opposite conclusions of scientists regarding the advantages and disadvantages of using sunflower meal during the period of rearing pigs, the relevance of a more in-depth study of this issue is beyond doubt.

The purpose of our work is to investigate the effectiveness of using high-protein sunflower meal for rearing young pigs in the conditions of an industrial pig complex.

MATERIALS AND METHODS

The material for the scientific and economic experiment was hybrid pigs obtained from F₁ sows of the English Large White breed and

English Landrace and boars of the synthetic terminal line PIC-337 of the English genetics company PIC in the conditions of Globinsky Pig Complex LLC, Poltava region, Ukraine.

To conduct the experiment in the spring of 2021, two groups of experimental piglets were formed in the amount of 300 heads each and placed for rearing in separate pens of 150 goals each in accordance with the technology of keeping piglets in the farm. When setting up for rearing, animals in both control and experimental groups were individually weighed and identified with tags of different colors.

During the equalization period from the seventh to the thirty-first day of life, the piglets of both the control and experimental groups received the first pre-starter compound feed traditional for the farm based on soy products. Starting from the 28th and the 31st day, all the experimental piglets were transferred to feeding with the second prearing compound feed, which was fed for 42 days of the piglets' life, after which, for three days, the piglets of both experimental groups were transferred to feeding with the starter compound feed according to the recipe shown in Table 1 whose the nutritional value is presented in Table 2.

Table 1. Composition (%) of compound feed for piglets on growing (41-70 days)

Feed components and their nutrition	Group I	Group II
Wheat	25.00	25.00
Barley	25.81	24.66%
Corn	21.52	21.00
Soybean meal (48% SP)	21.17	0
Sunflower meal (45% SP)	0	22.3
Soybean oil	2.00	2.12
Lysine sulfate (55%)	0	0.37
L-tryptophan (98%)	0	0.05
Acidifier	0.50	0.50
Premix (TC VPM s/p 4%) ¹	4.00	4.00

Source: own calculations.

Pigs of the control group received the traditional combined feed based on soybean products for the farm, and in their analogues from the experimental group, all soybean meal was replaced with sunflower meal "Proglot 45" of the LLC "Potoky", Dnipropetrovsk region, Ukraine. In the main

period of the experiment, the animals of the experimental group were given synthetic amino acids in the form of lysine sulfate and L-tryptophan in addition to the main diet for its balancing (Table 1). Animals received such a diet until 70 days of life, after which they were transferred to fattening.

Table 2. Nutrient value of combined feed for piglets during rearing (41-70 days)

Indicator	Group I	Group II
Exchange energy of pigs, %	13.7	12.9
Crude protein,%	17.80	17.80
Crude fat, %	4.10	4.10
Crude fiber, %	3.93	5.16
Lysine, %	1.33	1.33
Methionine, %	0.39	0.48
Methionine+Cystine,%	0.69	0.79
Threonine,%	0.83	0.85
Tryptophan, %	0.21	0.21
Valine, %	0.79	0.80
Ca,%	0.79	0.79
P,%	0.52	0.65
P absorbed, %	0.37	0.38
Na, %	0.19	0.18
NaCl, %	0.50	0.51
Vitamin A, thousand iu	13.00	13.00
Vitamin D, thousand iu	2.00	2.00
Vitamin E, Mk/kg	88.00	88.00
Vitamin K, Mk/kg	3.00	3.00
Vitamin B1, Mk/kg	2.50	2.50
Vitamin B2, Mk/kg	6.00	6.00
Vitamin B3, Mk/kg	20.00	20.00
Vitamin B4, Mk/kg	462.00	462.00
Vitamin B5, Mk/kg	40.00	40.00
Vitamin B6, Mk/kg	4.00	4.00
Vitamin B12, Mk/kg	0.030	0.030
Vitamin Bc, Mk/kg	1.00	1.00
Vitamin H, Mk/kg	0.25	0.25
Fe, Mk/kg	123.70	123.70
Cu, Mk/kg	145.00	145.00
Zn, Mk/kg	131.00	131.00
Mn, Mk/kg	98.00	98.00
Co, Mk/kg	0.45	0.45
I, Mk/kg	2.00	2.00
Se, Mk/kg	0.30	0.30

Source: own calculations.

When the pigs of each group were transferred to a new compound feed recipe, they were weighed in groups, and when transferred to the starter feed and after the experiment was completed, they were weighed individually.

All experimental piglets were kept in groups of 150 heads in adjacent pens on a partially slotted floor with an area of 0.33 m² per head.

The solid part of the pens, which made up 35% of the floor area of the pens, was heated to the required temperature with the help of warm water. The ventilation of the pigsty was carried out with the help of supply and exhaust fans (Big Dutchman, Denmark) which maintained the necessary temperature, humidity and gas composition of the air through the control processor.

Manure was removed from the premises with the help of a periodic vacuum gravity system.

Fodder was transported to the places where the animals were kept and distributed using the Spotmix II portioned feeding system (Schauer, Germany) which made it possible to prepare a separate compound feed recipe for each pens and take into account its quantity at each distribution to each of them. Dry fodder of the required recipe and in the required quantity was transported to its destination using compressed air, where during its discharge from the pipeline system to the feeder, it was moistened to a specified humidity using special high-pressure nozzles. Animals were fed in portions from metal feeders. The amount of feed in the feeder was supplied depending on the given feeding curves adopted in the farm. The frequency of feeding was adjusted automatically depending on the remaining feed in the feeders, which were monitored by special sensors. After feeding the feed, the final fragment of the feed pipe was flushed with clean water under pressure for four seconds.

During the experiment, in both experimental groups, daily control of the consumption of compound feed was carried out in the section of pens with the help of a feeding system control processor, and it was recorded daily on a paper medium. When pigs were removed from the group, record the date and reason for removal and the weight of the animals removed.

The economic efficiency of feeding the starter compound feed based on sunflower meal "Proglot 45" was calculated based on the data of the accounting information. According to the results of the experiment, calculate the index of fattening qualities using equation:

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

where:

A – gross growth during the growing period, kg;

B – duration of growing, days;

C – feed consumption per 1 kg of growth.

The obtained results of the experiment were calculated biometrically with the help of Microsoft Office Excel 2010.

RESULTS AND DISCUSSIONS

It was established that in both experimental groups during the equalization period of feeding in the first four weeks of rearing, during which the pre-starter compound feed traditional for the farm was fed, no significant difference in the dynamics of live weight of piglets of both experimental groups was observed (Fig. 1).

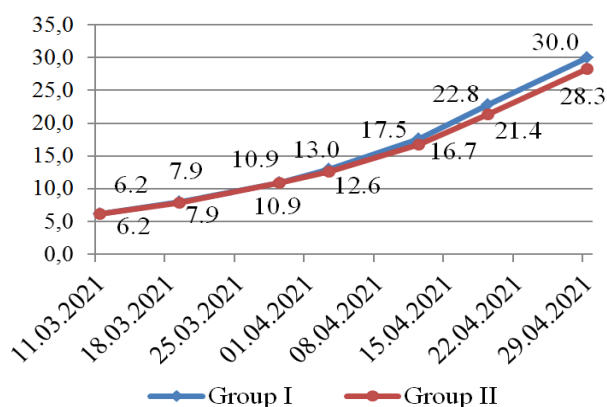


Fig. 1. Dynamics of changes in live weight of piglets during rearing

Source: Own determination.

While at the beginning of the main period of the experiment, the piglets of the experimental group showed lower dynamics of live weight compared to the control group. Thus, on the fifth week of rearing, they had a lower live weight compared to the counterparts of the control group by 0.82 kg, on the sixth by 1.39 kg, and 1.67 kg at the end of rearing. This is caused by the lower growth energy of piglets that consumed compound feed based on high-protein sunflower meal during the experimental period (Table 3).

Piglets of the experimental group for 28 days of the main period of the experiment had 62.1 g ($p < 0.001$) lower average daily gains, which caused 1.66 kg ($p < 0.001$) lower absolute

gains. A decrease in the intensity of growth of piglets of the second group during the main period of the experiment caused a decrease in their live weight at the end of rearing. Thus, it was probably ($p < 0.001$) 2.05 kg lower in the group I compared to the group II.

At the same time, in the group of animals that consumed ration feed based on soybean meal, the survival rate of piglets was 1.0% lower compared to their counterparts that consumed a ration based on sunflower meal during this period.

Table 3. Productivity of piglets in rearing with the use of high-protein sunflower meal

Indicator	Group I	Group II
The number of piglets at the beginning of the experiment, heads	300	298
Duration of the experiment, days	28	28
The average weight of 1 head of piglets at the beginning of the experiment, kg	13.00±0.26	12.61±0.21
The number of piglets at the end of the experiment, heads	294	295
Preservation of piglets in the experimental period, %	98.0	99.0
Average weight of 1 head at the end of the experiment, kg	29.95±0.37***	27.90±0.35
Weight of weaned piglets, kg	42	49
Gross growth, taking into account animals that have been eliminated, kg	4947	4604
Absolute growth of 1 head, kg	16.95±0.29***	15.29±0.23
Average daily increase, g	637.7±12.4***	575.6±11.6
Feed conversion, kg	1.66	1.70
Daily consumption of feed, kg	1.06	0.98
Index of fattening qualities (I), points	6.17	4.90

*** – $P < 0.001$

Source: own calculations.

The introduction of sunflower meal to replace soybean meal in compound feed resulted in a 0.08 kg less average daily consumption of it

per head, which, in our opinion, led to a deterioration in the growth intensity of piglets and, as a result, a deterioration in feed conversion by 0.04 kg.

According to the results of the calculation of the complex index of fattening qualities, its value was set lower by 1.27 points in the animals of the experimental group.

Thus, replacing soybean meal (SP-48) with sunflower meal (SP-45) in the diet of piglets during the period of their rearing from 42 to 70 days improved the survival of piglets during the experiment by 1.0%, while at the same time it led to a decrease of 7.6% of daily feed consumption, which caused a 9.7% deterioration in the intensity of animal growth and, as a result, a 6.8% decrease in live weight of piglets at the end of rearing and a 2.3% decrease in feed conversion.

According to the results of the study of the economic effectiveness of replacing soybean meal with sunflower concentrate in the diet of pigs, it was established that the cost of rearing piglets was reduced and its profitability increased. Due to the lower price of high-protein sunflower meal compared to its soybean counterpart, the cost of 1 kg of starter feed in the experimental group was EUR 0.011 lower (Table 4) compared to the control group.

Table 4. Efficiency of rearing piglets in the nursery with the use of high-protein sunflower meal

Indicator	Group I	Group II
Cost of starter compound feed in the experiment, EUR	0.25	0.24
Feed cost per 1 kg of growth, EUR	0.42	0.41
The cost of 1 kg of growth at the end of the experiment, EUR	0.93	0.91
The cost of an increase of 1 head, EUR	11.03	9.88
The cost of 1 head of piglets when placing them for rearing, EUR	20.28	20.28
The cost of 1 head of piglets at the end of the experiment, EUR	31.31	30.16

Source: own calculations.

This caused, regardless of the lower indicators of growth intensity, the feed cost per 1 kg of

growth was lower by EUR 0.010. The operational cost of the increase of piglets during the main period of the experiment also turned out to be EUR 0.02 lower when feeding in the diet of high-protein sunflower meal compared to soybean meal. The lower cost of growth in the animals of the experimental group led to an improvement of EUR1.15 cost of one piglet when it is transferred for fattening.

Thus, replacing soybean meal with high-protein sunflower meal in the ration of piglets from the 42nd to the 70th day of growth made it possible to reduce its cost by 4.7%, which contributed to a 2.4% reduction in the cost of 1 kg of growth, by 10.4% in the cost of growing 1 heads to be transferred for fattening.

Therefore, replacing soybean meal with high-protein sunflower meal in the diet of piglets from the 42nd to the 70th day of growing allowed reducing its cost by 4.7%, which contributed to a 2.4% reduction in the cost of 1 kg of growth, by 8.2% in the cost of growing 1 heads to be transferred for fattening. At the same time, due to a decrease in the productivity of animals and a decrease in their final weight in this group, the market value of one piglet when transferred for fattening decreased by 5.9% and the income per 1 grown head decreased by 1.7%. While the profitability of raising piglets turned out to be 3.89% better in the group of piglets that used sunflower meal instead of soybean meal in the recipe of the starter feed.

It was found that replacing the diet of piglets during their grow-out period with soybean products for high-protein sunflower concentrate resulted in a 7.6% decrease in daily feed intake, which is consistent with other reports [4], which also indicated a decrease in feed intake in parallel with by increasing the content of sunflower meal in the diet. But our data contradict these conclusions [4] about the absence of a decrease in the intensity of growth of pigs with such replacement of protein products. Also, our data contradict the findings [3, 13], which indicate a positive effect of sunflower products on the intensity of growth of pigs. In addition, our findings do not coincide with

evidence [18, 5], which indicate no effect of replacing soybean meal with sunflower. Whereas, in our research, 9.7% deterioration in growth intensity was found in pigs whose diet was replaced by soybean meal with sunflower meal, which is consistent with information [11, 26]. Also, in our study, a 2.3% deterioration of feed conversion was found in the experimental group, which is consistent with the findings [9, 26]. Replacing soybean meal with high-protein sunflower meal in our research made it possible to reduce the cost of 1 kg of growth by 2.4%, the cost of growing 1 head before transfer to fattening by 8.2%, and increase the profitability of raising piglets by 3.89%. We consider it expedient to continue research on the impact of high-protein products of sunflower origin on animal productivity and economic indicators of its use.

CONCLUSIONS

The intensity of growth of piglets during rearing did not differ between groups of animals before the replacement of soybean meal with sunflower meal, while after such replacement, the intensity of growth of piglets fed with sunflower meal decreased.

Replacing soybean meal with high-protein sunflower meal in the composition of the starter compound feed led to a 1.0% improvement in piglet survival and a 7.6% decrease in daily feed intake, which caused a 9.7% decrease in growth intensity and a 2.3% decrease in feed conversion and a decrease of 6.8% in the live weight of piglets at the end of rearing.

The exchange of meal made it possible to reduce its cost by EUR 0.014, which allowed for EUR 0.016 reduce the cost of 1 kg of growth and by EUR 1.15 to reduce the cost of growing 1 head before transfer to fattening. At the same time, this replacement caused a decrease of EUR 3.09 of the market value of one piglet when transferred for fattening and EUR 0.32 income per 1 head of piglets during rearing. While the profitability of raising piglets turned out to be 3.89% better in the group of piglets that used sunflower meal

instead of soybean meal in the recipe of the starter feed.

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