

## THE USE OF NUT KERNEL CAKE IN THE FEEDING OF YOUNG PIGS

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### Abstract

*The aim of the research was directed to: assess the nutritional potential and the impact on production indices, blood and economic, using in the food of the young pig breeding, the nut kernel cake in different proportions. The results of the analysis of the chemical composition showed that the nut kernel cake contains: 4.19% nitrogen, 26.2% crude protein, 9.34% crude cellulose, 13.6% fat, 12.69 Mj/kg metabolizable energy, 0.33% calcium and 0.44% phosphorus. The results of this study indicate that nut kernel cake represents a viable solution for the partial replacement of soybean meal in the food of the young pigs, because the use of the amount of 4%/t and 8%/t of compound fodder, reduces feed consumption by 3.8% and 5.2%, increases feed conversion rate by 5.3%-4.5%, the average daily increase in the experiment increases by 1.4%, does not negatively affect the state of health and blood indices reduces the cost price of 1kg of compound fodder on average by 1.3 and 2.2 cents.*

**Key words:** blood index, compound fodder, chemical composition, nut kernel cake, nutritional value.

### INTRODUCTION

Obtaining pigs with a high quality carcass represents an essential condition for all pig farmers in the Republic of Moldova.

From the point of view of the use of pig feed, it converts concentrated fodder into meat and fat better than other animals, and there is currently a tendency to reduce the proportion of cereals in pig rations, which is possible primarily by diversifying feed sources and using non-traditional fodder and waste from the manufacturing industry.

The identification of effective alternative nutritional solutions for the partial replacement, total or complementary substitution of some ingredients from pig rations with new feed resources, would allow not only the considerable supplementation of the nutritional value but also the reduction of the cost price of nutrition rations (Danilov & Donica, 2020). That is why the complex use of new or lesser-known feed resources in pig feed is an ever-present problem.

After the processing of agricultural products, impressive quantities of precious fodder waste are obtained, and walnut cultivation occupies an important place in the country's agriculture,

because the annual production of nuts is on average over 4.0-4.5 thousand tons per year.

Data on the chemical composition of walnut kernels indicate that it contains: fatty acids of which more than 50% linoleic acid, proteins, lipids, vitamins A, B1, B2, B6, C, E, F, tyrosine, gallic acid, ellagic acid, calcium, copper, zinc, fluorine, inositol, flavonoids, juglon, hydrogelone, extractive substances, magnesium, potassium, carbohydrates, etc.

After extracting the oil from the nut kernel, the nut kernel cake is obtained by pressing, and some of these valuable nutrients remain in this by-product. The cake resulting from the extraction of the oil is not further processed. Unfortunately, in the scientific and specialized literature, the information on the use of nut kernel cake in animal feed is very limited or totally missing. This product is a real storehouse of essential vitamins and other useful components. Research in this direction is up-to-date as diversifying and expanding the range of protein feed sources for the pig farming sector is an ongoing issue.

Data from the literature (Dinu et al., 2002; Kalashnikov et al., 2003) show that the practical application of new or less studied feeds requires thorough complex investigations

of the chemical composition and nutritional value of compatibility with other ingredients and the impact on productivity and economic indices.

Based on the above data, the purpose of the research was aimed at: assessing the nutritional potential and the impact on production and economic indices, using in the feed of young pig breeding, nut kernel cake in different proportions.

## MATERIALS AND METHODS

The research was carried out in the laboratories of SPIBZVM and in the precinct of the State Enterprise for Research in the Breeding and Hybridization of Pigs "Moldsuinhibrid", Orhei district, within the project: 20.8009.5107.12 "Strengthening the food-animal-production chain by using new feed resources, innovative sanitation methods and schemes". The object of the research was served with nut kernel cake and biracial pig youth. Walnut kernel cake (residue obtained from extracting nut kernel oil) was purchased from JSC "Azamet" PRO Ciadâr-Lunga district.

The biological testing of the nut kernel cake was carried out on a herd of 15 biracial sows (Yorkshire x Landrace) which were divided into three lots of 5 heads each, with the same level of development, constitution, health, with evidence growth energy during the leveling period according to classical methods (Ovsyannikov, 1976). The experimental period was 101 days, of which the leveling period lasted 15 days and the evidence period 86 days. The main indicators that were studied were: the chemical composition of the nut kernel cake and the combined fodder used in the experiment, the edibility and daily consumption of fodder in groups, the average daily increase, the specific consumption, the blood indices.

The determination of the chemical composition of the nut kernel cake and of the combined fodder used in the experiment was carried out according to the classical methods (Pochernyaev et al., 1977): total humidity - according to the general methods by drying, crude ash - by calcination, crude protein - after Kjeldahl, crude fat - after Soxhlet, crude fiber - after Kirchner, calcium and phosphorus by titration.

The assessment of the average daily increase and the specific consumption for 1 kg of increase was performed according to known techniques (Cuckoo et al., 2004). For the study of hematological indices, at the beginning and at the end of the experiment, blood samples were taken from three sows in each lot.

The analysis of the hematological parameters of the blood was performed using the biochemical analyzer STAT FAX-3300.

Economic efficiency was calculated using the VNIPI method (Loza et al., 1983).

By means of the computer program Microsoft EXCEL, using the classical methods (Plokhinsky, 1978), the biometric processing of the experimental data and the testing of the significance of the differences were performed.

Table 1 Scheme of experience

Lot	Livestock (n)	Average weight (kg)/head	The mode of nutrition
Control	5	37.0	BCF (recipe 1)
Experimental I	5	37.4	ECF* (recipe 2)
Experimental II	5	38.0	ECF* (recipe 3)

Note: BCF- basic compound feed, ECF\* - experimental compound feed

In the structure of the combined fodder recipe for pigs in the control lot was used (BCF), and in the experimental lots combined fodder was used, with the inclusion in the recipe of nut kernel cake in different proportions: in experimental lot I the cake was used from nut kernel in a proportion of 4% / t, recipe no. 2, and for the animals from the experimental lot II, the nut kernel cake was used in a proportion of 8% / t, recipe no.3 (Table 1).

## RESULTS AND DISCUSSIONS

The assessment of the sensory qualities of feed sources is of particular interest, as it is an important tool for making important decisions in accepting them for use in animal feed. As a result of the analysis of the conventional profile of the nut kernel cake according to four descriptors: appearance, color, taste and smell, we can mention that it has a compact structure, relatively crumbly, consisting of pieces or powder of different sizes, without the presence

of foreign particles or impurities and mold, dark gray to dark brown in color (Figure 1), has a sweet bitter taste and a nutty odor, with no hints of foreign taste. We could mention that consuming the nut cake after a while, the feeling of bitter taste disappears.



Figure 1. Nut kernel cake

The results of the analysis of the chemical composition showed that the fresh nut kernel cake has a moisture content of 10.82%, a nitrogen content of 4.19%, crude protein 26.21%, crude fat 13.61%, crude cellulose 9.34%, metabolizable energy 12.69 Mj/kg, calcium 0.33% and 0.44% phosphorus. Based on the received results, we find that nut kernel cake, obtained by cold pressing, as a nutritional value can be placed in an intermediate position between soybean meal and cakes and sunflower and is a valuable fodder. Using the native ingredients and using the computer program "HYBRIMIN", according to the nutrition rules in force, 3 recipes of combined fodder were developed for each growing period (Table 2).

Table 2. The structure of the combined fodder recipes used in the experiment

Ingredients, %	Lot					
	Control		Experimental I		Experimental II	
	Growth periods, kg					
	40-70	71-115	40-70	71-115	40-70	71-115
Maize	29.8	34.9	23.8	29.4	21.8	27.4
Barley	32.3	39.0	32.3	39.0	32.3	39.0
Wheat	23.1	10.0	29.1	15.0	29.1	15.0
Wheat bran	-	7.0	-	7.0	-	7.0
Soybean meal	12.0	6.5	8.0	3.0	6.0	1.0
Nut kernel cake	-	-	4.0	4.0	8.0	8.0
Chalk	1.0	1.2	1.0	1.2	1.0	1.2
Salt	0.4	0.4	0.4	0.4	0.4	0.4
Premix	1.4	1.0	1.4	1.0	1.4	1.0
Total	100	100	100	100	100	100

Biological testing of nut kernel cake was performed on biracial sows (Yorkshire x Landrace) selected according to the same level of development, constitution, health, with evidence of growth energy during the leveling period.

The nutritional value of the combined fodder recipes used in the feeding of breeding sows during the growing period (40-70 kg) was of 11.08; 10.88; 10.80 Mj metabolizable energy, crude protein 15.30; 15.31; 15.18%, gross fat 3.61; 2.64; 3.87%, crude cellulose 3.63; 5.09; 5.37%, non-nitrogenous extractive substances on average 68.80; 72.44; 65.31%, corresponding to the lots. The feed ration for

the growing period (71-115 kg) had, corresponding to the lots, a level of 12.70; 12.62; 12.44 Mj metabolizable energy, crude

protein 13.40; 13.1; 13.1%, gross fat 2.94; 3.23; 3.64%, crude cellulose 4.54; 4.62; 4.79%. Analyzing the data of the results of the chemical composition and the nutritional value of the nutrition ration used in the experiment, we can mention that they corresponded to the daily norms of nutrition, provided in the specialized literature (Kalashnikov et al., 2003). Data on the combined fodder consumption of the sows taken into studies are presented in (Table 3, Figure 2).

Table 3. Consumption of combined fodder in the experimental period

Specification	Consumption of combined fodder, kg		
	Control	Experimental I	Experimental II
In the first period of growth, per lot	494	412	398
In the second period of growth, per lot	566	608	607
In the experiment, on the lot	1060	1020	1005
On average at 1 head	212	204	201
Average daily feed consumption	2.47	2.37	2.34
Feed consumption per 1 kg increase	3.79	3.59	3.62

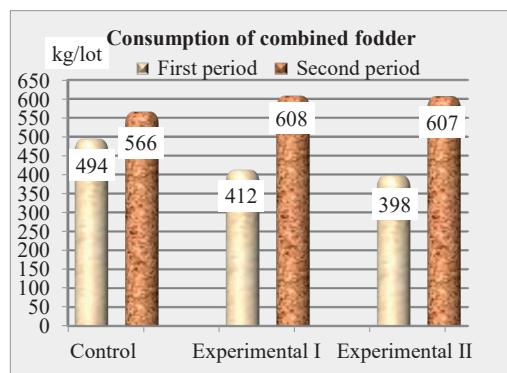


Figure.2. Consumption of combined fodder per lot

Table 4 Evolution of body mass dynamics

Specification		Lot		
		Control	Experimental I	Experimental II
Live mass, kg	at the beginning of the experience	37.0±1.00	38.0±0.500	37.4±0.570
	end of I growth periods	67.4±0.908	67.8±1.193*	68.0±0.935**
	end of experience	93.0±5.397	94.8±3.130	93.0±3.708
Growth increase, kg	in the first period	30.4±1.351	29.8±0.741	30.6±0.447
	in the second period	25.6±4.698	27.0±2.031*	25.0±3.335
	in the experiment	56.0±5.062	56.8±2.724	55.6±3.492
Increase environment daily, g	in the first period	676±30.021	662±16.480	695±10.163**
	in the second period	612±110.829	658±49.537	595±79.414
	in the experiment	651±58.861	660±31.684	647±40.614
Feed consumption per 1 kg increase, kg		3.79	3.59	3.62

Note: \* p < 0.05, \*\* p < 0.01

The results of the research showed that, in the second period of the experiment, the administration of nut cake in the amount of 4% of compound fodder (experimental lot I),

As a result of the monitoring carried out during the experiment, it was found that the nutrition rations including nut kernel cake in different proportions were well tolerated by sows, and throughout the experiment, the combined fodder consumption by a sow in experimental lot I of was lower by 3.8% and in experimental lot II by 5.2% compared to the sows in the control lot.

The sows in the control lot had an average daily consumption of 2.47 kg/head, while the sows in the experimental groups consumed an average of 2.37-2.34 kg of fodder. The basic indicator that characterizes the success of efficient pig breeding is the average daily increase which is influenced by the quantity and quality of the administered fodder (Danilov & Donica, 2020; Kalashnikov, 2003).

The data obtained (Table 4) allow us to find that the sows in the experimental lots had a higher growth rate, and at the end of the first growing period, depending on the combined fodder recipe administered, the body mass of the sows in the experimental lots was higher than the sows in the control lot by 0.4 kg and 0.6 kg (p < 0.05; p < 0.01).

In the first growth period, the sows from the experimental lot II achieved an average daily increase of 695g times by 19 g higher (p < 0.01) compared to the average daily increase achieved by the sows from the control lot.

increases the increase in body weight by 1.4 kg (p < 0.05) compared to the increase of sow growth in the control lot. It was found that a higher growth intensity in the experiment was

achieved by the sows in experimental lot I where the average daily increase was 660 g or by 9 g higher than that of the sows in the control lot. Based on fodder consumption data, as well as the absolute weight gain, the feed conversion index for a production unit was calculated. The feed conversion index (kg compound fodder/kg increase) had values between 3.79; 3.59 and 3.62 kg, corresponding to lots. The sows of the experimental lot I had an index of fodder conversion by 5.3% better than in the case of sows in the control lot.

We believe that nut kernel cake, obtained mainly by cold pressing, due to its organoleptic qualities and its rich content in natural proteins, fibers, fats, minerals could be accepted for use in the diet of breeding sows as a nutritional supplement.

Establishing hematological values provides important data on the general health of animals, the nutritional and metabolic status of pigs.

Data on the evolution of some hematological indices of breeding sows at the end of the experiment whose rations were supplemented with nut kernel cake in the proportion of 4%/t and 8%/t of combined fodder, compared to the animals in the control lot are shown in Table 5. The results of the biochemical analyzes at the beginning and end of the experimental period showed that all the animals were healthy and the blood indices in the animals in all lots showed no changes and were characterized by average values of the limits of the norms provided in the literature.

Table 5. Average values of hematological indices at the end of the experiment

Indices	Unit of measure	Lot			
		norm	control	experimental I	experimental II
Hemoglobin	g/l	90-130	98.3±5.401	95.0±3.535	105±9.354
Erythrocytes	10 <sup>12</sup> g/l	5-7	8.77±0.889	9.47±1.846	8.13±0.864
Leukocyte	10 <sup>9</sup> g/l	11-22	21.67±2.265	19.63±0.531	17.53±2.138
ESR*	mm/hour	1.0-9.0	7.66±2.483	8.33±2.857	8.67±2.160
Lymphocytes	%	35-75	49.33±1.080	53.00±6.042	44.33±2.273
Eosinophils	%	0-15	8.0±2.121	14.33±4.021	11.67±1.080
Unsegmented neutrophils	%	20-70	33.0±1.871	22.33±1.453	30.3±1.472
Segmented neutrophils	%	4-8	9.67±1.08	10.33±2.160	13.66±2.160

Note: \*ESR - erythrocyte sedimentation rate

The results of the hematological analyzes at the beginning of the experiment showed that the average values of the leukocyte content had individual oscillations ranging from 27.5 \* 10<sup>9</sup> g/l in the control lot to 30.4 \* 10<sup>9</sup> g/l in the experimental lots (Figure 3).

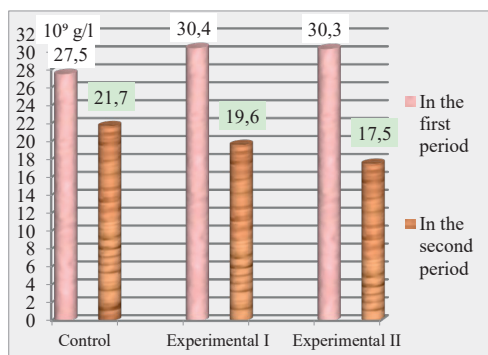


Figure 3. The amount of leukocytes in the experiment

A tendency to decrease of the number of leukocytes at the end of the experiment was reported from 21.67 \* 10<sup>9</sup> g/l in the control lot to 19.63 \* 10<sup>9</sup> g/l in the experimental lot I and 17.53 \* 10<sup>9</sup> g/l in experimental lot II.

In research, the level of uric acid was important, which characterizes the work of renal functions and an important marker of the efficiency of the use of protein from food, which was in the range of 6.43 mol/l, 7.30 mol/l and 4.8 mol/l corresponding to lots. The amount of uric acid was maintained in a range corresponding to the limits of physiological norms (2.8-8.8 mmol/l). It should be noted that the amount of creatinine in all lots taken into studies increased from 87 mmol/l at the beginning of the experiment to 110 mmol/l at the end of the experiment in the control lot, in the experimental lot I from 76 mmol/l at the beginning of the experiment to 195 mmol/l at

the end of the experiment and from 84 mmol/l to 160 mmol/l in experimental lot II.

We find that the amount of blood creatinine is maintained in a range corresponding to the limits of physiological norms (70-208 mmol/l). The study of the serum alkaline phosphatase content at the end of the experiment revealed a decrease from 130.7 u/l in the control lot to 101.0 u/l in the experimental lot I and 109.7 u/l in the experimental lot II, but which was within the parameters of the limits of physiological norms (41-176 u/l).

The assessment of the economic efficiency of the use of the nut kernel in recipes of mixed fodder in different proportions was made on the basis of the absolute increase of the animals during the experiment, the cost of 1 kg absolute increase, the consumption of combined fodder, the cost price of the combined fodder and of nut kernel cake. The cost of 1 kg of combined fodder used in the first growing period was 25.3; 23.8; 23.2 cents and in the second period 22.8; 21.5; and 20.8 cents corresponding to the lots. The positive effects of the ratios which contained the nut kernel cake were observed by increasing the daily weight gain during the experiment periods and more importantly, by reducing the cost price of a kg of combined fodder in the first growing period by 1.5 and 2.2 cents, and in the second period respectively with 1.3 and 2.0 cents compared to the cost of 1 kg of compound fodder used in feed of the breeding sows in the control lot.

During the experimental period, the cost of the combined fodder used varied depending on the specific consumption of the animals and the cost of 1 kg of combined fodder, being within the limits of 50.27 \$,USD in the control lot and 45.75-43.68 \$,USD in the experimental lots.

Feed consumption is a main indicator of economic efficiency because in the experimental lots this index decreased by 8 kg and 11 kg or by 3.8% and 5.2% compared to the control lot. During the experimental period, the average price of achievement of breeding sows was 4.49 USD/kg, the cost of 1 kg of nut kernel cake - 20.9 cents/kg and of soybean meal - 55 cents/kg. According to the results obtained, the use of nut kernel cake in the amount of 4%/t of combined fodder gave the possibility to obtain an economic effect on the animal in the amount of - 7.22 \$,USD, and in

the amount of 8%/t of combined fodder- 4.38 USD.

Taking into account the current high level of purchase price of soybean meal and other protein ingredients due to their complex chemical composition and, in particular, their high protein and fat content and their unique functional properties, for reducing the cost of food recipes and save of fodder, nut kernel cake could be an attractive ingredient for use in pig feed.

## CONCLUSIONS

Nut kernel cake is of economic interest and can be used as part of the daily diet of pigs as an additional protein source, because it has good sensory qualities and contains 4.19% nitrogen, 26.2% crude protein, 9.34% crude cellulose, 13.6% fat, 12.69 Mj metabolizable energy/kg, 0.33% calcium and 0.44% phosphorus.

The results of the experimental investigations show that the use of nut kernel cake in the feed of breeding sows in the amount of 4%/t and 8%/t of compound fodder reduces the cost price of 1 kg of compound fodder, on average, with 1.3 and 2.2 cents, does not negatively influence the state of health, reduces the consumption of fodder by 3.8% and 5.2%, increases the fodder conversion rate by 5.3%-4.5%, in the experimental lot II the average daily increase increases by 1.4%.

The results of this study indicate that nut kernel cake represents a viable solution for the partial replacement of soybean meal in the feeding of breeding sows because under the conditions of an inclusion rate of 4%/t of compound fodder was obtained an economic effect of -7.22 USD/head, and the inclusion of 8%/t ensured an economic effect for each sow in the amount of - 4.38 USD/head.

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