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THE USE OF PUMPKIN SEED CAKE IN THE DIETS OF FATTENING PIGS

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Abstract

The work presents the results of a study on the chemical composition of pumpkin seed cake with shell and its potential use in the feeding of fattening piglets. It was established that including pumpkin seed cake in the diets of meat hybrids at proportions of 4%/t and 7%/t of combined fodder did not have a negative impact on health, productive performance, carcass quality, and economic indicators. Tests showed that substituting soybean meal with pumpkin seed cake at a rate of 4%/t in the first fattening period and 7%/t of combined fodder in the second period provides an average daily growth increase of 789g, with a slaughter yield (hot carcass weight) of 80.53%, average backfat thickness at the 6/7 thoracic vertebra of 29.33 mm, 23.00 mm at the spine, 18.67 mm at the rump, eye muscle area of 42.69 cm², ham weight of 11.763 kg, and fat content in the Longissimus dorsi muscle of 4.53%, provided an economic benefit of 10.62 euros for each raised and fattened head.

Key words*: carcass; nutritional value; pumpkin seed cake; productive indices; slaughter yield.*

INTRODUCTION

Pigs, depending on their age, sex, physiological condition, etc., require assimilable energy, a specific level of protein, minerals, and vitamins, all in proportion to achieve efficient utilization of their genetic potential. To ensure high productivity, pig rations need to be controlled separately for approximately 32 nutritional elements, utilizing around 500 types of feeds and nutritional additives (Danilov & Donica, 2020). The use of concentrated feeds in pig nutrition, as well as their substitution with other feeds, is determined by the physiological requirements of different pig categories and a series of technical and economic conditions, such as: the ability to consistently provide quality feeds, their cost, the goal and the performances that are being pursued (Dinu et al., 1993; Coshman et al., 2023).

Industrial waste contains a complex range of nutritional compounds that, despite being of interest for animal feed, are not fully utilized and, on the contrary, are used irrationally and incompletely. Currently, the complex processing of raw materials and the rational management of waste are important issues that need to be resolved.

The obtained waste from agricultural production processing should be divided into waste whose storage generates additional expenses and waste that can bring profits. Until recently, waste from agricultural production processing was not considered by livestock farmers as income-generating waste. Diversifying and expanding the assortment of protein feed sources for the zootechnical sector is an ongoing issue in the Republic of Moldova. Currently, in the republic, several small and medium-sized enterprises (JSC "Azamet" PRO) specialized in producing pumpkin seed oil with and without shells. The by-product obtained from cold-pressing pumpkin seeds for oil extraction is referred to as "oilcake" or "cake" from pumpkin seeds. It has a complex chemical composition and high nutritional value (Svezhentsov & Korobko, 2023). Available sources from the literature indicate that 100 grams of pumpkin seeds contain: 26 kcal, protein, fats, fibers, 16 mcg folate, 6 mg niacin, 2 mg pantothenic acid, 0.6 mg pyridoxine, 11 mg riboflavin, 0.5 mg thiamine, Vitamin A, Vitamin C, Vitamin E, Vitamin K, 1 mg sodium, 21 mg calcium, 340 mg potassium, 44 mg phosphorus, 262 mg magnesium, 515 mcg alpha-carotene, 3100 mcg beta-carotene, and 8 types of

essential amino acids (Butch, 1983; Vasilyeva et al., 2010). Literature data suggest that, following the cold pressing of pumpkin seeds, up to 10% of nutrients are found in pumpkin seed oil, and the main part of nutrients is present in the seed cake (Coshman et al., 2023). Regrettably, scientific and specialized literature provides very limited or entirely missing information about the use of pumpkin seed cake in animal feed (especially for pigs). Based on the mentioned facts and considering the periodic occurrence of severe droughts in the Republic, often compromising cereal crops (corn, barley, wheat, soybeans, peas, etc.), the purpose of the research was to study the chemical composition and nutritional value of pumpkin seed cake. Additionally, the study aimed to assess the impact of using pumpkin seed cake in the diet of fattening young pigs on production performance, blood indicators, and economic factors.

MATERIALS AND METHODS

The investigations were conducted in the laboratories of the Scientific-Practical Institute of Biotechnologies in Zootechnics and Veterinary Medicine, as well as within the unit of reproduction, growth, and fattening of pigs IE "Secrieru Aliona" in Stoianovca village, Cantemir district, Republic of Moldova. The subject of the research was pumpkin seed cake with shells and three-way crossbred piglets (Yorcshire x Landrace x Duroc), selected using the batch-analogue method, considering their origin, body weight, health status, and growth potential during the leveling period (Table 1).

Table 1. Experimental design scheme

Lot	Livestock (n)	Feeding particularities
The first period of fattening 40-70 kg		
Control	12	NCB* - (recipe 1)
Experimental	12	NCE** - (recipe 2)
Second fattening period 71-125 kg		
Control	12	NCB* - (recipe 3)
Experimental	12	NCE** - (recipe 4)

Note: NCB* - standard combined feed;
NCE** - experimental compound feed.

The research focused on studying the chemical composition and nutritional value of pumpkin seed cake and the combined fodder, morphological and biochemical parameters of blood, production performance, and economic indicators depending on the proportion of pumpkin seed cake in the rations.

In the recipes of combined fodder from experimental groups, the pumpkin seed cake had a participation rate of 4% (Recipe 2) and 7% (Recipe 4), while the quantity of soybean meal was reduced in the same proportions.

The combined fodder recipes for each fattening period were developed using the computerized program "HYBRIMIN," following current nutritional standards (Kalashnisov et al., 2003), and prepared in the feed production section of the designated enterprise. The chemical composition of pumpkin seed cake and the combined fodder used in the experiment was assessed using classical methods (Lebedev & Usovich 1976; Petukhova et al., 1989).

Animals selected were raised under the same spatial and microclimate conditions, with ad libitum feeding and daily recording of consumption. Access to water was provided continuously.

Animals were selected using classical methods (Ovsyannikov, 1976). At the beginning and end of the experiment, blood samples were collected from three piglets in each group and analyzed using the STAT FAX-3300 biochemical analyzer.

The chemical composition of the meat (water, protein, fat, collagen) from the Longissimus dorsi muscles was evaluated using the computerized program "Scanlab NIT 98".

Biometric data processing and testing the significance of differences were conducted using the computerized program EXCEL, employing classical methods (Plokhinsky, 1978).

RESULTS AND DISCUSSIONS

Pumpkin seed cake with shells (residue obtained from cold-pressing pumpkin seeds for oil extraction) was acquired from ISC "Azamet" Pro, Ciadir-Lunga, Republic of Moldova. Based on organoleptic analysis, it was determined that the pumpkin seed cake with shells consists of granules of various sizes, exhibiting a range of colors from brown to light gray with greenish shades characteristic of pumpkin seeds (Figure 1). It has a pleasant

cereal-like aroma and a subtly sweet taste without any foreign tastes.

Figure.1 Pumpkin seed cake with crust

As a result of the chemical composition analysis, it was determined that pumpkin seed cake with shells is a valuable protein supplement containing up to 40.5% crude protein, with a significant proportion of crude fiber at 28.07%. Pumpkin seed cake obtained through cold-pressing contains: nutritional units - 1.06; metabolizable energy - 11.21 MJ; crude protein - 40.5%; crude fat - 14.41%; crude fiber - 28.07%; non-nitrogenous extractive substances - 1.21%; calcium - 0.09%; phosphorus - 0.21%; with a sugar content of 2.29% and carotene content of - 4.50 mg/kg. According to current nutritional standards and the experimental design, using local ingredients, two new combined fodder recipes were formulated and tested for the fattening period (Table 2).

Table 2. Structure of the combined fodder recipes used in the experiment (%)

Ingredients	Fattening period			
	40-70 kg		71-125 kg	
	Control	Experim.	Control	Experim.
Corn	20.0	20.0	20.5	20.5
Barley	13.5	13.5	30.0	30.0
Wheat	30.0	30.0	23.5	23.5
Wheat bran	4.0	4.0	4.5	4.5
Soybean meal	17.0	13.0	12.0	5.0
Sunflower seed cake	6.0	6.0	4.0	4.0
Pumpkin seed cake	-	4.0	-	7.0
Fish meal	3.0	3.0	-	-
Premix	3.0	3.0	3.0	3.0
Zeolite	3.5	3.5	2.5	2.5
Total	100	100	100	100

According to the results of the chemical composition analysis, the nutritional value of 1 kg of combined fodder used during the 40-70 kg fattening period corresponded to the following values for the groups: crude protein - 175.20; 179.24 g/kg, metabolizable energy - 10.44; 10.75 MJ/kg, crude fat - 52.08; 52.83 g/kg, crude fiber - 55.32; 42.31 g/kg, non-nitrogenous extractive substances - 53.41; 55.79%, calcium - 0.79; 0.61%, nutritional units - 0.87; 0.90%. For the 71 kg to slaughter fattening period, the values were: crude protein - 153.96; 152.46 g/kg, metabolizable energy - 10.90; 10.73 MJ/kg, crude fat - 58.41; 79.09 g/kg, crude fiber - 70.08; 101.6 g/kg, non-nitrogenous extractive substances - 57.25; 48.50%, calcium - 0.43; 0.47%, nutritional units - 0.91; 0.89%. These values complied with nutritional standards (Kalashnisov, 2003).

The biological test was conducted at the reproduction, growth, and fattening unit IE "Secrieru Aliona" in Stoianovca village, Cantemir district, Republic of Moldova, involving 24 three-way crossbred piglets (Yorkshire x Landrace x Duroc) over a period of 112 days, with the first fattening period (40-70 kg) comprising 50 days and the second fattening period (71 kg to slaughter) lasting 62 days. The test animals were randomly allocated into two homogeneous groups, each with 12 piglets, with an initial average weight per group of 40-41 kg.

Replacing soybean meal with pumpkin seed cake at proportions of 4% and 7% did not significantly affect the feed intake, and the average daily feed consumption had values of 2,934 kg and 2,944 kg, respectively, corresponding to the groups.

The study of the live weight dynamics revealed that the animals in the control group had a slower growth rate compared to those in the experimental group and exhibited lower average daily weight gain rates.

During the testing period, the live weight obtained was 86.25 kg/head for animals in the control group and 88.42 kg/head for animals in the experimental group, representing an increase of 2,170 kg (2.52%) in the experimental group (Table 3).

Table 3. Evolution of live weight dynamics and daily weight gain

Specifics		Lot	
		Control	Experimental
Live weight, kg	at the beginning of the experiment	39.75±0.809	41.42±0.552
	end of I growth periods	72.75±0.577	74.58±0.623
	end of experience	126.00±0.932	129.00±1.205
Growth increase, kg	in the first period	33.00±0.532	31.17±0.343
	in the second period	53.25±1.182	55.25±1.256
	in the experiment	86.25±1.311	88.42±1.049
Average daily gain, g	in the first period	660±9.621	663±6.210
	in the second period	859±19.060	891±20.263
	in the experiment	770±11.709	789±9.365
Feed consumption, kg per 1 kg of gain		3.810	3.730

The best results for average daily gain in the second fattening period were observed in the experimental group with 891 g, representing a 3.73% increase compared to the control group with 859 g. It's worth noting that over the 112 days of the experiment, the average daily gain in the control group was 2.3% lower than in the experimental group. The best feed conversion ratio was achieved by piglets in the experimental group II, which was by 80 g lower than in the control group, representing a 2.1% improvement.

It was determined that the use of pumpkin seed cake in the diet of fattened piglets in various proportions did not have a negative impact on blood parameters.

Based on the results of blood parameter analysis at the end of the experiment, several positive points regarding the studied parameters in the groups of piglets under study can be mentioned. The total protein content in the blood serum of piglets in the control group increased from 62.20 g/l at the beginning of the test to 82.49 g/l at the end of the test, an increase of 20.29 g/l. In the experimental group, the total protein content increased from 68.78 g/l to 81.77 g/l, an increase of 12.99 g/l.

It is noteworthy that at the end of the experiment, the albumin content showed small fluctuations and ranged from 22.83 g/l to 18.57 g/l, with deviations within the acceptable physiological norms (20-60 g/l). In our research, the amount of uric acid in the blood, an indicator characterizing the activity of renal functions, ranged from 5.27 mmol/l in the control group to 3.25 mmol/l in the experimental group, falling within the permissible physiological norms (2.8-8.8 mmol/l). The study of blood serum indicators demonstrates that the combined fodder recipes used in the experiment do not significantly alter the blood parameters (Figure 2). This suggests normal functioning of all organs and systems in the animals from both groups.

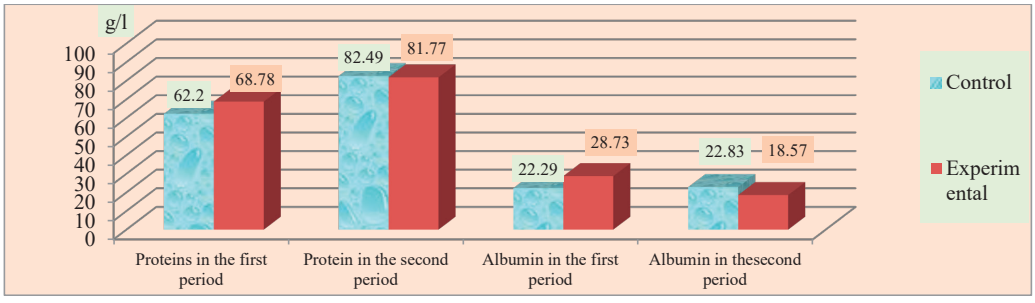

Figure 2.The amount of protein and albumin in the blood serum (g/l)

In the objective assessment of pig carcasses, slaughter yield represents a criterion that is highly important both quantitatively and qualitatively. We found that sows in both groups achieved good carcasses with a relatively high slaughter yield (hot carcass weight) of 78.10% in the control group and 80.53% in the experimental group. According

to this index, the animals in the experimental group exceeded the control group by 2.43%.
The main characteristics influencing carcass quality in pigs are the thickness of the dorsal fat layer, carcass length, and the proportion of meat, especially high-quality meat, which is closely related to the surface of the Longissimus dorsi muscle eye (Dinu et al., 1993). According to the results obtained, there is a trend of reducing the thickness of the back fat layer at the 6/7 thoracic vertebra by 4 mm and the spine by 2 mm in the carcasses of sows from the experimental group. Both groups of sows showed a uniform deposition of thin fat at the rump, with an average of 18.67 mm (Table 4).

Table 4. Formation of fat layer thickness (mm)

Carcass region	Lot	
	Control	Experimental
6/7 thoracic vertebra	33.33±3.342	29.33±2.483
Spine	25.00±3.674	23.00±2.550
Hams	20.33±0.408	21.00±1.871
Rump	18.67±0.816	18.67±1.633
Chest	19.00±0.707	21.67±2.858
Abdomen	13.67±2.677	14.66±0.408

Among the dimensional determinations, the large length of the carcass is important. The larger it is, the more extended loin and hams we will benefit from. The measurements of the large length (Table 5) demonstrate that the carcasses of animals in the experimental group were by 1.2 cm longer than those in the control group.

Table 5. Main measurements of sacrificed pig carcasses (cm)

Indices	Lot	
	Control	Experimental
Lomg length	128.8±1.814	130.0±3.742
Short length	97.3±0.965	97.2±0.736

Regardless of the administered recipes, both in the control and experimental groups, the small length of the carcasses was almost the same, with an average value of 97 cm.
It is well known that in increasing pork production, an important role is played by the development and appreciation of the Longissimus dorsi muscle. Based on the measurements and calculations performed, it was established that all sacrificed piglets produced long carcasses with a muscle eye area of 41.98 cm² in the control group and 42.69 cm² in the experimental group, as shown in Figure 3.

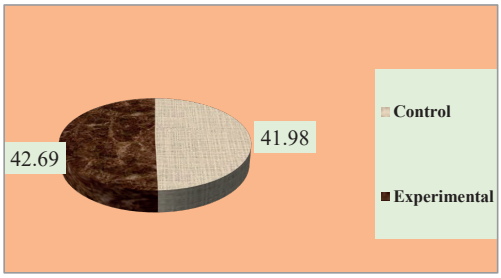

Figure 3. Eye muscle area (cm²)

The muscle eye area was larger in the experimental group by 1.69%.
Since the ham is a region that provides high-quality and substantial meat, our investigations confirmed that animals from both groups produced heavy hams, weighing 11,567 kg and 11,767 kg, respectively. The hams of piglets from the experimental group were heavier by 200g compared to those from the control group, representing a 1.73% increase (Figure 4).

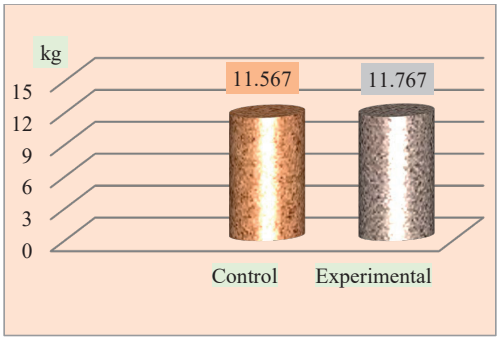

Figure 4. Ham weight (kg)

In the muscle tissue of sacrificed animals, the water, protein, and collagen content varies within relatively narrow limits. Animals that consumed a feed mix containing pumpkin seed cake showed a tendency to increase the fat content, providing the meat with tenderness, juiciness, and high energy value. The meat of piglets from the experimental group recorded an increased fat content of 4.5%, surpassing the control group by 0.70% (Figure 5).

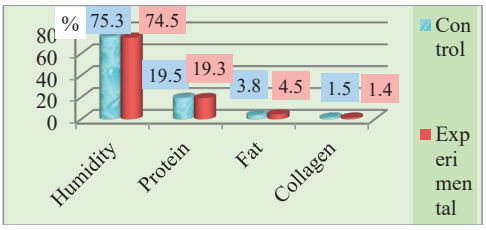

Figure 5. Chemical composition of meat (%)

The economic efficiency of using pumpkin seed cake in pig feeding was calculated based on the absolute weight gain of the animals during the experiment, the cost of 1 kg of absolute weight gain, the consumption of combined fodder, the cost of combined fodder, and the cost of pumpkin seed cake with shells. It was determined that the use of pumpkin seed cake with shells reduces the cost of 1 kg of combined fodder during the growth-fattening period by 9.4 cents (2.7%) and 16.7 cents (6.2%) during the finishing period.

Substituting soybean meal in combined fodder recipes with pumpkin seed cake at proportions of 4% and 7% resulted in an economic benefit per animal, with a weight gain effect of 5.88 euros per head and a reduction in the cost of combined fodder of 4.74 euros per head.

The use of pumpkin seed cake in pig diets led to an economic benefit of 10.62 euros for each pig raised and fattened.

CONCLUSIONS

Based on the obtained data, we can conclude that pumpkin seed cake with shells is a valuable protein supplement. Due to its good organoleptic qualities, it can be positioned as a high-ranking source of plant-based protein and can be accepted for use in the feeding of growing and fattening pigs.

The tests showed that substituting soybean meal with pumpkin seed cake at proportions of 4% in the first period and 7% in the second fattening period provides an average daily weight gain of 789 g, slaughter yield (hot carcass weight) of 80.53%, backfat thickness at the 6/7 thoracic vertebrae of 29.33 mm, at the spine of 23.00 mm, at the rump of 18.67 mm, eye muscle area of 42.69 cm², ham weight of 11,767 kg, and fat content in the *Longissimus dorsi* muscle of 4.53%.

The research results indicate that pumpkin seed cake with shells is a viable solution for the partial replacement of soybean meal in the diets of fattening pigs, as it reduces the cost per kg of combined fodder by 2.7% in the first period and 6.2% in the second fattening period, resulting in an economic benefit of 10.62 euros for each piglet raised and fattened.

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