Szkoła Główna
Politechniczna z siedzibą
w Nowym Sączu

GENERAL AND COMPLEX PROBLEMS OF TECHNICAL SCIENCES: EXPERIENCE OF EU COUNTRIES AND IMPLEMENTATION IN THE PRACTICE OF UKRAINE

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USE OF PEA CONCENTRATE IN MIXED FODDER'S PRODUCTION

Makarynska A. V., Turpurova T. M.

INTRODUCTION

The need for high-grade protein is increasing due to the accelerated development of industry, the production of broilers, meat and bacon pork, as well as the intensive fattening of young cattle.

Most feed mills are trying to reduce the cost of the finished feed by replacing some components without losing the balance of the finished product by optimizing the feed recipe. At the same time, the main critical points in the calculation of compound feed recipes are their balancing in terms of crude protein content and metabolizable energy.

There are several ways to provide animal rations with protein:

- increase in gross production of vegetable protein;
- breeding plant varieties with a high content of protein and the best amino acid composition;
- expansion of production of protein concentrates and isolates;
- expansion of fodder yeast production;
- use of protein feed substitutes;
- use of animal feed.

Currently, the production of various types of feed meal of animal origin in Ukraine has decreased dramatically due to the reduction of livestock of farm animals and poultry, as well as the introduction of resource-saving technologies for processing animal raw materials into food[1].

Today, the feed market has fish meal substitutes, fake fish meal, as well as flour with increased bacterial contamination, which can lead to deterioration of feed or the production of poor quality products.

At the same time, according to the Law of Ukraine No. 2264-VIII dated December 21, 2017 "On safety and hygiene of feed", the use of feed of animal origin is prohibited, therefore, the use of vegetable protein concentrates (VPC) in feeds is relevant. VPC allow you to achieve the desired balance of crude protein, as well as a certain ratio of essential amino acids in the feed.

Depending on the degree of protein purification, its concentration after the enzymatic treatment, different types of protein products are obtained. So:

[1] Мустафин А.С. Горох в комбикормах для кур-несушек. URL: https://www.dissercat.com/content/gorokh-v-kombikormakh-dlya-kur-nesushek.

– if the protein concentration in the hydrolyzed product is 50%, it is called the hydrolysate;

– at a concentration of 70–75% – the concentrate;

– at a concentration over 75% – the protein isolate.

The need for hydrolysis is due to the presence in the raw material of a special type of protein – keratin, which is a chemically resistant, hard-to-digest substance[2].

The main raw materials for the production of VPC are leguminous crops – soybeans, peas, chickpeas, which give much more protein per unit of area compared to cereals and one of the cheapest vegetable proteins[3].

With the introduction of peas in the feed it's must pay attention to the presence of α-galactosidase, which at high concentrations can lead to disruption of the gastrointestinal tract and swelling. With wet feeding, due to the ability to swell, peas can be maximally incorporated into the compound feed composition up to a maximum of 20% (Tabl. 1).

Table 1

Norms of the introduction of high-protein raw materials in feed for feeding farm animals [3]

Types of animals	Norms of introduction to compound feed,%			
	Peas	Soybean meal	Meat and bone meal	Fish meal
Young birds of an agricultural bird	0…10	0…20	0…4	2…10
Adult poultry	0…12	0…15	0…7	0…7
Small Pigs	0…10	0…15	0	2…6
Pigs	0…20	0…10	0…5	0…4
Cattle				

[2] Макаринська А.В., Чернега І.С., Оганесян А.А. Переваги використання білкових рослинних концентратів у виробництві комбікормової продукції. *Зернові продукти і комбікорми.* 2018. № 3 (71). С. 34–39. DOI: 10.15673/gpmf.v18i3.1077.

[3] Єгоров Б.В. Технологія виробництва комбікормів. Одеса : Друкарський дім, 2011. 448 с.

Burstin J., Duc G. Protein content and protein composition of pea seeds. The relationship between protein content and protein composition of pea seeds. *Grain Legumes*, 2006. V. 44. P. 16–17.

Кудинов П.И., Щеколдина Т.В., Слизькая А.С. Современное состояние и структура мировых ресурсов растительного белка. *Известия вузов. Пищевая технология.* 2012. № 5–6. С. 7–10.

Егоров Б.В., Давиденко Т.М. Повышение эффективности использования кормового потенциала зерна при производстве комбикормовой продукции. *Наукові праці ОНАХТ.* Одеса: 2007. Вип. 30. Т. 2. С. 76–79.

Єгоров Б.В., Турпурова Т.М. Розробка енергозберігаючої технології виробництва комбікормів для сільськогосподарських тварин. Procesing of III International Conferernce. *Strategy of Quality in Industry and Education*, June 4–11, 2010. Varna, Bulgaria. V.1.

Feed of animal origin, namely fish and meat and bone meal, the most scarce and valuable components in the production of animal feed (Fig. 1).

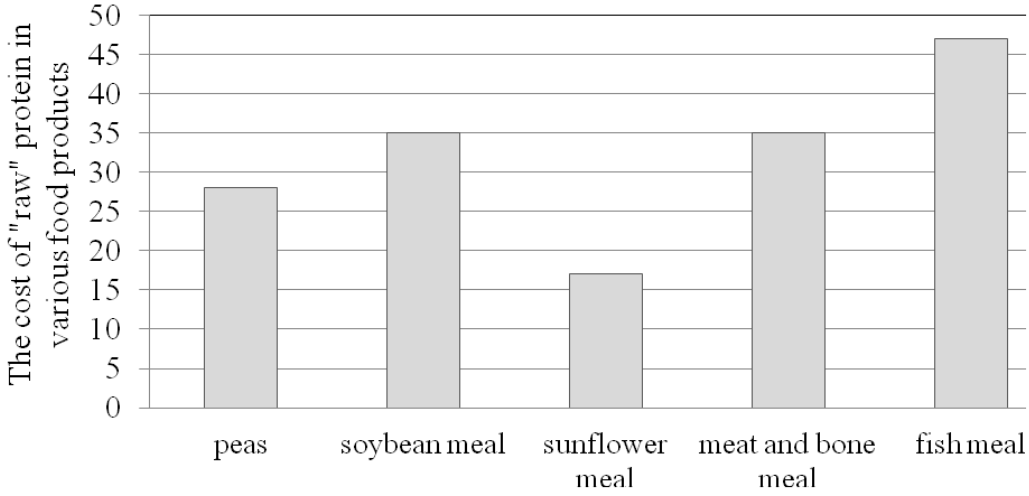

Fig. 1. The cost of "raw" protein in various food products

The *purpose of the work* is to study the effectiveness of the use of pea concentrate in the production of extruded pig feed.

Objectives of the study:

– to analyze and characterize the existing methods of preparing peas in the production of animal feed, as well as vegetable pea concentrates (VPC);

– to investigate the physical-chemical properties of the VPC;

– calculate recipes for complete feed using VPCC;

– to develop technological methods for the introduction of VPC in the production of animal feed;

– to determine the physical properties of compound feeds using VPC;

– to evaluate the biological effectiveness of VPC.

1. Literature review

Over the past five years, Ukraine has seen an increase in acreage and pea production (Fig. 2). Growing peas is attractive, the ability to restore soil fertility and the profitability of this crop is 55%[4].

[4] Лищенко В.Ф. Мировая продовольственная проблема: белковые ресурсы (1960–2005 гг.). Москва : Делипринт, 2006. 272 с.

Grosjean F., Bastianelli D., Bourdillon A., Cerneau P. Feeding value of pea (Pisum sativum, L.) 2. Nutritional value in the pig. *Animal Science.* 1998. V. 67. № 3. P. 621–625. DOI: 10.1017/S1357729800033063.

Pea grain is an excellent source of protein, which has a high solubility (the amount of water- and salt-soluble fractions reaches 90%). Depending on the variety and pea cultivation technology, the protein content is 21–27% (Tabl. 2)[5].

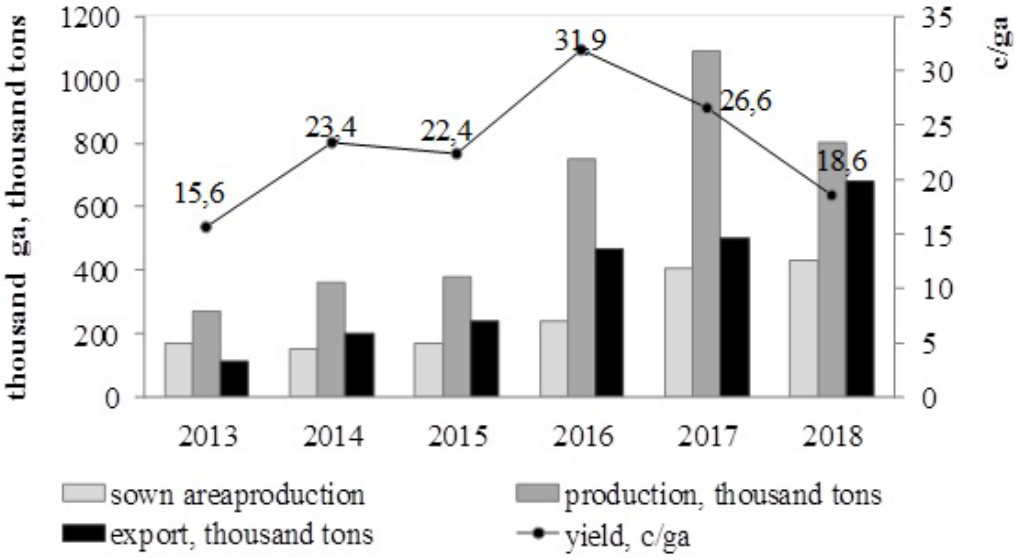

Fig. 2. Dynamics of pea production in Ukraine

The biological value of pea protein depends on its amino acid composition, the presence of methionine, cystine, tryptophan and threonine. With the introduction of peas in the feed must pay attention to the amount of sulfur-containing amino acids – methionine and cystine. This is due not only to the presence of trypsin inhibitors (pancreatic enzyme), which reduces the rate of separation of amino acids from the protein molecule, mainly methionine. The amount of enzymes – trypsin inhibitors – in the pea grain is in the range from 3 to 18.2 g/kg, depending on the variety[6].

[5] Jansman A.J.M. Bioavailability of protein single gumeseeds. *Grain Legumes,* 1996. № 11. P. 19.

[6] Stein H.H., Benzoni G., Bohlke R.A., Peters D.N. Assessment of the feeding value of South Dakota-grown field peas (Pisum sativum L.) for growing pigs. *Journal of Animal Science.* 2004. V. 82. № 9. P. 2568–2578. DOI: 10.2527/2004.8292568x.

Table 2

Content of nutrients in feed[7]

Nutritional value	Soybean	Peas	Soy-bean meal	Soy-bean cake	Sun-flower schrot	Fish meal	Meat and bone meal
OE, MJ / kg	14,7	11,1	12,4	12,9	10,6	10,5	10,0
Protein,%	34,0	21,2	42,0	35,6	42,9	59,1	41,8
Cellulose,%	5,0	6,5	7,0	7,3	14,4	14,2	6,9
Lysine,%	2,10	1,41	2,71	2,26	1,42	4,7	35,3
Methionine,%	0,40	0,20	0,60	0,45	0,8	1,2	5,5
Cystine,%	0,50	0,27	0,63	0,49	0,87	1,4	5,9
Tryptophan,%	0,36	0,17	0,59	0,55	0,99	5,3	5,1
Ca,%	0,30	0,14	0,38	0,42	0,36	0,59	0,94
P,%	0,55	0,37	0,65	0,63	0,65	0,33	0,48
Na,%	0,03	0,03	0,04	0,04	0,04	0,17	0,08

All anti-nutritional substances contained in pea grains are partially destroyed by heat treatment, although to varying degrees, depending on the treatment regimes[8].

A known technology for the production of feed protein products from green mass of legumes. The green mass of peas after mowing and grinding is fed to the press in presses, and then coagulated to obtain a protein paste, which is then sent for drying. Protein paste from green peas contains 44–65% of crude protein, 2–4% fat, 4–7% fiber, used in feeding young farm animals[9].

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[7] Stein H.H., Benzoni G., Bohlke R.A., Peters D.N. Assessment of the feeding value of South Dakota-grown field peas (Pisum sativum L.) for growing pigs. *Journal of Animal Science.* 2004. V. 82. № 9. P. 2568–2578. DOI: 10.2527/2004.8292568x.

Экспертиза кормов и кормовых добавок : учебно-справочное пособие / Мотовилов К.Я. и др. Новосибирск : Сиб. унив. изд-во, 2004. 303 с.

Петрухин И.В. Корма и кормовые добавки : справочник. Москва : Росагропром-издат, 1989. 526 с.

[8] Martens S.D., Tiemann T.T., Bindelle J., Peters M., Lascano C.E. Alternative plant protein sources for pigs and chickens in the tropics – nutritional value and constraints: a review. *Journal of Agriculture and Rural Development in the Tropics and Subtropics*. 2012. V. 113. № 2. P. 101–123.

Grosjean F., Bastianelli D., Bourdillon A., Cerneau P. Feeding value of pea (Pisum sativum, L.) 2. Nutritional value in the pig. *Animal Science.* 1998. V. 67. № 3. P. 621–625. DOI: 10.1017/S1357729800033063

[9] Петрухин И.В. Корма и кормовые добавки : справочник. Москва : Росагропром-издат, 1989. 526 с.

The most effective is the use of roasted peas in the composition of animal feed for ruminants and extruded peas in the composition of animal feed for pigs, especially piglets[10]. V. Golushko and A. Golushko in their research compared various methods of heat treatment of pea grain. It was found that after extruding pea grain, the content of trypsin inhibitors decreased by 19.7%, and that of chymotrypsin, by 28.1%. Granulation made it possible to reduce these figures by 18.2 and 27.5%, respectively. Thus, only extrusion most improves the feed value of pea grains[11].

Recently, pea protein appeared on the world market, which meets the technological requirements for isolates[12]. Pea protein is a type of protein supplement, which is obtained from ordinary peas according to the technological scheme presented in fig. 3[13]. Pea protein is a pea protein isolate with a protein content of up to 90%. It has many advantages in comparison with other vegetable proteins:

– functional ingredient – has water and fat binding properties;

– safe – the vegetable origin of the protein is easily identified, does not contain genetically modified organisms;

– useful – is a concentrated source of easily digestible protein and its amino acid composition is close to the “ideal protein”;

– technological – due to the granular form of the product, the formation of dust, foam and lumps during the production process is reduced.

– has a neutral taste.

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[10] Макаринська А.В., Чернега І.С., Оганесян А.А. Переваги використання білкових рослинних концентратів у виробництві комбікормової продукції. *Зернові продукти і комбікорми.* 2018. № 3 (71). С. 34–39. DOI: 10.15673/gpmf.v18i3.1077.

Єгоров Б.В., Турпурова Т.М. Розробка енергозберігаючої технології виробництва комбікормів для сільськогосподарських тварин. Procesing of III International Conferernce. *Strategy of Quality in Industry and Education*, June 4–11, 2010. Varna, Bulgaria. V.1.

[11] Stein H.H., Benzoni G., Bohlke R.A., Peters D.N. Assessment of the feeding value of South Dakota-grown field peas (Pisum sativum L.) for growing pigs. *Journal of Animal Science.* 2004. V. 82. № 9. P. 2568–2578. DOI: 10.2527/2004.8292568x.

[12] Shand P.J., Ya. H., Pietrasik Z., Wanasundara P.K.J.P.D. Physicochemical and textural properties of heat-induced pea protein is olategels. *Food Chemistry,* 2007. V. 102. P. 1119–1130.

Бобков С.В., Уварова О.В. Перспектива использования гороха для производства изолятов запасных белков. *Земледелие,* 2012. С. 47–48.

Компанцев Д.В., Попов А.В., Привалов И.М., Степанова Э.Ф. Белковые изоляты из растительного сырья: обзор современного состояния и анализ перспектив развития технологии получения белковых изолятов из растительного сырья. *Современные проблемы науки и образования*. 2016. № 1.

[13] Хрулев А.А., Бесчетникова Н.А., Федотов И.А. Тенденции развития и экономические аспекты производства горохового протеина. *Пищевая промышленность.* № 4. 2016. С. 24–28.

Today pea protein is used in the meat, fish, dairy, oil and fat and confectionery industries[14]. Pea protein, namely pea insulated protein NUTRALYS®, is used in meat processing plants.

NUTRALYS® pea insulated protein is produced by ROQUETTE at a pea processing plant in Northern France.

Pea insulated protein is added during the preparation of minced meat in hydrated form, replacing a certain amount of lean meat raw materials. The results of the studies indicate the feasibility of using pea protein in the production technology of boiled sausages[15].

Pisane® Pea Protein Isolate, a natural, highly purified plant vegetable derived from the seeds of traditional yellow peas, is produced in Belgium by Cosucra Groupe Warocoing. Due to its high nutritional value, digestibility and lack of contraindications, Pisane® is used in the production of specialized types of food (sports, dietary), as well as in the production of fortified and vegetarian products. Pea protein can replace up to 50% caseinate in the production of cheese products[16].

Pea protein contains a full complex of all essential amino acids and has a high bioactivity. The content of essential amino acids in pea protein compared to the reference protein is shown in Fig. 4.

Pea protein satisfies almost all of the requirements for the protein standard amino acid composition[17]. The use of pea protein in the production of feed products is a very promising direction. Replacing flour of animal origin with pea protein in animal feed will significantly reduce the import of this raw material, reduce the cost of the finished feed.

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[14] Шелепина Н.В. Использование продуктов переработки зерна гороха в пищевых технологиях. *Известия вузов. Прикладная химия и биотехнология,* 2016. № 4, Том 6. С. 110–117.

Магзумова Н.В., Малиновская Е.Е., Келешян М.В. Изучение возможности применения горохового белка при производстве колбас варёной ассортиментной группы. *Харчова наука і технологія,* 2013. № 2. С. 20–22.

Улицкий З.З. Гороховый протеин для переработчиков мяса – не только функциональная добавка. *Мясной Бизнес*. 2009. № 3. С. 22.

[15] Магзумова Н.В., Малиновская Е.Е., Келешян М.В. Изучение возможности применения горохового белка при производстве колбас варёной ассортиментной группы. *Харчова наука і технологія,* 2013. № 2. С. 20–22.

[16] Гороховый белок, Бельгия. URL: https://agroserver.ru/b/gorokhovyy-belok-belgiya-362657.htm.

[17] Хрулев А.А., Бесчетникова Н.А., Федотов И.А. Тенденции развития и экономические аспекты производства горохового протеина. *Пищевая промышленность.* № 4. 2016. С. 24–28.

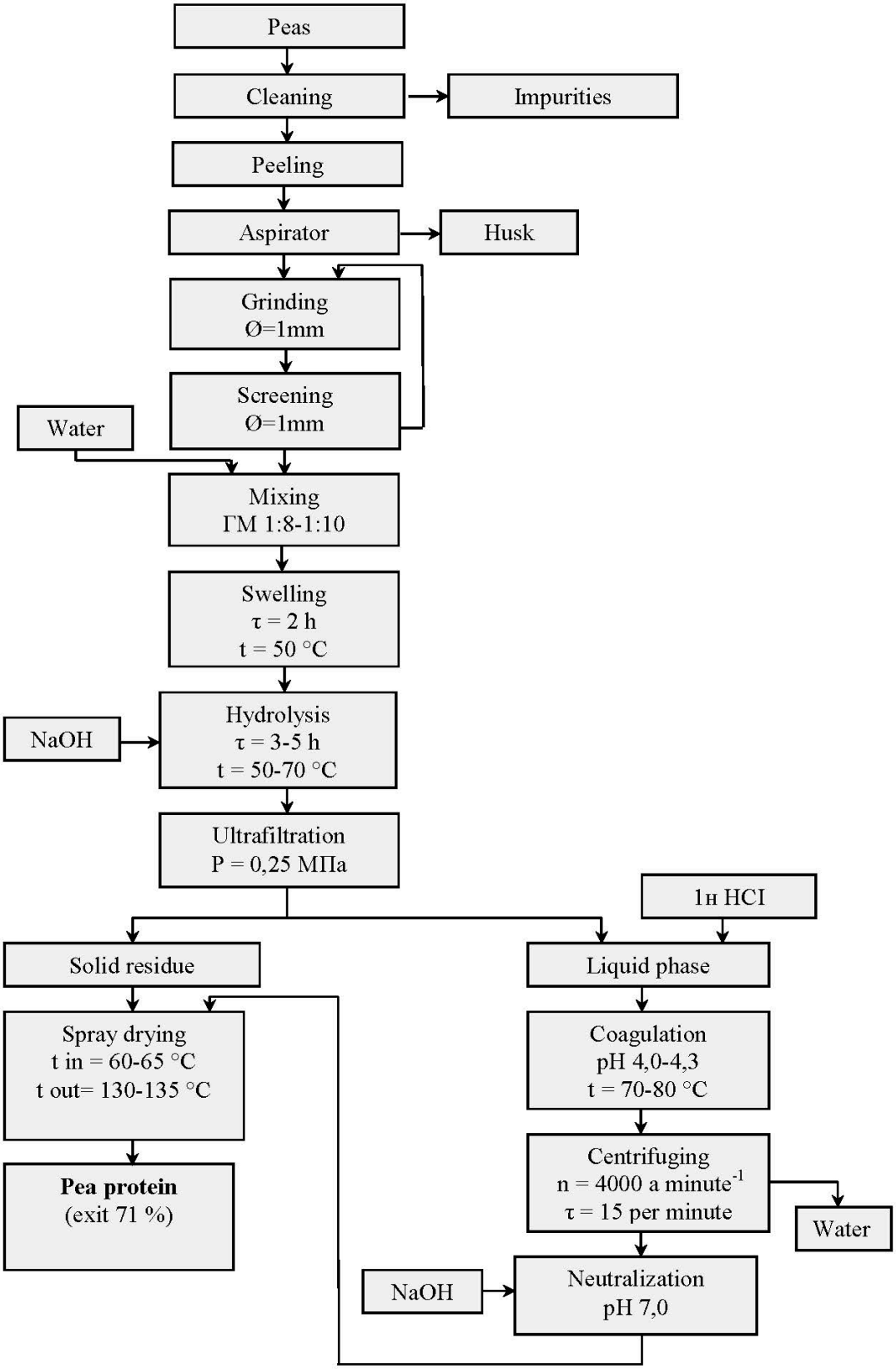

Fig. 3. Technology of pea protein production

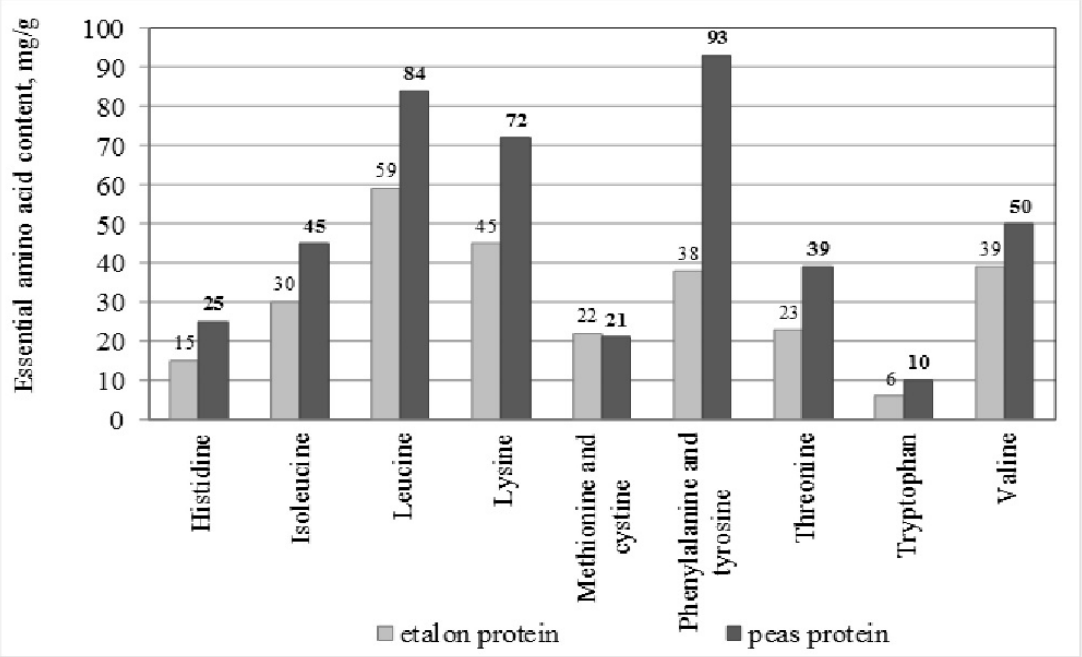

Fig. 4. Comparison of amino acid composition of pea protein with reference protein according to FAO/WHO 2013

2. Materials and methods

In the manufacture of feed additives “N.S. Moroz” variety of peas were used as the raw materials. Extrusion of additive has been carried out with grain extruder EZ-150 (Figure 5) at a temperature of 110...120°C and a pressure of 2...3 MPa.

Fig. 5. Extruder EZ-150 (Bronto, CherkasyElevatorMash)

Feed additives has been assessed by physical parameters such as moisture content, bulk density, modulus size, flowability, angle of repose, index of extrudate expansion.

Moisture content was determined by drying the sample of the product in the weighting cup in the drying oven at a temperature of 130°C for 40 min. and was calculated using the formula:

$$W = \frac{q_1 - q_2}{q_1 - q_0} * 100, \%, \quad (1)$$

where q_0 – mass of empty weighting cup, g; q_1 – mass of weighting cup with a lifting bar before drying, g; q_2 – mass of weighting cup with a lifting bar after drying, g.

Extrudate expansion ratio was determined by extrudate diameter to the diameter of the outlet of the extruder matrixes.

Bulk weight of additive has been determined with a half-liter grain-unit scale, which consists of jack, filler, cylinder head, bailer, knife, puller and measurer. The cylinder was closed with funnel, put down on filler with bailer and after the product was poured in filler, the cylinder with bailer has been removed. The knife was removed faster from the crack and after the puller and the product fell in the measurer the knife was again gently inserted into the slot. Then the measurer with the filler has been removed from the jack, overthrown, holding the knife and the filler, and poured the excess remaining on the knife. Then the knife has been removed from the crack, the measurer with the product has been weighed and the nature of the product was set up accurate within ± 0.5 g.

Angle of natural repose was determined by the product pouring from the filler on a horizontal surface. The product has been poured through a metal funnel that has a cone angle of 60°, until the top reached the height of vertical walls of the device. There has been performed protractor angle measurement. For this the protractor has been applied to the cone generatrix and determined by screeching angle β. Then the angle of natural repose α was considered as: $\alpha = 90 - \beta$.

Flowability has been determined by the method of pouring the product through hole of a certain size (diameter 4 cm). The product was poured in a box with the outlet, which was closed with the latch. To determine the product flowability the latch has been open and the time of pouring of the product through the outlet on a horizontal surface has been noted. Volume of poured product was measured with the cylinder. Flowability was determined by the formula:

$$V = \frac{q}{S*t}, cm/s, \quad (2)$$

where q – volume of product that passed through the hopper outlet, cm^3; t – duration of pouring of the product, s; S – cross-section area of the outlet, cm^2.

Determining the size of the module was performed on a laboratory plansifter. Sample of the product on the top sieve placed laboratory plansifter, closed the lid

and sieved for 5 minutes at 190...210 sieve oscillations per minute. After sifting weighed stairs on each sieve.

Size modulus determination has been carried out with the help of the laboratory diffuser. Sample of the product was placed on the top sieve of the laboratory diffuser, then it was closed with the lid and sieved for 5 minutes at 190...210 sieve oscillations per minute. After sifting remaining residue on each sieve were weighed.

The size modulus was determined by the formula:

$$M = \frac{3.5*m_1+2.5*m_2+1.5*m_3+0.78*m_4+0.28*m_5}{100}, mm, \quad (3)$$

where m_1, m_2, m_3, m_4 – mass of remaining residue from the sieves with holes Ø 3, Ø 2, Ø 1, Ø 0.56 mm, g; m_5 – mass of passage with holes Ø 0,56 mm, g; 3.5; 2.5; 1.5; 0.78 – the average size of the particles remaining on sieves with holes Ø 3, Ø 2, Ø 1, Ø 0.56 mm, accordingly, mm; 0.28 – the average size of the particles, which passed through a sieve with holes Ø 0.56 mm; 100 – mass of the sample taken for the analysis, g.

All tests were performed at 3-fold review of measurements and experimental results have been processed by software (Mathsoft, Inc., USA; Mathcad Professional)[18].

3. Results of research and discussion

In this work, NUTRALYS® VPCs were used, for which the physicochemical properties were studied, the results of the studies are presented in Table. 3

The study of the physical properties of VPC allows you to choose the right conditions and storage modes, technological modes of preparation of raw materials, the angle of gravity, the design and the angle of the bottom of the bunkers.

If you're introducing VPC into combined feed:

– preparation of mineral raw materials and meals;

– through the composition of the protein-vitamin supplements, protein-vitamin-mineral supplements;

– on the line of extrusion of leguminous crops;

– on the line of extrusion of ready loose feed;

– as a filler on the premix production line[19].

[18] Yegorov B., Makarynska A., Cherneha I., Oganesian A. Scientific and practical basis of using protein plant concentrates for the production of compound feeds. *Food science and technology.* 2018. Vol. 12, Issue 4. P. 94– 101. DOI: http://dx.doi.org/10.15673/fst.v12i4.1205.

[19] Технологія виробництва premіксів / Б.В. Єгоров, О.І. Шаповаленко, А.В. Макаринська. Підручник. Київ : Центр учбової літератури, 2007. 288 с.

Table 3

Organoleptic and physical-chemical indicators VPC NUTRALYS®

Name of indicator	Content, characteristics and value of indicators
Organoleptic characteristics	
Appearance, shape and particle size	Fine floor without lumps, 90% of particles less than 38 microns
Taste, smell	Sweetish with a faint taste and smell inherent in the original raw materials
Colour	Light-yellow inherent in raw materials
Physical and chemical indicators	
Moisture content,%	8,15
Mass fraction of protein,% on c.d.s.*	54,78
Mass fraction of fiber,% on c.d.s.	3,05
Fat content,% on c.d.s.	3,85
Mass fraction of ash,% on c.d.s.	5,00
Mass fraction of fiber,% on c.d.s.	1,50
Mineral impurities	No

* *c.d.s. – completely dry substance.*

Table 4

Recipes feed for young pigs 2–4 months old

Component	Content,%		
	Control recipe 1	Recipe 2	Recipe 3
Wheat	20,00	9,50	10,00
Barley without films	9,35	40,00	39,30
Oat without films	30,00	20,00	19,00
Corn	6,40	-	-
Wheat bran	5,00	10,00	10,00
Sunflower meal СП 30%, СК 20%	11,00	4,90	6,55
Soybean meal СП 40%, СК 18%	10,00	8,00	7,00
Fish flour	4,91	-	-
Crushed peas	-	4,97	-
PVC	-	-	5,00
Lysine monohydrochloride 98%	0,09	0,18	0,18
Table salt	0,19	0,25	0,23
Chalk feed	0,13	1,20	1,20
Tricalcium phosphate	0,98	-	0,54
Limestone flour	0,95	-	-

Continuation of the Table 4

Premix П52-1 [25]	1,00	1,00	1,00
Nutritional value			
OE pigs Mj	13,5	13,5	13,5
Feed units	120,0	118,5	120,0
Crude protein	19,02	18,81	19,13
Crude fiber	5,01	5,05	5,00
Lysin	0,99	0,98	0,99
Metionin	0,36	0,38	0,35
Metionin+Cys	0,72	0,73	0,72
Ca	0,80	0,80	0,80
P	0,60	0,60	0,60
NaCl	0,30	0,40	0,30

In order to reduce the cost and increase the productive effect of animal feed for farm and domestic animals, we propose the replacement of fish meal in recipes at the PVC, as well as the production of animal feed in extruded form. Taking into account the need for nutrients were calculated and optimized using the software complex KormOptimaExpert (Voronezh), recipes of feed for repairing young pigs (Tabl. 4).

According to the calculated recipes, experimental batches of extruded feed were produced. For the obtained feeds, the main physical indicators were studied: mass fraction of moisture, angle of repose, bulk weight, flowability, size. The research results are presented in Table 5.

Table 5

Physical properties of extruded feed for young pigs aged 2–4 months

Indicator Value	Meaning		
	Recipe 1	Recipe 2	Recipe 3
Appearance	Homogeneous dry mix no lumps and mold		
Smell, color	Characteristic of the set of components		
Mass fraction of moisture,%	11,5	11,4	11,2
Angle of repose, hail	45	45	45
Flowability, cm/sec	3,12	3,25	3,18
Bulk density, kg/m^3	460	455	458
The modulus of size, mm	1,56	1,60	1,52

As can be seen from the data, the replacement in the recipe for young pigs aged 2–4 months fish meal on crushed peas or VPC does not significantly affect the performance of the physical properties of bulk feed. Thus, loose feed for young pigs using RGC is characterized by satisfactory physical properties.

The total nutritional value of compound feeds using RGCs was determined using a biological assessment, which is characterized by the final product of feeding, i.e. full-fledged, productive action – improving the physiological state of animals, increasing average daily weight gain and reducing feed costs.

To conduct a biological assessment of the effectiveness of animal feed, an in vivo experiment was conducted on laboratory animals. To do this, on the basis of the laboratory of biochemistry of the Institute of Dentistry of the Academy of Medical Sciences of Ukraine, two groups of white laboratory rats with an average live weight of 230 g were formed. The duration of the experiment was 14 days.

The productive effect of compound feed was evaluated by the average daily weight gain of rats and the conversion of feed. The research results are presented in Fig. 6 and Fig. 7.

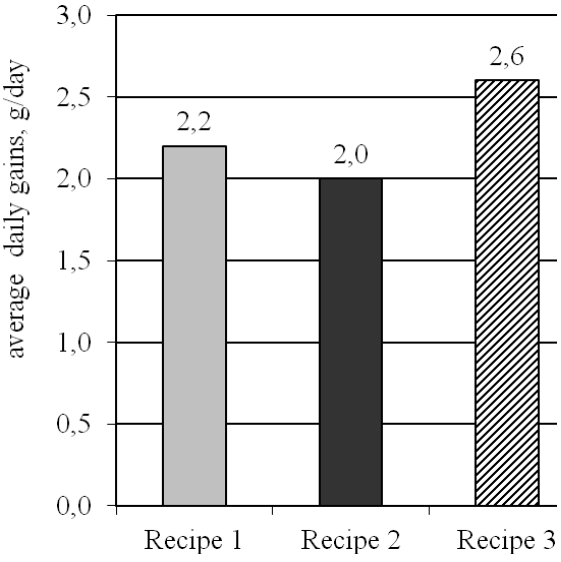

Fig. 6. Average daily gain of rats of the control and experimental groups

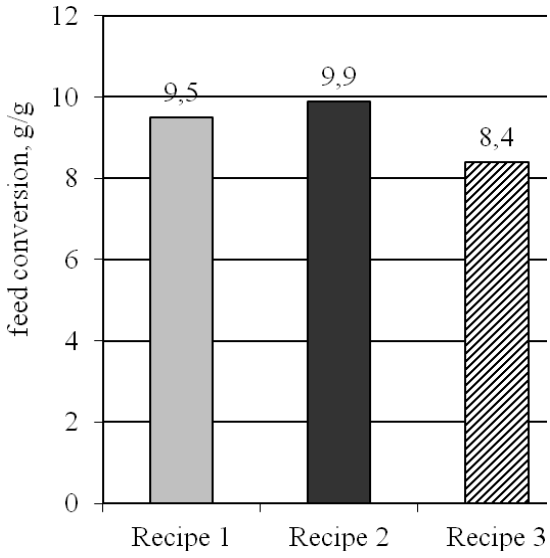

Fig. 7. Conversion of feed in the control and experimental groups

The average daily weight gains of rats in the control group were 2.2 g/day, and in the experimental group receiving feed according to the recipe of 3–2.6 g/ day, which is 18.2% more than in the control, respectively.

The cost of feed per 1 gram of increase in live weight of rats in the control group was 9.5 g/g, and in the experimental group – 8.4 g/g, which is 11.6% less than in the control group.

Thus, the obtained results indicate a high biological efficiency of the use of RGC in the diets of pigs.

CONCLUSIONS

The use of vegetable proteins can solve the problem of protein deficiency in the production of animal feed products. Analysis of the cost of “raw” protein and the amino acid composition of the s compared with other protein types of feed raw materials is economically beneficial in the production of animal feed.

Defined quality indicators of feed on the physical-chemical parameters. It has been established that the introduction of VPCs into the composition of mixed feeds does not affect the change in the physical properties of bulk mixed feeds.

Biological evaluation carried out on laboratory animals showed that mixed feed using VPC has high biological value, since the average daily increase in live weight in the experimental group was 18,2% higher than in the control group; the cost of compound feeds for the increase in live weight in the experimental group was 11,6% less than in the control group.

The use of VPCs as an alternative to an expensive source of protein, fish meal, helps to maintain the growth rate of animals and reduce the cost of compound feed.

SUMMARY

The problem of providing humanity with food, especially of animal origin, is one of the most important. Increasing the quantity and quality of these products can be achieved by increasing the population and increasing the productivity of farm animals, that is, increasing the proportion of protein components of the feed.

An important task for feed producers is to solve the problem of protein deficiency. An insufficient amount of protein in the diet or protein of unsatisfactory quality disrupts the normal functioning of the animal organism.

Today 70% of the cost of livestock products are feed. Analysis of the cost of feed shows that the most cost component – protein. The cost of compound feeds is significantly increased with the use of cost protein components: fish and meat and bone meal, yeast, soybean meal. Most of the high-protein components are imported into the country, their prices remain quite high, so the economic efficiency of the livestock industry is very low.

To reduce the cost of feed can be by introducing an inexpensive high-protein raw materials, namely peas and pea concentrate.

Peas – one of the main legumes, the use of which in the feeding of farm animals and poultry due to its feeding properties, relatively low cost and the

possibility of growing in almost any conditions. In contrast to carbohydrate-rich cereal and fat-rich oilseeds, pea culture is valued for its high content of biologically complete protein compared to protein from meat meal and soybean meal. Pea protein contains a significant amount of essential amino acids, well absorbed by animals.

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