International Transaction Journal of Engineering, Management, & Applied Sciences & Technologies

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PAPER ID: 11A05M

DEVELOPMENT OF TECHNOLOGY FOR PRODUCTION OF PROTEIN-VITAMIN GRANULATE

Sergei Dotsenko [1*], Lyudmila Kryuchkova [2], Viktor Samuylo [3]

[1] *Department of Building Production and Engineering Structures, Far Eastern State Agrarian University, RUSSIA*
[2] *Department of Higher Mathematics, Far Eastern State Agrarian University, RUSSIA*
[3] *Department of Operation and Repair of Transport-technological Machines and Complexes, Far Eastern State Agrarian University, RUSSIA*

ARTICLEINFO

Article history:
Received 06 April 2019
Received in revised form 19 November 2019
Accepted 09 December 2019
Available online 23 December 2019

Keywords:
Micro-additives; Production line; Feed technology; Mechanized feeding system; Feed binder; Vitamins; protein substances; Biological value; Compound feed.

ABSTRACT

This article presents the results of the development of a new method for the preparation of protein and vitamin granules of high biological value. An innovative method for producing protein and vitamin granules with a high content of protein substances in an amount of at least 30%, β-carotene at a level of 240 mg/kg, vitamin E 910 mg/kg with a pellet strength of at least 95% were substantiated and proposed. The implementation of this method in the system of mechanized feeding of animals and poultry on small and medium-sized farms allows you to prepare a feed product of high biological value with a significant reduction in costs, energy, labor, and funds.

Disciplinary: Animal Sciences (Animal Nutrition and Feed Technology).

1. INTRODUCTION

Despite certain advances in the science and practice of mechanized feeding of animals and birds, unresolved issues related to the preparation of feed products containing a combination of protein substances and vitamins in their concentrated form and in the form of additives.

Protein and Vitamin Supplements (PVS), protein-vitamin calcium supplements (BVKD) and others are homogeneous mixtures of high-protein fodder products and micro additives, crushed to the required size, used for the preparation of compound feed based on grain fodder.

Improving the efficiency of production of livestock and poultry products is possible only if there are feeding diets balanced for such basic nutrients as proteins, fats, carbohydrates, minerals, and vitamins (Zhitnikova, 2008).

At the same time, in the cost structure of livestock and poultry products from 50 to 60% and

*Corresponding author (Sergei Dotsenko). Tel: +7-989-99-87887. Email: lyudmila0511@mail.ru

higher falls on the share of feed.

At the same time, the harvested feed contains only 65 - 70% of the protein of its needs, so the deficit of its content is 1 unit makes up 19 - 20% (Melnikov, 1978).

This leads to a shortage of livestock and poultry products, cost overruns, reduced livestock, and poultry productivity, labor productivity and inefficient use of feed, which in turn increases production costs.

The so-called technology of fractionation of green plants in order to obtain protein-vitamin concentrate was not widely used.

This is due to the need to process large volumes of grass and only in the summer. In addition, the equipment developed for these purposes is cumbersome, and therefore metal- and energy-intensive (Mionchinsky, 1991).

The lack of technology for this purpose does not allow increasing the efficiency of agricultural production, especially on small and medium-sized farms.

The aim of the study is to substantiate the innovative method of producing protein-vitamin granulate (PVF), having a significant content of nutrients with the development of a technological and structural-technological scheme (STS) for its preparation.

2. MATERIALS AND METHODS

As the analysis of literary sources, as well as practice, shows today, methods are known for preparing concentrates formed into granules and briquettes in the form of an amide-concentrate additive (AKD), as well as granular concentrate.

According to the first option, an extruded mixture is prepared on the basis of the grain component, urea and a binder component in the form of sodium bentonite (white clay) (Dotsenko, et al., 2018).

According to the second variant, urea is dissolved in molasses, and the resulting solution is used as a binder component in the granulation of animal feed (Tutelian, 2005).

The disadvantages of these methods are the presence of toxic properties in urea, as well as the relatively low biological value of the finished product due to the lack of the original components containing fat-soluble vitamins in the form of β-carotene and tocopherol (vitamin E), as well as a number of other vitamins of the natural nature of their creation in synergism, providing antioxidant protection of a living organism (Stepanova, 1999).

In addition, these methods are material-intensive and energy-intensive, since their implementation requires labor costs for heating the binder component - molasses. Moreover, the use of urea-molasses solution does not allow to obtain granules of the required structural strength (Ostroumov, 1998).

Evaluate the effectiveness of the developed technological and technical solutions can be due to the following economic and mathematical model, which is the system of equations:

$$
\begin{aligned}
E_i &= \sum_{i=1}^{2} (C_{pi} - Z_E - C_{IC}) \times Q_i \times t \times k_i \to \max \\
PZ &= \sum_{i=1}^{2} (Z_E + E_H + K_i) \times Q_i \times t \times k_i \to \min \\
N_{UD} &= \sum_{i=1}^{2} N_i / \lambda \times Q_i \to \min
\end{aligned}
\qquad (1)
$$

where E_i– economic effect of granulate production; K_i– tax factor; C_{pi}, Z_E and C_{IC}– cost of granulate according to the existing technology, operating costs, as well as the cost of raw materials, etc. (soybean, pumpkin, carrot and water seeds); Q_i– granulate production line; t– line operating time; k_i– utilization rate of the line; PZ– приведенные затраты; $E_н$– normative efficiency coefficient ($E_н$ = 0,15); K – capital investments; N_{UD}– energy intensity of the granulate production process; N– power consumption; λ – degree of grinding of raw materials.

3. RESULTS AND DISCUSSIONS

It is possible and advisable to increase the biological value of the finished product by creating in its structural composition a vitamin composition β-carotene + vitamin E with antioxidant activity. The reduction of labor, energy and funds costs is ensured by the exclusion of operations associated with heating molasses and spraying a urea-molasses solution to wet the feed particles while increasing the structural strength of the granules.

According to the proposed method, when producing a granular concentrate, corn grits are used as a grain component, and soya-carrot paste is used as a binder component (weight parts (wp)) - non-fat-free heat-treated soy flour: chopped carrots = 1 wp: 4 wp, while the granular mixture is produced by the disintegration redistribution of newly formed corn particles in a soya-carrot binder with a ratio (weight part) of corn grits: soya-carrot paste a = 1 w.p. : 2 parts by hour, with its formation and subsequent drying.

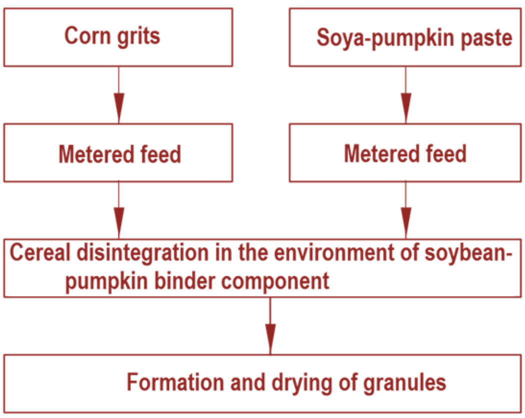

Figure 1: The technological scheme for the implementation of the proposed method.

The technical result consists in the fact that this method allows you to create a granular concentrate containing a complex of safe protein-vitamin carbohydrate substances and obtained at a relatively lower cost of energy, labor, and funds.

shows the technological scheme for the production of granular concentrate Figure 1, pre-prepared corn grits and soya-carrot paste are dosed fed from hopper-dispensers - 1 to the receiving hopper - 2 pressing devices - 3 and then to the grating-knife apparatus -4 and the pressing matrix -5 with holes.

When it gets into the grate-knife apparatus - 4, the corn grits are subjected to intensive movement from the side of the knife in a soya-carrot environment. At the same time, in the same medium, cereals are destroyed into smaller particles, the surface of which is intensively enveloped with soya-carrot paste with their simultaneous saturation with moisture and binding due to the internal adhesive properties of the soya-carrot paste.

Due to the redistribution of moisture between the particles of corn and soya-carrot paste, a composition is formed with an average humidity of 40%, at which there is a high internal bond between the particles.

On the basis of the mixture obtained, granules are formed, which are then fed into a tray - 6 and dried in a chamber dryer - 7.

The structural and technological scheme of the PVF production line is presented in Figure 2. Comparative characteristics of the quality indicators of the resulting product are presented in Table 1.

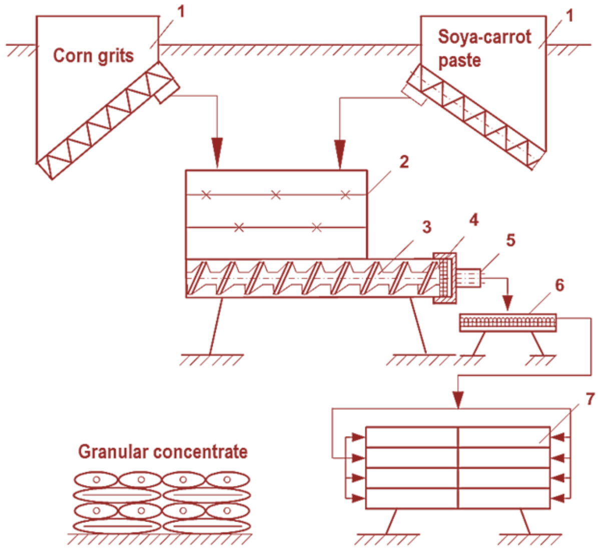

Figure 2: The structural and technological scheme of the PVF production line.

Table 1: Comparative characteristics of concentrates.

Components	Indicators						
	Water, %	Protein, %	Fats, %	Carbohydrates, %	β-carotene, mg/ru	Vitamin E, mg/kg	Strength, %
Corn grits	6-8	8.0	1.2	73.0	-	-	-
Soya carrot composition	60-65	10.0	4.0	16.0	70.0	320.0	-
Ready granular concentrate according to option 1-2	8-10	30.0	9.4	50.0	240.0	910.0	95-98
Compound feed	10-14	6.0-8.0	-	78.0	-	-	-
Urea-molasses solution	25	-	-	75.0	-	-	-
Ready granular concentrate according to option 4-5	10-12	6.0-8.0	0.5	81.0	-	-	70

Obtained protein-vitamin granulate are characterized by high organoleptic characteristics, has a characteristic pronounced color, taste, and aroma corresponding to the raw materials used (Figure 3).

Figure 3: General view of protein-vitamin granulate.

Granules of cylindrical shape with a matte surface with a diameter of 2 mm. The length of the granules varies from 0.8 to 1.0 cm. Humidity is not more than 14%. Crumbling no more than 5%.

4. CONCLUSION

An innovative method for producing PVF with a high content of protein substances stuffed in an amount of at least 30%, β - carotene - at a level of 240 mg/kg, vitamin E - 910 mg/kg with a pellet strength of at least 95% was substantiated and proposed. The implementation of this method in the system of mechanized feeding of animals and poultry on small and medium-sized farms allows you to prepare a feed product of high biological value with a significant reduction in costs, energy, labor, and funds. The annual economic effect is 1757744.5 rubles/year.

5. AVAILABILITY OF DATA AND MATERIAL

Data can be made available by contacting the corresponding author.

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Professor Dr.Sergei Dotsenko is Professor, Far Eastern State Agrarian University. He holds a Doctor of Technical Sciences. His research includes Production Line, Feed Technology, Binder, Vitamins, Protein Substances, Biological Value.

Lyudmila Kryuchkova, is an Associate Professor, Department of Higher Mathematics, Far Eastern State Agrarian University. She is a Candidate of Technical Sciences. Her research involves Applications of Math.

Professor Dr. Viktor Samuylo is Professor, Department of Operation and Repair of Transport-Technological Machines and Complexes, Far Eastern State Agrarian University. He holds a Doctor of Technical Sciences His research encompasses Production Line, Feed Technology, Binder, Vitamins, Protein Substances, Biological Value.