Using protein concentrate in livestock and poultry diets for sustainable agriculture

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Abstract. The paper presents the main results of the experiment on the use of high-protein concentrate "Gorlinka" in the diets of dairy cows and laying hens on their productive qualities. It was found that in terms of the main indicators of nutritional value (protein, fat, nitrogen-free extractives, ash elements), as well as in terms of amino acid composition and mineral substances, the studied concentrate surpasses the traditionally used in feeding farm animals and birds, oil cake and meal from sunflower seeds. The results of studies have shown that the groups of animals that received protein concentrate with the diet were in the lead. The use of protein concentrate "Gorlinka" in the feeding of dairy cows and laying hens increased the average daily milk yields of cows by 5.47-7.12%. There were also positive changes in the mass fraction of protein in milk by 0.03-0.04%, in dry matter by 0.04-0.09%, in the number of eggs laid by laying hens by 216-822 pieces, in the average egg weight by 0.77-1.66 g. Thus, the use of protein concentrate "Gorlinka" in feeding dairy cows and laying hens had a positive effect on the quality of the products (milk and edible eggs), while economic indicators improved.

1. Introduction
The fundamental tasks of the development of agriculture and food security in Russia are the development of livestock and poultry industries, as well as an increase in the volume of products produced with its further export. The solution of this issue will ensure the growth of the competitiveness of the agro-industrial complex of the Russian Federation, will contribute to the revival of rural areas, will allow to regulate the food security of the state [1, 2]. The decisive role in this direction primarily belongs to the balanced feeding of animals and poultry, which is the most expensive item of expenditure [3, 4, 5].

In this regard, it is necessary to constantly search for more affordable and cheaper feed ingredients (food waste processing products, drought- and heat-resistant grain varieties), which are not inferior in nutritional value to traditional feeds [6, 7, 8, 9].

The prospect of our research consists in the search for cheaper alternative sources of feed protein of local origin and the enrichment of diets with various biologically active additives.

Increasing the productivity of dairy cows and egg-producing hens due to the introduction of the protein concentrate "Gorlinka" into the diet has become the goal of our research.
2. Materials and methods

Before the establishment of scientific and economic experiments, identification was carried out by the elementary composition of feed components - meal and oil cake from sunflower seeds, as well as protein concentrate "Gorlinka" (developed by scientists of the Department of Feeding and Breeding of Farm Animals of the Volgograd State Agrarian University together with LLC "Rodos").

After that, a series of experiments was carried out, in which the effect of the use of the protein concentrate in the feeding diets of dairy cows and egg-producing chickens on their productive indicators and the quality of the products obtained was studied. The research was carried out at the enterprises of the Volgograd region (Volgograd State Agrarian University, laboratory "Analysis of feed and livestock products", CJSC poultry farm "Volzhskaya", LLC "Donagrogaz") and Moscow city (Research Center "Cherkizovo").

In the course of scientific and economic experiments, the dairy productivity of cows and egg laying hens were taken into account. The scheme of the studies performed is shown in Figure 1.

![Figure 1. General scheme of research.](image-url)

Based on the data obtained on the nutritional value of protein concentrate, oil cake and meal from sunflower seed, the following can be concluded. The studied feed additive showed its superiority over sunflower oil cake and meal in such indicators as: crude protein by 2.1% and 0.6%, respectively, crude fat by 0.4% and 5.6%, nitrogen-free extractives by 13.2% and 0.8%, crude ash by 1.4% and 0.2%, total amount of studied amino acids by 2.63% and 2.9%. At the same time, it was revealed that the studied concentrate had the leading position in terms of the main mineral elements, such as calcium, phosphorus, magnesium, iron, as well as vitamins of group B and vitamin D.

To conduct a scientific and economic experiment, animals were selected into groups by the method of pairs of analogues. When forming experimental similar groups, the age of animals, the main indicators of productivity, live weight, physiological condition, etc. are taken into account. 10 cows of the same age were selected for each of the groups.

The experiment was carried out according to the scheme presented in Table 1. Lactating cows of the I control group were given a diet, the concentrate part of which included sunflower oil cake in the amount of 1 kg per head per day. Animals of the II and III experimental groups were fed diets in which oil cake from sunflower seed was replaced by 50% and 100% of the studied protein concentrate.
Table 1. Scheme of the experiment on black-and-white cows.

| Indicator                  | Groups of cows                      |
|----------------------------|-------------------------------------|
| Number of cows in the group| I control 10                        |
| Cow feeding conditions     | II experimental 10                  |
|                           | III experimental 10                 |
| The basic diet (BD) using oil cake from sunflower seed | BD + protein concentrate “Gorlinka” instead of 50% of sunflower oil cake |
|                           | BD + protein concentrate “Gorlinka” instead of 100% of sunflower oil cake |

Then, studies were conducted to study the effect of protein concentrate on the egg productivity of poultry. The experimental hens were kept in identical conditions in accordance with the guidelines for working with the Haysex Brown cross poultry and the recommendations of Federal Scientific Center "All-Russian Scientific Research and Technological Institute of Poultry Farming" of the Russian Academy of Sciences. The selection of young and adult laying hens into groups was carried out according to the generally accepted method of analogues.

Young poultry from the first day of life were grouped into 4 groups, of which there was one control (I) and three experimental (II, III, IV). The number of young animals in the group was 100 heads, adult birds was 60 heads. In terms of time, the experiment on young livestock lasted 120 days, and on an adult bird lasted 52 weeks. The scheme of the experiment on the egg poultry of the Haysex Brown cross is presented in Table 2.

The diet of the I control group consisted of compound feed, in which there was a greater amount of corn and wheat. During the experiment, protein concentrate was injected into poultry of the II, III and IV experimental groups as part of compound feed instead of 50%, 75% and 100% of sunflower seed meal, respectively.

Table 2. Scheme of the experiment on the egg poultry of the Haysex Brown cross.

| Groups of hens          | Feeding features                          |
|-------------------------|-------------------------------------------|
| I control               | BD + replacement of 50% of sunflower seed meal with protein concentrate “Gorlinka” |
| II experimental         | BD + replacement of 75% of sunflower seed meal with protein concentrate “Gorlinka” |
| III experimental        | BD + replacement of 100% of sunflower seed meal with protein concentrate “Gorlinka” |

3. Results and discussion

Throughout lactation, the effectiveness of the productive use of animals can be assessed by milk productivity, which in particular can be judged by the average daily milk yield (Table 3) [10].

The average daily milk yields from the cows of the experimental groups differed somewhat. The use of the studied high-protein concentrate in the concentrate part of the diet had a certain effect on these differences. The best results for this indicator were observed in cows whose diets included the studied concentrate, 27.56 kg and 27.98 kg versus 26.12 kg in the I control group.

As you know, the percentage of fat in milk is a genetically stable and difficult-to-change indicator. In our experience, there were no differences in this indicator. However, in terms of protein content in milk, there were slight differences in favor of cows fed protein concentrate “Gorlinka”, in the II and III experimental groups this indicator was 3.26% and 3.27%, respectively, against 3.23% in the I control group. A similar trend was observed in the percentage of dry matter in cow milk. The difference in favor of the experimental groups versus the I control group for this indicator was 0.04% and 0.09%.
The difference between the indicators is not reliable. The zootechnical indicators of the productive period of the egg poultry by content of protein, minerals and vitamins in eggs (tIV) by 4.25%, and in the IV experimental groups of the cross are presented in Table 4. According to the results of the experiment, the feed costs per 1 kg of live weight of young hens of the experimental groups was less, in relation to the I control by 2.4-6.7%.

Table 3. Indicators of dairy productivity of cows.

| Indicator                      | I control      | II experimental | III experimental |
|--------------------------------|----------------|----------------|-----------------|
| Average milk yield per day, kg | 26.12 ± 1.69   | 27.56 ± 1.78   | 27.98 ± 1.73    |
| Fat in milk, %                 | 3.61 ± 0.13    | 3.61 ± 0.13    | 3.61 ± 0.13     |
| Protein in milk, %             | 3.23 ± 0.03    | 3.26 ± 0.03    | 3.27 ± 0.04     |
| Dry matter in milk, %          | 12.99 ± 0.22   | 13.03 ± 0.25   | 13.08 ± 0.25    |
| Dry skimmed milk residue, %    | 9.38 ± 0.08    | 9.42 ± 0.06    | 9.47 ± 0.06     |
| Lactose in milk, %             | 5.38 ± 0.10    | 5.39 ± 0.10    | 5.42 ± 0.09     |
| Ash in milk, %                 | 0.77 ± 0.01    | 0.77 ± 0.01    | 0.78 ± 0.01     |

Partial or complete replacement of sunflower oil cake used in the basic diet with the studied concentrate had a positive effect not only on the quantity and quality of the products obtained, but also on economic indicators. In the II and III experimental groups, the profit from the sale of the received milk was higher compared to the I control group by 6028.00 rubles and 7810.00 rubles, respectively. An increase in the profitability of milk production amounted 46.67% in II experimental group and 49.15% in III experimental group.

At the end of the experiment to study the effect of protein concentrate on the egg productivity of poultry, the following results were obtained. The II experimental group of young poultry was the leader in weight by 14.47 g compared to the I control group, in the III and IV experimental groups the live weight also exceeded the control by 44.85 g and 22.26 g. On average, eggs were obtained per laying hen in the II experimental group by 1.12% more than in the I control group, in the III experimental group by 4.25%, and in the IV experimental group by 3.07%. In terms of average egg weight, the II, III and IV experimental groups of hens were in the lead - from 1.2 to 2.6%, and there was also an increase in the content of protein, minerals and vitamins in eggs (the difference between the indicators is not reliable). The zootechnical indicators of the productive period of the egg poultry of the Haysex Brown cross are presented in Table 4.

Table 4. Zootechnical indicators of the productive period of the egg poultry of the Haysex Brown cross (M ± m).

| Indicator                                      | I control   | II experimental | III experimental | IV experimental |
|------------------------------------------------|-------------|----------------|------------------|-----------------|
| Live weight of young hens at the age of 4 months | 1364.17 ±   | 1378.64 ±      | 1409.02 ±        | 1386.43 ±       |
| Total eggs received                            | 19350 ±     | 19566 ±        | 20172 ±          | 19944 ±         |
| Eggs received per laying hen                   | 322.5 ±     | 326.1 ±        | 336.2 ±          | 332.4 ±         |
| Average egg weight, g                          | 63.47 ± 1.90| 64.24 ± 2.15   | 65.13 ± 1.96     | 64.91 ± 2.04    |
| Feed costs per 1 kg of growth of young hens, kg| 4.67 ± 0.03 | 4.62 ± 0.03    | 4.52 ± 0.03      | 4.59 ± 0.03     |
| Feed costs per 1 kg of egg mass, kg            | 2.08 ± 0.03 | 2.03 ± 0.03    | 1.94 ± 0.03      | 1.97 ± 0.03     |

According to the results of the experiment, the feed costs per 1 kg of live weight growth of young hens in the groups that received protein concentrate as part of the feed were higher by 0.05 kg, 0.15 kg and 0.08 kg than in the I control group. The amount of compound feed consumed per 1 kg of egg mass in the hens of the experimental groups was less, in relation to the I control by 2.4-6.7%.
The presence of lead in the eggs of laying hens of all experimental groups was in the range from 0.01 to 0.03 mg/g, which is lower than the maximum permissible concentration. The concentration of cadmium, mercury, arsenic and cobalt was below the detection limit.

The difference in the cost of consumed compound feeds due to the use of protein concentrate "Gorlinka" for young hens in the II experimental group was 234.84 rubles, in the III experimental group was 389.34 rubles, and in the IV experimental group was 519.12 rubles. Additional profit was obtained by introducing the protein concentrate "Gorlinka" into the diet of laying hens instead of the traditionally used sunflower seed meal and it amounted to 2419.25-6162.82 rubles.

4. Conclusion
Based on the results obtained in the course of research, it can be argued that the greatest effect of production is achieved in animals and poultry that received protein concentrate with a diet: this allows increasing the level and quality of purchased products, as well as increasing the production of milk and edible eggs. The use of protein concentrate “Gorlinka” in diets increased the average daily milk yields of cows by 5.51-7.12% and egg productivity of laying hens by 1.12-4.25%. Additional profit when introducing protein concentrate instead of sunflower seed meal into the diet of hens was 2419.25-6162.82 rubles. Thus, the use of the provided protein concentrate is economically feasible.

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