Effectiveness of the use of a symbiotic preparation feeding broilers

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Abstract: The article presents the production technology and the results of using a symbiotic preparation based on the E. coli strain VL-613 as a lysine producer in poultry farming. In the practice of feeding productive animals and birds, the problem of lysine deficiency is solved by introducing components of animal origin into the type of diet, as well as synthetic or microbial lysine. A symbiotic preparation (trade name “Proliser”) was produced by periodic controlled deep cultivation of E. coli VL-613 strain in a nutrient medium, based on the Hottinger's overcook, the concentrated bacterial mass was mixed with a protective medium and cool dehumidificated for long-term retention of biological properties. The E. coli VL-613 strain is able to multiply in the digestive tract of farm animals and birds, can synthesize lysine up to 6.0 μg/cm³, and is not pathogenic to animals and birds. The symbiotic preparation was treated to Cobb-500, Avian-48 and Smena-7 cross broiler chickens by unsoldering or applying to feed pellets. The use of the "Proliser" preparation allowed to increase viability, average daily weight gain and the yield of category 1 meat in broiler chickens, as well as reduce the yield of low-grade meat. The results of tests on a large number of poultry population of poultry farms in the Moscow region showed, that the use of the "Proliser" symbiotic preparation will allow to completely replace synthetic lysine in feed diets for broilers of highly productive crosses.

1. Introduction

With intensive poultry farming under the conditions of industrial technology for keeping poultry, proper feeding is a decisive factor in obtaining high productivity [1,2,3]. At the same time, it is stipulated for providing birds not only with high-quality protein and energy components, but also with key amino acids. Most of the key amino acids are received by the body with traditional feed in insufficient quantities [4,5]. Most often, there are not enough lysine and methionine in animals and birds diets. From literary sources it is known, that with sufficient intake of lysine and methionine into the body, up to 20% of the total amount of protein, introduced into the diet, can be saved. This means, that each daily portion of the feed should contain a sufficient amount of key amino acids, and their optimal level should be maintained throughout the bird rearing period [6].

Currently, in many countries, synthetic lysine (lysine monohydrochloride) is used to feed productive animals and birds. To increase the usefulness of feed, synthetic amino acids are widely used, which are imported to Russia from other countries [7,8].

Most feed products are crystalline chemically synthesized lysine preparations. Currently, in Russia there is no production of crystalline lysine, the quality of which would satisfy the consumer [9].
Symbiotics are biotechnological products, containing live microorganisms, that produce amino acids (including key ones), enzymes, vitamins in the gastrointestinal tract of animals and birds, and thus contributing to increased productivity. For the purpose of industrial production in Russia, it is economically efficient to obtain lysine in a biosynthetic method, using active strains of microorganisms [10].

The purpose of this research was to develop a technology of producing and evaluate the effectiveness of using a symbiotic preparation based on E. coli VL-613 strain, a producer of the key amino acid lysine as a feed additive in poultry farming.

2. Experimental
"E. coli VL-613" strain was used as a producer of lysine. The cultivation of Escherichia was carried out on nutrient media based on the Hottinger's overcook.

The strain cultivation was carried out in the "ANKUM-2M" fermenter (Russia) with a capacity of 10 dm³, which is equipped with automatic control and regulation systems of the main cultivation parameters. The selection of optimal conditions for the controlled process of cultivation of the strain - the lysine producer, were carried out using the Gauss - Seidel mathematical planning method, which ensured the achievement of the maximum possible result in a commercial fermenter. The symbiotic preparation was frozen in the "LSSH-28" refrigeration units (Russia), and then dried in the "TG-50" freeze dryer (Russia). The symbiotic preparation "Proliser" was tested as a feed additive on highly productive broiler crosses: “Cobb-500”, “Avian-48”, “Smena-7”. The safety of the preparation was tested on outbred mice, on SPF-embryos of chickens and on one-day-old chickens.

The symbiotic preparation "Proliser" was treated to broilers by unsoldering or spraying onto feed pellets in comparative tests with respect to expensive synthetic lysine ("L-lysine monohydrochloride" manufactured by “PT.Cheil Jedang Indonesia”, Indonesia; “CEBOH L-lysine monohydrochloride 99%” manufactured by "DAESANG CORPORATION", South Korea). To determine the efficiency of replacing crystalline lysine (lysine monohydrochloride) with a lysine producer, based on the Escherichia coli VL613 strain, experiments were carried out in poultry farms in the Moscow region.

3. Results and considerations
A symbiotic preparation (trade name "Proliser") was produced by periodic controlled deep cultivation of E. coli VL-613 strain in a nutrient medium, based on the Hottinger's overcook, the concentrated bacterial mass was resuspended in a protective medium and cool dehumidificated for long-term retention of biological properties. The E. coli VL-613 strain is capable to multiply in the digestive tract of farm animals and birds, is not pathogenic, and can synthesize lysine up to 6.0 μg/cm³. The accumulation of viable E. coli VL-613 cells amounted to 16.6 billion/cm³ after 4-6 hours of cultivation. Wherein, the adaptation phase lasted 0.15 hours, and the log phase lasted 2.2 hours. The maximum specific growth rate of the E. coli VL-613 population was 1.64 h⁻¹, and the doubling time was 0.42 hours. Figure 1 shows a typical morphological culture of E. coli VL-613 strain.

Figure 1. Colonies of culture of E. coli VL-613 strain.
The results of tests of the effectiveness of the use of the preparation "Proliser" as a feed additive on broiler chickens are presented in tables 1, 2 and in figure 2.

**Table 1.** The results of the test of the symbiotic preparation "Proliser" on broiler chickens cross "Smena-7".

| Indicators                              | Control\(^a\) | Experimental\(^b\) |
|-----------------------------------------|---------------|-------------------|
| Live weight, g aged:                    |               |                   |
| one-day-old                             | 40±0.15       | 40±0.11           |
| 7 days                                  | 141.35±0.09   | 143.11±0.01       |
| 14 days                                 | 298.12±0.21   | 304.89±0.02       |
| 21 days                                 | 701.24±0.33   | 799.57±0.06       |
| 28 days                                 | 1147.02±0.21  | 1222.78±0.09      |
| 37 days                                 | 2043.72±0.11  | 2165.73±0.08      |
| 45 days                                 | 2065.50±0.41  | 2209.52±0.11      |
| The safety of the poultry population, % | 93.8          | 96.7              |
| Feed consumption per one broiler during the raising period, kg | 3.5±0.21 | 3.19±0.04 |
| The cost of feed per 1 kg weight gain   | 1.69±0.06     | 1.44±0.01         |
| The average daily live weight gain, g   | 45.6±0.04     | 49.5±0.09         |
| Poultry population, (number of head of birds) | 42,400 | 42,300 |

\(^a\) Control group - a complete diet with the addition of crystalline lysine.

\(^b\) Experimental group - a complete diet with the symbiotic preparation "Proliser".

**Table 2.** The results of tests of the effectiveness of the symbiotic preparation on broiler chickens of the cross "Cobb-500".

| Indicators                              | Broiler chickens group |
|-----------------------------------------|------------------------|
|                                         | Control\(^a\) | Experimental\(^b\) | %   |
| Safety, %                               | 95.2        | 96.5             | +1.36 |
| Slaughter yield of meat,%               | 67.8        | 68.3             | +0.74 |
| Yield of meat,%                         |             |                  |      |
| - of the 1st category                   | 75.9        | 80.8             | +6.46 |
| - for industrial processing             | 20.5        | 19.3             | -5.85 |
| The average daily weight gain, g/head   | 45.9        | 49.1             | +6.97 |
| Feed consumption per 1 kg of weight gain, kg | 1.66    | 1.45             | -12.65 |
| Feed consumption per 1 head per day, g | 76.0        | 71.11            | -6.43 |
| Feed consumption per 1 head             | 3.42        | 3.2              | -6.43 |
| for the entire raising period, kg       |             |                  |      |

\(^a\) Control group - feeding on a full diet with crystalline lysine for a given cross.

\(^b\) Experimental group - feeding on the diet with the addition of the symbiotic preparation "Proliser".

The results of tests on a large number of poultry population of poultry farms in the Moscow region showed, that the use of the "Proliser" symbiotic preparation allow to completely replace synthetic lysine in feed diets for broilers of highly productive crosses. From the data, presented in tables 1, 2 and in figure 2, it follows, that the live weight of broiler chickens of the experimental group significantly exceeded the live weight of the bird from the control group.
Figure 2. Dynamics of live weight gain of broilers of the "Avian-48" cross.

The studied symbiotic preparation contributed to the synthesis of lysine in the body of chickens in the most important period of life, when the digestive system is most vulnerable and immature. Using the preparation increased the safety of broilers and reduced feed consumption for the entire raising cycle. The use of the "Proliser" preparation allowed to increase the average indicators of daily weight gain of broilers and the yield of 1st category meat.

In vivo biological methods were used to determine the safety of the test symbiotic preparation. One-day-old chickens, white mice were unsoldered with 0.5 cm³ of the test dose of the symbiotic preparation one time. 4 sets of the preparation were tested, 10 heads in each group. All chickens were alive by the end of the observation period, there was no inhibition of the bird's behavioral reactions and activity of eating feed. The tests were carried out on 5 healthy white outbred mice of the same sex weighing 14 - 16 g, which were quarantined and not used previously in experiments. In the absence of dead mice, signs of their health conditions and weight loss by the end of the observation period, it was concluded, that with the administration of the maximum tolerated dose, the symbiotic preparation did not have toxicity.

4. Summary
The main task of all sectors of agriculture, including poultry farming, is to increase profitability, which implies an increase in production volumes while reducing production costs. This can only be achieved, if the animals and birds are in good health and resistant to exposure of adverse environmental factors. It is impossible to provide resistance and increase productivity without full proper feeding and the use of various feed additives. Currently, microbiological synthesis is considered the most promising method for producing lysine, which allows to obtain L-isomers on media, consisting of inexpensive and non-deficient components. The technology for producing L-lysine by deep cultivation of E. coli VL-613 strain with a total concentration of 16-30 billion cubic meters/cm³ at the end of the cultivation is the cheapest source of enrichment of plant feed and more efficiently increases the growth and productivity indicators of animals, than crystalline L-lysine.
Thus, as a result of the conducted studies, a technology for the production of a symbiotic preparation was developed (cultivation modes using inexpensive nutrient media, freeze-drying in a protective medium); preclinical studies of their safety and specific activity were conducted; methods of application in liquid form (unsoldering or applying to feed pellets) are developed; the treatment-and-prophylactic and economic efficiency is evaluated at fattening broilers of highly productive crosses. It is shown, that the preparation is not toxic to mice and chicken SPF-embryos and is harmless to one-day-old chickens. The use of a symbiotic preparation contributed to an increase in zootechnical indicators of broiler raising.

Based on the conducted studies, it can be concluded, that it is advisable to use the symbiotic preparation "Proliser", when raising broilers of highly productive crosses.

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