Amino acid preparations in feeding young pigs and laying hens

E Y Nemtseva*, A Y Lavrentev, VS Sherne, V A Alekseev, N V Ev dokimov, N S Petrov and N V Danilova

Department of General and Special Zootechnics, Chuvash State Agricultural Academy, 29 K. Marx street, Cheboksary 428003, Russian Federation

*E-mail: eunemtzeva@yandex.ru

Abstract. The paper deals with the effectiveness of the drug "L-lysine monohydrochloride feed". Animals of the experimental group additionally included in the main diet of 2.5% L-lysine monohydrochloride feed by weight of concentrates. The inclusion of the studied additive in the diets of young pigs contributes to an increase in the average daily gain of 14.1%, reducing the cost of feed by 11.73% compared with the control group. As a result of the research it was found that due to the use of the drug L-lysine monohydrochloride feed, an additional 3.38 kg gain per head or 253.5 rubles was obtained. During the study on laying hens aged 25 to 33 weeks, egg production was studied, which by the end of the experiment was: 93.7% in the control group, 95.2% in the experimental, which is 1.5% more. In addition, there is a tendency to increase egg weight by 1 g or 1.8%, yolk weight and its specific weight in the egg by 2 g or 13.3%, respectively, as well as thickening of the shell by 3 microns or 8.1%, and a decrease in shell content by 1%.

1. Introduction

Currently, all over the world, including Russia, the introduction of environmentally friendly, biologically active substances in animal husbandry, stimulating and improving digestion, digestibility of feed, growth and development processes, having a preventive and therapeutic effect [1,2].

In modern industrial technologies, an important role is played by feeding farm animals and poultry. The provision of feed and basic nutrients according to detailed standards is the determining factor [3,4]. The lack of energy, protein, amino acids, minerals and vitamins in the diets of farm animals and poultry leads to a decrease in productivity, an increase in feed consumption per unit of production and ultimately to an increase in the cost of products [5-7].

Biologically active substances in the feeding of farm animals and poultry contribute to the replenishment of nutrients of diets and improve the digestibility of feed nutrients [8-10]. According to modern concepts, protein nutrition is presented as an amino acid, and the protein of the main components of animal feed and diets, grain feed, is deficient in amino acids [11].

According to a foreign researcher, M. A. Eliot: "in recent years, the productivity of laying hens has increased significantly.

Increased not only indicators such as the number of eggs, egg weight, feed conversion, but also the duration of egg laying. This in itself has an impact on the optimal content of amino acids in the diets for modern breeds of laying hens. That is, an increased yield of egg mass means an increase in the amount of amino acids that must be consumed with food. At the same time, as the criterion of productivity of
In water, containing at least 98.5% of the active substance.

It is of interest in the practice of pig breeding and poultry farming. The study of feeding synthetic forms of lysine, one of which is the preparation "L-lysine monochlorhydrate feed" is of interest [12, 16, 17].

In studies of foreign authors to determine the content of the ideal protein simultaneously conducted seven tests to establish the ideal ratio of methionine, methionine+cystine, threonine, tryptophan, arginine, isoleucine and valine to lysine in terms of obtaining the maximum egg mass. One basic diet was used, to which crystalline amino acids were added to determine lysine levels [13].

The concept of an ideal protein is used to calculate the body's need for essential amino acids, which in a simplified form is represented by the "Liebig barrel". This model clearly demonstrates that the first limiting amino acid limits protein synthesis and the use of nutrients from the feed. Body protein cannot be synthesized if one of the essential amino acids is missing. In this case, the excess of others should be removed from the body. As a result, additional energy is spent on the disposal of excess, the total nitrogen content in the excrement increases, more ammonia is released. The consequences of amino acid imbalance in the feed affect not only the body but the environment [14].

The quality of protein feeds directly depends on its amino acid composition. To date, more than 100 amino acids are known, but only 20 of them are of particular importance in feeding farm animals and poultry. Amino acids are divided into replaceable and indispensable. Amino acids that can be synthesized in the body are called interchangeable. Some amino acids can be converted into each other (methionine + cysteine, phenyl alanine + tyrosine, glycine + serine). Arginine can be partially synthesized in pigs.

It is necessary to take into account the content of the following amino acids in the diets of pigs and laying hens: arginine, gesticin, leucine, isoleucine, lysine, methionine, phenylalanine, threonine, tryptophan and valine. One of the limiting amino acids is lysine. Lysine (α, e-diaminocaproic acid, C₆H₁₂N₂O₂) is known as two optically active D- and L-forms and a racemic DL-form.

It was found that the protein of the main components of the rations of pigs – grain feed was deficient in amino acids. Thus, when only barley fed to pigs the average daily gain is 350 g, wheat – 151…240 g, and corn – 158…200 g [12,13]. The enrichment of these diets increases the amino acids increases to 607 – 634 g. Reducing excess protein in feed by adding amino acids is the most cost-effective way to solve the problem of nitrogen pollution as a consequence of the unbalanced feeding of animals. On average, reducing the protein content in food by 1% reduces nitrogen excretion with excrement by 10% [14].

It has been established that lysine in the body determines not only the biological value of the protein. Amino acid performs many other biochemical functions – it promotes secretion of digestive enzymes and transport of calcium into cells, improves the overall nitrogen balance in the body. This amino acid is ahead of the others in terms of the importance of the presence of lysine in the diet of animals. Lysine more fully affects the synthesis of proteins, especially necessary for the formation of skeletal tissues, enzymes and hormones, improves calcium absorption and its transport to bone tissue, which positively affects the growth and formation of bones, strengthens immunity to viral infections, promotes tissue repair, serves as a source of energy, regulates feed intake. Lysine is included in the composition of all proteins, affects the redox reactions in the body, catalyzes the processes of transamination and deamination, affects the acyl process. Lysine is associated with mineral metabolism, promoting the absorption of calcium and phosphorus. It has a positive effect on the hematopoietic function of the bone marrow and the nervous system [15].

However, lysine contained in legumes is characterized by low availability, and animal feed is overpriced, so the use of feed additives with high availability of amino acids at a moderate cost is of particular interest. In this regard, the drug "L-lysine monochlorhydrate feed" is of interest [16,17].

In this regard, the study of feeding synthetic forms of lysine, one of which is the preparation "L-lysine monochlorhydrate feed" is of interest in the practice of pig breeding and poultry farming.

The drug "L-lysine monochlorhydrate feed" is a feed additive used in the production of premixes and feed for farm animals, including birds and fish. In appearance it is a white to light brown powder, soluble in water, containing at least 98.5% of the active substance.
From the above, the drug "L-lysine monochlorhydrate feed" produced by joint stock company Chuvashbioagro (factory Kanashsky, Kanashsky District, Chuvash Republic, Russia) is of interest for practical use, as previously studied the effectiveness of this drug only laboratory method "in vitro".

The goal of the research is the study of the feasibility and effectiveness of using L-lysine monochlorhydrate feed in the diets of young pigs and laying hens.

2. Material and methods
The studied feed additive L-lysine monochlorhydrate feed \( (C_{6}H_{12}N_{2}O_{2}, \text{ChuvashAgroBio, Russia}) \) was used in the production of premixes and compound feed for farm animals, including birds.

For the experiment on the principle of group analogs, two groups of young pigs were formed, 15 heads each. The content of young pigs was group-wide. Experimental animals are in similar conditions of feeding, housing, and care, in compliance with zootechnical parameters. Pigs of the control and experimental groups were fed with the basic ration according to detailed feeding norms. Animals of the experimental group additionally included in the main diet of 2.5% L-lysine monochlorhydrate feed by weight of concentrates, which was added to the mixture of concentrates and thoroughly mixed. The duration of scientific experience was 50 days.

An experiment was conducted in the conditions of the poultry factory Kanashsky, Kanashsky District, Chuvash Republic to study the effect of feeding the studied supplement when feeding laying hens. Two groups of 25 weekly laying hens of the “Hisex white” cross in the amount of 55 animals each were selected according to the group-analog method for the experiment. The birds of the experimental groups were fed with feed with the addition of feed additives in the amount of 2.5% by weight of feed. Laying hens of the control group did not receive it. The preparation containing the synthetic form of L-lysine is produced in the form of beige granules, the solubility in water is 500 g/l at 20°C. It is produced microbiologically with 98.5% content of the active substance.

The safety of livestock, the live weight of experimental animals, the absolute increase, the average daily weight gain for growing period, the cost of feed per 1 kg of body weight was taken into account in the course of the experiment on pigs, large white breeds with a live weight of 35...40 kg at the age of 4 months to determine the effect of feeding L-lysine monochlorhydrate feed. For this control weighting was carried out.

The dynamics of changes in live weight of young pigs was established by individual weighing at the beginning and at the end of the experiment, and the safety of the livestock by daily accounting of mortality and culling. In all experiments, we kept daily records of given feeds and their residues. Upon completion of the experiments, the total feed consumption was determined by groups and their costs were calculated for obtaining 1 kg of a live weight gain. The growth rate was characterized by absolute and relative indicators. The cost of feed was carried out every decade accounting for specified feeds and their residues to identify L-lysine monochlorhydrate feed. The absolute gain for the entire experiment was calculated by subtracting the live weight at the end and at the beginning of the growing period. The average daily gain was estimated as the absolute increase in live weight in one day. Rations for experimental gilts were compiled according feeding norms in [3] and were balanced by periods of fattening depending on age, body weight, growth rate, taking into account the chemical composition and nutritional value of the compound feed.

The norms of the area, light, temperature, humidity regimes, the front of feeding and watering of experimental animals during the experiment corresponded to the recommendations of VNITIP.

All groups of experimental chickens were under the same conditions and were grown in the second tier of four-tier cellular batteries KBN – 1 to 5 heads in a cage. Dimensions of one cage, mm: length – 700, width – 455, height – 400. Differences in live weight and productivity between the chickens of the control and experimental groups did not exceed 3% by the beginning of the main period.

The microclimate indicators of the premises where the test livestock was kept were systematically monitored and regulated by the zoo-technical and veterinary services of the enterprise in accordance with the zoo-technical requirements.
The air temperature was measured three times a day, at the same time, in three vertical zones: in pigsties: 0.3 m from the floor and 0.6 m from the ceiling. At the cellular content of the bird, the temperature was measured in the passages between the batteries and in the area of the cells of the lower, middle and upper tiers. The duration of the temperature measurement at one point was at least 10 minutes from the time of installation of the thermometer. Observation hours: in the morning before the start of the service personnel, in the afternoon and in the evening.

To assess the illumination of pig and poultry rooms in the suites with the help of a luxmeter (TKA, St. Petersburg, Russia), the illumination was measured during the whole light day 1 times a week every 2 h. Artificial lighting of the premises was determined in the zone of maximum, average and minimum illumination twice a day. Then we determined the average value of all measurements, which expressed the artificial illumination of the room.

A dynamic psychrometer was used to determine air humidity. The Asman's psychrometer was installed in the study site and after 10 min, the readings of dry and wet thermometers are written off. The absolute humidity of the air when using Asman's psychrometer was calculated by the Regnault formula.

The speed of atmospheric air movement, the speed of air movement in exhaust ventilation pipes and in livestock premises was measured with the help of a winged anemometer. To characterize the air flow, they were checked at the following points: a) at the gate in the end and longitudinal walls; b) at the windows and supply channels; C) in the area of the exhaust channels; d) in the area of animals and birds.

Determination of ammonia, carbon dioxide and hydrogen sulfide in the air of livestock and poultry premises was carried out universal gas analyzer UG-2. The drug "L-lysine monochlorhydrate feed" was introduced into the composition of the feed and thoroughly mixed. The duration of the experiment was 60 days.

In the course of the scientific experience, the following indicators were taken into account: egg production, egg weight, shape index, the weight of egg components, percentage of egg components, shell thickness.

The intensity of egg production in birds was determined for 8 weeks of the biological cycle of egg laying, egg weight by weighing at the beginning and at the end of the experimental period.

The following equipment and reagents were used to determine the overall performance of eggs:
1. Egg as a whole (weight, density, shape index) - technical scales brand VLKT-500 (Gosmetr, St.-Petersburg, Russia), indexomer IM-1 (Hans Turck GmbH & Co., Germany);
2. Shell (thickness, relative weight) – micrometer MK Micron (MICRONTOOLS S. P. O., Czech Republic), technical brand VLKT-500;
3. Protein (height, large and small spreading diameters, weight) – altimeter, caliper;
4. Yolk (height, diameter, weight) – altimeter (Orka Food Technology), caliper indicator 824 (Harbin Measuring & Cutting Tool Group Co., China), scales VLKT-500.

Index of protein (yolk) were calculated by dividing its height by the average diameter. The ratio of protein mass to yolk mass was obtained by dividing the protein mass by the yolk mass. Biometric processing of digital data and assessment of their reliability was carried out according to accepted methods.

The drug "L-lysine monochlorhydrate feed" was added to the mixture of concentrates and thoroughly mixed in the unit for the preparation of compound feed "Dose-Agro". To assess the level of feeding of experimental pigs, analyses of the nutritional value of feed rations were carried out and the actual nutritional value was calculated.

Grain mixture was used when feeding pigs, 100 g of which contained: exchange energy 12.1 MJ, EFU 1.21, crude protein 14%, crude ash 5.57%, crude fat 3.7%, crude fiber 7.4%, Calcium 0.08%, phosphorus 0.21%, humidity 13.6%. Analysis of the composition of the grain mixture (feed) met the requirements for feed for nutritional value and corresponded to the rate of feeding.
3. Research results

Accounting for specified feeds and their residues showed that during the experimental period, experimental animals did not have a difference in the amount of feed eaten. Animals willingly ate the given feed. On average, during the experimental period, the animals ate 1.8 kg of grain mixture per day. The dynamics of animal growth and feed costs for the period of cultivation is presented in Table 1.

Table 1. Dynamics of animal growth and feed expenditure.

| Indicator                                      | Control group | Experimental group |
|------------------------------------------------|---------------|--------------------|
| Average live weight of 1 head, kg             |               |                    |
| in the beginning                              | 38.27         | 37.93              |
| in 170 days                                   | 62.44         | 65.48              |
| The absolute gain, kg                         | 24.17         | 27.55              |
| Average daily gain, g                         | 483           | 551                |
| in % to control                               | 100           | 114.1              |
| Age of reaching live weight 100 kg, days      | 205           | 179                |
| Total spent feed, EFU                         | 74.38         | 74.38              |
| Feed spent per 1 kg of gain                   |               |                    |
| Energetic feed unit, kg                       | 3.07          | 2.7                |
| in % to control                               | 100           | 88.27              |

At the beginning of the experiment, the live weight of the experimental animals was the same in all groups, and by the end of the experiment, they had significant differences. The absolute gain in live weight of young pigs of the experimental group was higher by 3.38 kg compared to the control group and amounted to 27.55 kg (Table 1). The average daily gain in live weight of young pigs in the experimental group was 551 g, which is 68 g or 14.1% higher than in control group (Table 1).

74.38 EFU was spent both in the control group and in the experimental groups. Feed costs per 1 kg gain in the experimental group were 2.7 EFU, which is lower than the control by 0.37 EFU or 11.73%. The age of attaining a live weight of 100 kg was 205 days in the control group, and 179 days in the experimental group, which is 26 days less than in the experimental group (Table 1).

The economic efficiency of the research results was determined by calculating the additional profit per 1 RUB of additional costs.

As a result of the research it was found that due to the use of the drug L-lysine monochlorhydrate feed, an additional 3.38 kg gain per head or 253.5 RUB was obtained. The cost of the drug consumed per head for the period of the experiment was 22.5 RUB, and for 1 RUB of additional costs, there were products for 11.26 RUB (Table 2).

Table 2. Cost-effectiveness of using L-lysine monochlorhydrate feed.

| Indicator                                      | Control group | Experimental group |
|------------------------------------------------|---------------|--------------------|
| Average live weight of 1 head, kg             |               |                    |
| in the beginning                              | 38.27         | 37.93              |
| in 170 days                                   | 62.44         | 65.48              |
| The absolute gain, kg                         | 24.17         | 27.55              |
| Average daily gain, g                         | 483           | 551                |
| Additional gain, kg                           | -             | 3.38               |
| The cost of the drug spent on 1 head, RUB     | -             | 22.5               |
| Sale price, RUB                               | 75            | 75                 |
| The cost of additional products, RUB          | -             | 253.5              |
| Provided additional production on 1 RUB costs, RUB | -             | 11.26              |
Feeding of laying hens of all groups was carried out with PC 1-2 feed. Feed consisted of: grain feeds - 63%, bagasse and meal pellets - 14%, meat and bone meal - 6%, mineral feeds - 9%, sunflower oil - 3%, protein-vitamin concentrate - 5%. The content of exchange energy in it was 253 kcal / 100 g, crude protein - 16.6%, lysine - 0.86%, methionine and cysteine - 0.74%). The analysis of diets showed that this feed meets the requirements of the feed rate for exchangeable energy by 93.7%, crude protein content by 95.8%, lysine by 72.7%, methionine and cysteine by 69.1%. Against the background of this diet, an additional 2.5% of the studied feed additive L-lysine monochlorhydrate feed was fed to the bird of the experimental group by fodder by weight of the compound feed.

During the study on laying hens aged 25 to 33 weeks, egg production was studied, which by the end of the experiment was 93.7 % in the control group compared to 95.2% in the experimental. The effect of the studied additives on the morphological qualities of eggs is given in Table 3.

Table 3. Morphological parameters of eggs of experimental laying hens.

| Indicator                  | In the beginning of the experiment | Upon completion of the experiment |
|----------------------------|-----------------------------------|----------------------------------|
|                            | Control group                     | Experimental group               |
| Weight of eggs, g          | 54.0±0.4                          | 54.7±0.4                         |
| The index form, %          | 79.4±0.5                          | 78.5±0.3                         |
| Mass of albumen, g         | 35.1±1.3                          | 35.4±1.1                         |
| Yolk weight, g             | 15.1±0.6                          | 14.5±0.3                         |
| Shell weight, g            | 4.7±0.19                          | 4.8±0.15                         |
| Protein content, %         | 63.9±2.0                          | 64.7±0.6                         |
| The contents of the yolk, %| 27.5±1.2                          | 26.5±0.8                         |
| The contents of the shell, %| 8.6±0.2                           | 8.8±0.3                          |
| Shell thickness, µm        | 336±1.2                           | 335±0.9                          |

Analysis of the research results revealed that there are insignificant changes in the morphological indices of the eggs of experimental birds against the background of the use of L-lysine monochlorhydrate feed in the rations of laying hens.

From figure 1 it can be concluded that the morphological parameters of eggs at the beginning of the experiment in both the control group and the experimental group corresponded to the normative indicators characteristic of this egg cross. Egg weight at the beginning of the experiment was in the control group – 54.9 g, in the experimental group – 54.8 g, protein weight – in the control group – 35.1 g, in the experimental group – 35.1 g, shell weight – in the control group – 15.1 g, in the experimental group – 14.5 g.
Figure 2. Morphological parameters of eggs at the end of the experiment

In the study of morphological indicators of food eggs (figure 2), there is a slight increase in egg weight by 1.4 g or 2.49%, an increase in the weight of the yolk and its specific gravity in the egg by 1.6 g or 2.08%, as well as a thickening of the shell by 3 µm or 0.92% compared to the control group. As a result of the experiment, no significant difference was found between the control and experimental groups in egg production (1.6%).

However, there is a tendency to increase the mass of eggs by 1 g or 1.8%. With an increase in the thickness of the shell by 3 mm or 0.92%, the weight of the shell decreases. Similar results were obtained in the studies of Kharlamov K. V. using crystalline preparations of lysine Shebekinsky BHZ with a content of monochlorhydrate 60.1% in the diets of laying hens. The egg productivity of poultry was studied in the experiment. For 6 months of experience, the intensity of egg production was 82-85%. Laying hens treated with lysine had an egg-laying intensity higher by 1.2-3% [18].

4. Summary

On the basis of the obtained results, it can be concluded that the addition of the compound feed preparation "L-lysine monochlorhydrate feed" at a dose of 2.5% of the dry matter of the feed increases the growth rate in young pigs by 14.1% with a slight increase in the slaughter yield of meat and a decrease in feed costs per unit of body weight gain compared to the indicators of control groups. In laying hens, there is an increase in egg production by 1.8% and egg weight by 2.49%, an increase in egg yolk by 2.08%. This dose is recommended for use in compound feeds used in the technology of growing young pigs and laying hens.

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