Study of efficiency of feeding fodder bioproduct based on seedlings of hydroponic greens in quail diets

A I Petenko1, M V Aniskina1,2, A N Gneush1,2, A A Danilova2, D A Yurin2 and N A Yurina2

1 Kuban State Agrarian University, 13, Kalinina str., Krasnodar, 350004, Russia
2 Krasnodar Research Centre for Animal Husbandry and Veterinary Medicine, 4, Pervomayskaya str., village Znamenskiy, Krasnodar, 350055, Russia

E-mail: 4806144@mail.ru

Abstract. An environmentally friendly and cost-effective method of grain germination for fodder purposes with content of probiotic strains has been developed. A cost-effective scheme of application of fodder bioproduct in diets for quail is proposed. The results of studies can be used to increase the productivity and safety of agricultural poultry, reduce the incidence rate and obtain high-quality products. When examining the product at various dosages in the scientific and economic experience, the best result was obtained by administering it at a dose of 2% to the weight of compound feed. The introduction of the product at this dose increased the live weight of quails by 8.6%, increased their safety by 5% and reduced feed consumption by 15.1%.

1. Introduction

The most significant branch of the country's agro-industrial complex is poultry farming. The development of this industry determines not only the level of satisfaction of the country in valuable food products, but also the economic development of the agricultural sector [1-3].

Recently, there has been an active development of this industry, innovations and technologies are being introduced. With the transfer of poultry farming to an industrial basis, the conditions for keeping birds have changed dramatically, their isolation from their natural habitat has increased, the body's adaptation reactions to external stress stimuli have changed, with the concentration of large quantities of livestock in limited areas, the physiological state of the bird's body is disturbed, natural resistance is reduced, productivity is reduced [4-6].

The issue of full feeding is becoming increasingly important in connection with the intensification of poultry farming, since it is important not only to satisfy the bird's need for basic nutritional factors, but also the ratio of individual nutrients in the diet, the absence of toxins and other anti-nutrients in the feed [7, 8].

To improve the quality of feed and diets, and due to the increase in productivity of the poultry industry, various feed additives are used.

Thus, in conditions of intensification of production, in order to organize high productivity, it is necessary to organize full-fledged feeding on the one hand, on the other hand, to contribute to the optimization of digestion processes in order to increase the digestibility and digestibility of nutrients, especially high-protein concentrated foods. Therefore, there is a need to support the digestive system with the help of functional fodder bioproducts that increase the efficiency of digestion of fodder [9-12].
Based on the above, any feed should be given to the bird in the form of feed mixtures and feed combinations balanced throughout the food elements, since the feed in its pure form is not able to satisfy the body's nutrient requirement [13-15].

2. Materials and methods

The purpose of the work was to study the effectiveness of using a fodder bioproduct based on the strains Lactobacillus acidophilus and Saccharomyces cerevisiae, seedlings of hydroponic greens and various fillers of functional action in feeding quail.

When setting the experience, they were guided by methodological recommendations for feeding agricultural poultry (Sergiev Posad, 2005).

The quail of the Texas white rock was used. They belong to the meat direction. The color of the feathers is white with small embossments of black feathers. The experience was carried out in the experimental vivarium of Kuban State Agrarian University named after I.T. Tubilin.

To conduct scientific and economic experience, four groups of quail were created, each of them had 22 heads.

The scheme of scientific and economic experiments is presented in Table 1.

Table 1. Scheme of scientific and economic experiments

| Groups               | Number | Feeding characteristics                                           |
|----------------------|--------|------------------------------------------------------------------|
| Control              | 22     | Standard feed                                                   |
| 2-nd experimental    | 22     | Standard feed + bioproduct in the amount of 1% of the weight of feed. |
| 3-d experimental     | 22     | Standard feed + bioproduct in the amount of 2% of the weight of feed. |
| 4-th experimental    | 22     | Standard feed + bioproduct in the amount of 3% of the weight of feed. |

Table 2. Composition of feedstuffs

| Raw materials                  | Age, weeks |
|-------------------------------|------------|
|                               | 1-4        | 5-6 | 7 and older |
| Peas                          | 15         | 15  | 15          |
| Sunflower                     | 5          | –   | 5           |
| Hydrolysis feed yeast 42%     | 4          | 4   | 5           |
| Corn                          | 16         | 24  | 25          |
| Soy                           | 10.5       | –   | –           |
| Chalk fodder                  | 0.3        | –   | 1           |
| Shell flour                   | –          | –   | 8           |
| Lysine monochlorohydrate 98%  | 0.10       | 0.6 | 0.10        |
| DL-methionine 98.5%           | 0.35       | 0.9 | 0.20        |
| Meat and bone flour SP 40%    | –          | 4   | –           |
| Premix PK-90-1                | 0.2        | 0.2 | 0.2         |
| Wheat                         | –          | 15  | –           |
| Winter rapeseed               | 10         | 10  | –           |
| Table salt                    | 0.55       | 0.5 | 0.30        |
| Soybean full-fat extruder 34% with P.G. | 6       | 10  | 10          |
| Tricalcium phosphate          | 2          | 1.5 | 2           |
| Sunflower meal SP 36%, SK 19% | 10         | –   | 28.2        |
| Sunflower flour               | –          | 14.3| –           |
| Corn crush                    | 20         | –   | –           |

The quail was contained in cells of welded galvanized mesh. The feed was handed out manually, the conditions of detention, feeding were the same.

During the experiment, such indicators were taken into account as: dynamics and increase in live mass, safety of the livestock, consumption of feed, digestibility and balance of nutrients in the poultry
body, indicators of meat productivity in the 56-day age.
Table 2 shows the composition of feedstuffs that were used in scientific and economic experiments.
Table 3 shows the nutritional value of the feedstuffs used.

Table 3. Nutritional value of feedstuffs

| Quality indicators | 1-4 weeks | 5-6 weeks | 7 weeks and older |
|--------------------|-----------|-----------|------------------|
| Exchange energy, kcal/100 g | 286 | 292 | 267 |
| Crude protein, % | 23.46 | 22.53 | 18.94 |
| Raw fiber, % | 5.19 | 4.50 | 4.69 |
| Calcium, % | 0.99 | 1.26 | 3.41 |
| Total phosphorus, % | 0.75 | 0.82 | 0.68 |
| Lysine | 1.39 | 1.36 | 1.05 |
| Methionine | 0.67 | 0.66 | 0.47 |
| Methionine + Cystine | 1.00 | 1.01 | 0.75 |

Thus, the feeding of quail was carried out by feedstuffs, which were balanced in composition and nutrition.

The feed additive production scheme consists of the following operations: double washing of wheat seeds, sterilisation, soaking of seeds using mineral water Goryachij Klyuch no. 104, germination with established temperature and time parameters. Then, paste is obtained from seedlings, seeded by a consortium of microorganisms, cultured. Then the next is the gentle drying to give the product a more convenient process shape.

Table 4 shows the characteristics of the obtained bioproduct in two different process forms.

Table 4. Characteristics of the developed bioproduct

| Al₂O₃ powder content, % | Sphericity coefficient of lead inclusions | Average size of lead inclusions, µm |
|------------------------|------------------------------------------|-------------------------------------|
| Moisture,% | 10.1 | 56.8 |
| Raw fiber,% | 9.9 | 11.0 |
| Crude protein,% | 10.8 | 14.2 |
| Raw fat,% | 1.0 | 1.4 |
| Toothless extractive substances of fodder, % | 60.0 | 13.0 |
| Ash,% | 8.2 | 3.6 |
| Vitamin E, mcg/g | 214 | 215 |
| Vitamin B2, mcg /g | 7.1 | 6.6 |
| Carotene, % | 14.8 | 16.1 |
| Number of microorganisms, CFU at expiration date |
| – Lactobacillus acidophilus | 2.2×10⁷ | 3.2×10¹⁰ |
| – Saccharomyces cerevisiae | 8.1×10⁸ | 5.1×10⁹ |

3. Results and its discussion
The data obtained from the experiment are shown in Table 5.

The highest safety of the livestock was observed in the fourth experimental group and amounted to 100%. In the second and third trial groups, the percentage of preservation was also high and was 95.5% in both groups. In control, the percentage of preservation was the lowest and amounted to 90.7%.

The living mass of quail on the fourth day had practically no difference, which is a necessary condition for conducting an experiment in assessing the growth energy during the equalizing period of the bird.
Table 5. Effect of different doses of bioproduct on main zootechnical indices of quails, n = 22

| Indicators                      | Groups                      | 1-st contol | 2-nd experimental | 3-d experimental | 4-th experimental |
|--------------------------------|-----------------------------|-------------|-------------------|------------------|-------------------|
| Safety, %                      | 90.9                        | 95.5        | 95.5              | 100              |
| 4 days                         | 19.09±0.10                  | 19.27±0.10  | 19.04±0.12        | 19.22±0.11       |
| 7 days                         | 28.72±0.45                  | 36.36±0.57* | 33.72±0.61*       | 31.72±0.59*      |
| 14 days                        | 76.02±2.12                  | 90.54±2.10* | 92.01±1.96*       | 87.54±2.06*      |
| 21 days                        | 148.68±3.12                 | 157.72±2.90*| 165.0±3.02*       | 162.27±2.87*     |
| 28 days                        | 210.00±4.27                 | 202.42±4.21 | 222.91±4.10*      | 217.92±4.31      |
| 35 days                        | 252.61±5.21                 | 255.45±5.12 | 265.90±4.90*      | 258.63±5.12      |
| 42 days                        | 287.90±5.58                 | 290.85±5.63 | 307.90±5.56*      | 285.27±5.72      |
| 49 days                        | 302.80±6.24                 | 317.42±6.21 | 327.52±6.20*      | 303.54±6.15      |
| 56 days                        | 311.80±6.97                 | 319.33±7.08 | 338.76±6.86       | 311.45±7.100     |
| Increase in live weight of quail during the growing period |                           |             |                   |                  |
| Total, kg                      | 5.85                        | 6.30        | 6.71              | 6.42             |
| Daily average, g               | 5.22                        | 5.35        | 5.70              | 5.21             |
| One head on average, g         | 292.71                      | 300.06      | 319.72            | 292.23           |

Note: * - difference with control is valid (P < 0.05)

On the seventh day, the largest increases were obtained in the second group, they reached 36.36 g. In the third group, the increase was 33.72 g, and in the fourth - 31.72 g. In control, this indicator was at the level of 28.72 g.

For the second week, the live mass of quail in the experimental groups exceeded the control by 19.1; 21.0; 15.1% (second, third and fourth groups).

For the third week of scientific and economic experience, the indicator of living weight dynamics in experimental groups exceeded the indicator of the control group by 6, 10.9 and by 9.1%. Accordingly, the average weight in the second group was 157.72 g, in the third group - 165.0 g, and in the fourth group - 162.27 g. In the first control group, the average weight of birds was 148.68 g.

For the fourth week of quail life, the increase in the 3rd experimental group and in the 4th experimental group was higher by 5.6% and by 3.7% than that in control. In the second experimental group, the values were 3.6% less than that the control.

On day 35 of clinical observation, the difference in gains was 1.1% in the second, 5.3% in the third group and 2.4% in the fourth group, respectively, compared to the control.

On the 42nd day of the experience, the indicators of the experienced also continued to differ towards an increase in growth, compared with control. The increase in living weight of the second group was 1% more, the increase in the third group - 6.7%. However, the performance of the fourth pilot group and control was almost at 285.27 g for the fourth pilot group and 287.90 g for the control group.

On the 49th day of experience, the performance of control groups deteriorated slightly. Growth of the second group was 4.82% higher than that in the control group, growth of the third group was 8.2% higher. The fourth group did not have significant differences in performance compared with the controls. (gains in the 4th group were more control on the 0.5%).

In the last week of the test, the live weight of the control groups was 2.4 and 8.6% higher than the control (second and third trial groups, respectively). The data of the fourth pilot group remained at the same level as the control.

The obtained and analyzed data indicate a positive effect of the developed fodder synbiotic supplement on the poultry body. The amount of feed to obtain 1 kg of live weight gain in the second group was 4.16 kg, in the third group - 3.69 kg, in the fourth group - 3.89 kg. In the control, the amount of feed to produce 1 kg of live weight gain was 4.33 kg.

The increase in live weight of birds in experimental groups compared with control can be justified by the positive effect of the developed bioproduct, which contributes to an increase in the digestibility of nutrients of the feed, as well as provides combined feed with additional vitamins. In addition, the
developed drug is a probiotic agent, which ensures better safety of the livestock.

Digestion is a complex process consisting of mechanical, enzymatic and biological (microbial) processing of feed. Therefore, the absorption of nutrients depends on many factors, among which it is worth naming both the age characteristics and the properties of the feed itself.

The factors determining nutrient digestibility of the diet are very diverse. Conventionally, they can be divided into 2 groups: factors related to the animal body itself and factors related to feeding. The determination of nutrient digestibility is presented in Table 6.

| Indicators                             | Groups                           | 1-st control | 2-nd experimental | 3-d experimental | 4-th experimental |
|----------------------------------------|----------------------------------|--------------|-------------------|------------------|-------------------|
| Organic matter                         |                                  | 62.2±1.32    | 62.8±1.18         | 63.6±1.25        | 62.6±1.89         |
| Raw fiber                              |                                  | 51.1±1.07    | 52.4±1.98         | 55.0±1.16        | 55.9±1.23         |
| Crude protein                          |                                  | 73.8±1.57    | 74.8±1.68         | 74.9±1.58        | 74.3±1.49         |
| Raw fat                                |                                  | 70.7±1.43    | 71.5±1.50         | 71.7±1.52        | 72.2±1.54         |
| Toothless extractive substances of fodder |                                | 56.9±1.16    | 57.6±1.23         | 58.5±1.30        | 57.9±1.28         |

Thus, the introduction of the developed bio-additive into the diet positively affects the process of digestibility of nutrients in feed. Compared to the control, fiber digestibility increased by 2.5% in the 2nd experimental group, by 7.8% in the 3rd experimental group and by 9.5% in the 3rd experimental group. Digestibility of raw fat, raw protein and toothless extractive substances of fodder by bioproduct administration was slightly increased.

Recently, there has been increased attention to the study of acid binding ability of the feed. This is especially important for birds when kept under stress, when digestive disorders are prevented by regulating acid binding ability of the feed. The higher the acid binding ability of the feed, the worse the digestion of the components of the feed in the animal body. In addition, the probability of developing a pathogenic microflora, primarily E. coli and Salmonella, increased several times. Quail meat productivity is shown in Table 7.

| Indicators                             | Groups                           | 1-st control | 2-nd experimental | 3-d experimental | 4-th experimental |
|----------------------------------------|----------------------------------|--------------|-------------------|------------------|-------------------|
| Live mass of bird before slaughter, g  |                                  | 308.7±6.25   | 321.6±7.02        | 325.2±6.97       | 318.2±6.75        |
| Mass of carcass after bleeding, g      |                                  | 280.6±6.13   | 298.8±6.21*       | 300.1±6.54*      | 293.5±6.33        |
| % to live mass                         |                                  | 90.9         | 92.9              | 92.3             | 92.2              |
| Mass of unsheltered carcass, g         |                                  | 278.3±5.48   | 281.4±5.23        | 293.5±5.87       | 280.6±5.22        |
| % to live mass                         |                                  | 90.1         | 87.5              | 90.2             | 88.1              |
| Mass of rippled carcass, g             |                                  | 200.4±4.32   | 212.4±4.18        | 219.8±4.45*      | 209.1±4.48        |
| % to live mass                         |                                  | 64.9         | 66.0              | 67.5             | 65.7              |
| Hip muscle mass, g                     |                                  | 21.4±2.06    | 24.5±2.12         | 27.3±2.65        | 25.5±2.36         |
| % to live mass                         |                                  | 6.9          | 7.6               | 8.4              | 8.0               |
| Shin muscles, g                        |                                  | 10.8±1.07    | 11.8±1.57         | 13.2±2.05        | 12.0±1.45         |
| % to live mass                         |                                  | 3.5          | 3.6               | 4.0              | 3.7               |
| Pectoral muscles, g                    |                                  | 60.1±2.63    | 62.5±2.87         | 65.1±2.43        | 64.9±2.57         |
| % to live mass                         |                                  | 19.4         | 19.4              | 20.0             | 20.4              |
| Other muscles, g                       |                                  | 12.5±0.62    | 13.5±0.87         | 13.7±1.02        | 12.6±0.78         |
| % to live mass                         |                                  | 4.0          | 4.2               | 5.8              | 3.9               |
| Total edible muscles, g                |                                  | 104.8±2.21   | 112.3±2.57        | 119.3±2.35*      | 115.0±2.17*       |
| % to live mass                         |                                  | 33.9         | 34.9              | 36.6             | 36.1              |

Note: * - difference with control is valid (P < 0.05)
Thus, the mass of the ripped carcass in the 2nd experimental group was higher than that in the 5.9% control. In the 4th experimental group, the mass of the ripped carcass was higher than that in the 4.3% control. The best results were shown in the 3rd experimental group, where the mass of the ripped carcass was higher than the 9.6% control.

When evaluating the edible parts of the quail body, the largest increase in femoral muscle mass, relative to control, was also observed in the 3rd experimental group (the difference was 27.5%).

The largest mass of shin muscles could be observed in the 3rd experimental group, the indicator exceeded the control by 22.2%. The indicators of the 2nd and 4th experimental groups had practically no difference and on average exceeded the control by 19%.

The largest mass of thoracic muscles was quail in the 3rd experimental group, the mass was 65, 1 g, which was 8.3% more control.

Thus, the mass of edible muscles in all experimental groups was 7.1% more control; 14.7%; 9.7% (2nd, 3rd and 4th experimental groups, respectively).

To fully assess the effect of the resulting bioproduct on the meat productivity of quail breeds, the Texas White was analyzed for internal organ development at 56 days of age.

All the weight organs under investigation were within normal limits. It was also found that the synbiotic bioproduct positively affects the quail body, since there is a decrease in the amount of abdominal fat in experimental groups. So the amount of fat decreased by 5.76% in the 2nd experimental group, by 18.08% in the 3rd experimental group and by 14.27% in the 4th experimental group, compared to the control.

The measure of the energy value of meat in all experimental groups was practical equivalent and ranged from 535-550 kJ. In the 4th control group, there was a slight decrease in energy value compared to other experimental groups, since the energy value in kJ reached 548.95, or 131.14 kcal.

For the tasting evaluation of meat and quail broth, the pectoral and femoral muscles of quail carcasses were boiled. No significant differences were found in the test samples, the meat had a brown-gray color, a specific smell and a pleasant taste. The broth was clear, with a build-up of fat on the surface.

4. Conclusion
When examining the product at various dosages in the scientific and economic experience, the best result was obtained by administering it at a dose of 2% to the weight of compound feed. The introduction of the product in this dose increased the live weight of quail by 8.6%, increased their safety by 5% and reduced feed consumption by 15.1%, and as a result, the amount of feed to obtain 1 kg of live weight growth was 3.69 kg in the third group, against 4.33 kg in control. The introduction of the developed bio-supplement into the diet also positively influenced the digestibility of basic nutrients in the feed, especially fiber. Compared to the control, fiber digestibility increased in the 3rd experimental group per 7.8% (with the introduction of the product at a dose of 2%). However, digestibility of raw fat, raw protein and toothless extractive substances of the feed in connection with the introduction of the bioproduct increased to a lesser extent. The mass of the ripped bird carcass increased by 4.3-9.6%.

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