The feasibility of using a probiotic to increase the egg productivity of chickens

Olga Krotova[1*], *Olga* Sangadzhieva[2], *Olga* Kedeeva[2], *Kermen* Khalgaeva[2], and *Amulanga* Manzhikova[2]

[1] Don State Technical University, 1, Gagarin Sq., Rostov-on-Don, 344003, Russia
[2] Kalmyk State University named after B.B. Gorogovikov, 11, Pushkin St., Elista, 358000, Russia

Abstract. The authors conducted a scientific and economic experience in LLC "Alyona". For research on the principle of analogues from chickens of the Rhodonite-2 cross, 2 groups (400 heads each) were formed from the daily age, taking into account gender, body weight and physiological condition. The duration of rearing of the repair young was 17 weeks, after which the bird was transferred to the laying hens workshop. The planting density, light mode, and feeding front of birds of all groups were the same and corresponded to the norms of VNITIP. Feeding was carried out with the same full-fledged compound feed, balanced in all nutrients and metabolic energy, with the inclusion of a probiotic SUB-PRO in the feed mixture of the experimental group. The introduction of a probiotic into the diet when raising chickens up to 13 weeks of age ensured a higher safety of young animals in the experimental group. The addition of a probiotic reduced feed costs. During the growing period of 1-13 weeks, feed costs per 1 kg of growth were lower in the experimental group, by 3.3% for 14-21 weeks and by 3.9% during the experiment period.

1 Introduction

In industrial poultry farming, vaccinations, deworming are carried out to prevent diseases, preserve poultry, increase their productivity, antibiotics and other chemotherapy drugs are often used. Most of them have a negative effect on the bird's body, often causing dysbiosis. The use of antibiotics significantly disrupts the microbalance in the intestines of young animals and poultry [1, 2].

In order to ensure the environmental safety of food products, the use of antibiotics in the cultivation of farm animals and the production of livestock products is prohibited in the countries of the European Union. Therefore, all over the world, including Russia, there is an active development and implementation of safe, effective probiotic drugs as an alternative to antibiotics [2, 3].

The development of I.I. Mechnikov's idea of purposefully changing the composition of the microflora of the gastrointestinal tract by enteral administration of cultures of lactic acid bacteria as antagonists of putrefactive microbes took shape and led to the creation of a new class of bacterial preparations – probiotics [4].

* Corresponding author: alb9652@yandex.ru

Considering the problem of dysbiosis, biological preparations from normal microflora used for the prevention and treatment of this disease are called, probiotics are drugs and food products that include substances of microbial and non–microbial origin, which, with the natural method of administration, have beneficial effects on the physiological functions and biochemical reactions of the host organism through optimization of its microbiological status. This definition assumes that any living or killed microorganisms, their structural components, metabolites, as well as substances of other origin that have a positive effect on the functioning of the host microflora, contributing to its better adaptation to the environment in a particular ecological niche, can be considered as probiotics [5, 6].

The lack of a clear definition of drugs in this group, apparently, can be explained by insufficient knowledge of their pharmacodynamics. This became possible due to the fact that most authors attributed probiotics to feed additives. Based on the results of our long-term research, we believe that probiotics should be attributed to medicines that are preferable to use for preventive therapy and as ergotropics. In our opinion, probiotics are stabilized cultures of microorganisms and their fermentation products that have the property of optimizing intestinal microbiocenoses, suppressing the growth and development of pathogenic and conditionally pathogenic microflora, increasing metabolic processes and protective reactions of the body, activating cellular and humoral immunity [7-9].

For the production of probiotics, non-spore-forming bacteria were initially used, which have the properties to secrete lactic, acetic, propionic and other acids during the fermentation of carbohydrates. Since acidophilic bacillus prevails in the normal microflora of warm-blooded animals, acidophilic broth culture (ABC) was used as a probiotic [10, 11].

In the future, propionic acid bacteria were added to the ABC to enrich the drug with B vitamins, which undoubtedly improved the quality of the drug and expanded its scope of application. This drug began to be produced under the name PABC. The use of ABC and PABA increased the overall stability of animals and improved digestion, prevented the development of infectious diseases, cured gastrointestinal diseases, stimulated the growth of young animals, and also improved the course of pregnancy [11, 12].

Later, on the basis of live bifidobacteria and lactobacilli, various preparative forms were created (lactobacterin, bifidumbacterin, acidophilus, colibacterin, etc.), which are still widely used to restore normal microflora and treat gastrointestinal diseases. Bifidobacteria and lactobacilli, which predominate in the normal microflora of animals, suppress the reproduction of pathogenic and conditionally pathogenic microorganisms by acidification of the habitat and the development of antibiotic substances. Once in the gastrointestinal tract, the microorganisms present in these preparations multiply, synthesize many biologically active substances (organic acids, lipids, vitamins, antibiotics, immunomodulators, etc.) and increase the nonspecific resistance of the host organism [13].

Bifidobacteria prevent the development of dysbiosis. In the process of their vital activity, vitamins B1, B2 and K are formed, as well as lactic and acetic acids. Acidic environment promotes better absorption of fats, vitamins, iron and calcium, delays the reproduction of pathogenic and opportunistic microorganisms.

Over time, the range of microorganisms used for obtaining probiotics expanded. The development of lyophilization technology has allowed to solve these problems, now probiotics are produced in the form of dry preparations of lyophilically dried microorganisms in pure form or in technical form with a nutrient medium. Milk powder, sucrose are used as fillers for dry preparations, and corn, fish or other flour is used for the technical form. Such forms are most convenient (unlike liquid ones) for group assignment to animals with food [14].

The most promising for the creation of probiotics were bacilli belonging to the species Bacillus subtilis, B. pumilus, B. polymyxa. These species are consistently isolated from a variety of biotopes, including from the body and tissues of warm-blooded, insects and

plants. The strains of these species are characterized by high resistance to adverse environmental conditions, enzymatic and antagonistic activity. Live cultures of spore-forming aerobic bacteria from the genus Bacillus should be considered environmentally friendly and promising for use in animal husbandry [15].

2 Materials and methods

Scientific and economic experience was conducted by LLC "Alyona".

LLC "Alyona" specializes in the production of chicken eggs. Every year, the factory sells more than 120 million pieces of eggs to consumers, over 1,000 tons of chicken meat, the production of semi-finished meat products has been established, these are various sets of packaged meat, sets of offal, and special sets of chicken fat.

The average number of poultry is 670 thousand heads, including laying hens - more than 400 thousand heads.

The productivity of poultry exceeds 300 eggs from each laying hen per year.

For research on the principle of analogues from chickens of the Rhodonite-2 cross, 2 groups (400 heads each) were formed from the daily age, taking into account gender, body weight and physiological condition. The duration of rearing of the repair young was 17 weeks, after which the bird was transferred to the laying hens workshop. The scheme of the experience is presented in Table 1.

Table 1. Scheme of experience.

Group	The studied indicator
1- control	Basic diet
2- experienced	Up to 17 weeks of age OR + SUB-ABOUT drinking through water at the rate of 20 g per 1000 heads, from 18 weeks of age OR + 50 g per 1000 heads, for an adult bird 1 time within 5 days

The planting density, light mode, and feeding front of birds of all groups were the same and corresponded to the norms of VNITIP. Feeding was carried out with the same full-fledged compound feed, balanced in all nutrients and metabolic energy, with the inclusion of a probiotic SUB-PRO in the feed mixture of the experimental group.

The effectiveness of the drug was taken into account and studied according to the following indicators: safety of livestock — daily inspection of the bird and accounting of its case;

the development of reproductive organs was determined at the slaughter of young chickens of 4 heads from each group: the weight of the ovary and oviduct was weighed on electronic scales with an accuracy of 0.1 g, the length of the oviduct was set on millimeter paper with an accuracy of 0.1 cm.;

egg productivity was assessed by daily counting of the number of eggs laid; egg weight — by individual weighing on electronic scales with an accuracy of 0.1 g for 5 adjacent days of each month with their division into incubation categories, the mass of egg products (kg) for the initial and average laying hen was calculated respectively as the product of egg production of the initial, average laying hen and average weight one egg;

the intensity of egg laying was determined by the ratio of the number of eggs laid to the number of feed days, expressed as a percentage;

the conversion of compound feed to produce 10 eggs and 1 kg of egg mass was calculated by dividing the feed actually eaten by the number of eggs received and the amount of egg mass.

The quality of eggs was assessed according to the following indicators: the mass of protein, yolk, shell, unit of HOW, density, thickness of the shell, content of carotene, vitamin A, B2 in the yolk of eggs – by weighing and chemical analysis according to the methods.

The thickness of the shell was determined using a micrometer with an accuracy of 0.01 mm on three sections of the egg and the average value was calculated.

The density of the egg mass is determined by double weighing in air and in water.

The yield of incubation eggs is the ratio of the number of eggs suitable for incubation to the number of all eggs examined (%), and incubation qualities (fertilization, hatchability, hatchling and incubation waste) - by incubating eggs from each group at 26; 44 and 59 weeks of age of laying hens. The fertilization of eggs was determined by the ratio of the number of fertilized eggs to the number laid for incubation, expressed as a percentage.

The hatchability of eggs was expressed as the percentage of healthy young bred from the number of fertilized eggs.

The brood of young animals was determined by the percentage of the brood of young animals from the number of eggs laid for incubation.

The research results were processed by methods of mathematical statistics according to N.A. Plokhinsky (1970). Individual data were processed by single-factor analysis of variance.

The change in the live weight of the bird was controlled by monthly individual weighing of the control livestock in the morning before feeding.

In conditions of intensive industrial poultry farming, the main technological principle of productivity management is the feeding of full-fledged compound feeds to poultry in plenty or in a regulated mode.

Complete compound feeds are produced by enterprises of the feed industry according to the standards of maintenance, in particular for laying hens, individual nutrients and metabolic energy.

The basis of compound feed for chickens (Table.3) in our experience, plant-based feed was used, which accounted for 86% in the starting compound feed, 93% during the growth period and 88% when transferring young animals to an adult herd.

The starting compound feed consisted of 30% corn; 29.8% wheat; 11% fishmeal; 4.5% sunflower cake; 22% soy cake and 2.9% mineral additives.

In the second growing period, chickens received 20% of corn, 34% of wheat, 10.5% of barley, 11% of sunflower cake; 15% of soybean cake in the diet. 2.5% sunflower oil and 7% protein-vitamin supplements.

And in the final growing period, the diet of youngsters consisted of

41.8% corn, 11% wheat, 20% bran; 5.8% fishmeal; 14% sunflower cake; 6.5%% protein-vitamin supplements.

For egg hens, the rations are made taking into account changes in the nutritional needs of the bird, depending on age and productivity. The feeding of laying hens was divided into three phases. The first phase, from 92 to 141 days of age, was the pre-laying phase, the phase for stimulating egg production with the highest nutritional content, included 88.2% of vegetable feed; 4.8% of animal feed; 7.0% of vitamin and mineral supplements. The second phase provides a high egg-laying capacity of laying hens. The main part of the diet was occupied by vegetable feed – 82.0% and 4.0% of animal feed. The amount of protein-vitamin-mineral supplements in the diet was 14%.

The third phase of feeding was used for age-related declines in egg productivity, while the proportion of calcium in the diet decreased and the phosphorus content increased.

Feeding the SUB-PRO probiotic to the repair young did not have a negative effect on the indicators of live weight of poultry (Table 2).

Table 2. Dynamics of live weight (g) livestock safety (%).

Age, weeks	Group		Group 2 in % to 1
	control -1	experienced- 2	
daily allowance	36,1±0,07	36,2±0,07	-
4	326,3±3,4	333,3±2,34	+ 2.1
8	683,5±7,28	713,2±3,08	+4,3
13	1118,6±9,66	1151,0±8,07	+2,9
21	1796,0±12,34	1855,0±10,0	+3,3
Safety of livestock, %			
1-13	98,0	100,0	+2
13-21	100,0	100,0	

** - P<0,01; ***P<0,001

With almost the same staged live weight at the daily age, the chickens of the experimental group exceeded this indicator in the control group at the age of 4 weeks by 2.1%, 8 weeks – by 4.4%, at 13 weeks by 2.9% and when transferring the young to the adult herd by 3.3%.

Throughout the cultivation, the safety, as in both in the experimental and control groups, it was quite high. However, it should be noted that the introduction of a probiotic into the diet when raising chickens up to 13 weeks of age ensured a higher safety of young animals in the experimental group.

The dynamics of changes in the average daily increments of young animals corresponds to changes in their live weight.

The average daily feed intake in the groups was the same 85.9 g, but a completely different picture is presented in the table, which shows the conversion of feed.

Table 3. Feed costs per 1 kg of live weight gain, kg.

Age, weeks	Group	
	control	experienced
1-13	3,70	3,58
14-21	7,70	7,37
1-21	5,70	5,48

The addition of a probiotic reduced feed costs. During the growing period of 1-13 weeks, feed costs per 1 kg of growth were lower in the experimental group, by 3.3% for 14-21 weeks and by 3.9% during the experiment period.

Thus, it can be concluded that probiotics have a positive effect on the indicators of live weight, safety and feed costs.

It is known that in the pre-laying period, reproductive organs are formed and begin to function in young chickens. We studied the physiological parameters and development of reproductive organs in the first week of oviposition (Table 4).

Table 4. Development of reproductive organs of young.

Indicator	Group	
	control	experienced
Crest height, cm	1,20±0,03	1,33±0,03
Comb length, cm	1,30±0,06	1,57±0,07
Ovarian mass, g	21,718±1,085	24,193±0,689
Weight of the oviduct, g	26,613±0,831	30,967±0,371
Length of the oviduct, cm	41,750±2,562	57,625±1,143

It was found that the height of the crest of the chickens of the experimental group increased by 10.8%, and the length by 20.8% compared to the control.

The inclusion of the probiotic SUB-PRO in the feed mixture had a positive effect on the growth of the ovary, as well as the mass and length of the oviduct. The average weight of the ovary in young chickens of the experimental group was 24.193 g, which is 11.4% more than the weight of the ovary in chickens of the control group. According to the average weight of the oviduct, the young also exceeded the control by 16.36%. The average length of the oviduct was 38% shorter in the control group of young women.

Therefore, we can conclude that the introduction of probiotics has a stimulating effect on the development of reproductive organs. This subsequently had a positive effect on egg laying hens (Table 5).

Table 5. Egg productivity of laying hens.

Indicator	Group		Group 2 in % to 1
	control -1	experienced-2	
Livestock at the beginning of the experiment, heads	364	364	100
Average livestock, heads	339	350	+3,24
Egg production per initial laying hen, pieces	266,63	291,04	+9,12
Egg production per average laying hen, pieces	286,36	302,72	+5,69
Gross production of eggs, pieces	97415	106300	+9,12
Average egg weight, g	60,10±0,12	60,86±0,13	+1,25
Weight of egg products per laying hen, kg	5853,86	6467,93	+10,49
initial	16,07	17,76	+10,51
average	17,26	18,48	+7,01
Duration intensity of oviposition, days			
Oviposition intensity,%	84,87	89,47	+4,60
Index of egg production intensity, %	45,40	52,84	+16,13
Feed costs, kg			
per 1 kg of egg mass	2,415	2,263	-6,2
For 10 eggs	1,452	1,378	-,1

When the studied drug was introduced into the diet, an increase in egg production was noted for the initial and average laying hen, respectively, by 9.12 and 5.69%. In the experimental group of chickens, the intensity of egg laying was 52.84%, compared to 45.4% in the control group of chickens.

According to the index of egg laying intensity, laying hens of the experimental group exceeded analogues by 16.13%, which affected the gross egg production.

Egg weight is one of the most important indicators of chicken productivity. It was greatest in the laying hens of the experimental group and exceeded this control indicator by 1.25% percent.

Along with this, a positive effect on feed conversion has been established. For the formation of 1 kg of egg mass and 10 pcs . eggs they spent less feed.

Introduction of SUB-PRO probiotic in laying hens, the number of eggs of the "large" category increases (Table 6).

Table 6. Egg yield by category.

Category of eggs	Requirements of OST 10321-2013,year	Group					
		control			experienced		
		weight, g	pieces	%	weight, g	pieces	%
large	66-75	66,75 ±0,12	9239	9,48	67,32 ±0,19	13386	12,59
medium	58-65	59,93 ±0,09	81555	83,72	60,38 ±0,09	86497	81,37
small	48-57	52,94 ±0,18	6622	6,80	53,77 ±0,20	6418	6,04

The number of eggs classified as "large" in the laying hens of the experimental group was 12.59%, which is 3.2% higher than in the analogues of the control group. As a result of the use of probiotics, the number of eggs of the "average" category increased and the number of small eggs laid decreased.

Thus, the addition of a SUB-PRO probiotic ensures high egg productivity, and the yield of eggs classified as "large" and "medium".

Morphological parameters of eggs have a certain effect on incubation, so we studied this indicator (Table 7).

Table 7. Morphological qualities of eggs of laying hens in the age aspect.

Indicator	Group	
	control	experienced
At the age of 26 weeks		
Egg weight, g	57,16±0,20	57,62±0,013***
Shell weight, g	5,77±0,02	5,70±0,023
% by weight of egg	10,1±0,03	10,013±0,03
Yolk weight, g	15,68±0,09	15,83±0,06
% by weight of egg	27,44±0,18	27,48±0,10
Protein weight, g	35,53±0,17	36,17±0,68**
% by weight of egg	62,16±0,14	62,8±0,18
Protein height, mm	7,11±0,05	7,25±0,012
Shell thickness, microns	0,342±0,003	0,374±0,004
Egg density, g/ cm3	1,073±0,001	1,088±0,001
Unit of HOW	85,10	85,20
At the age of 44 weeks		
Egg weight, g	61,99±0,020	62,116±0,11
Shell weight, g	6,54±0,13	6,40±0,84
% by weight of egg	10,54±0,203	11,17±0,18
Yolk weight, g	17,78±0,10	18,33±0,100***
% by weight of egg	27,44±0,18	27,48±0,10
Protein weight, g	37,17±0,06	37,44±0,07**
% by weight of egg	59,9±0,19	60,3±0,11
Protein height, mm	7,176±0,024	7,217±0,015
Shell thickness, microns	0,351±0,013	0,374±0,004
Egg density, g/ cm3	1,079±0,001	1,091±0,001
Unit of HOW	84,00	84,10

3 Results

The introduction of the probiotic drug SUB-PRO had a positive effect on the morphological composition of eggs. Their protein mass increased relative to the control by 1.79% at 26

weeks of age and by 0.71% at 44 weeks of age. The proportion of yolk also increased in the various periods studied.

In the laying hens of the control group, the thickness of the shell was within the normal range, whereas in experimental chickens this indicator was higher by 9.36 and 6.66% at 26 and 44 weeks of age. The density of eggs determines the strength of the shell, on which the safety of eggs during selection and transportation depends. I. as previous indicators, the density of the shell was higher in eggs laid by chickens of the experimental group.

The indicators of HOW units of eggs of both groups were almost the same.

Thus, it can be concluded that the probiotic drug has a positive effect on the morphological composition of eggs.

The evaluation of the incubation qualities of eggs is given in Table 10.

Evaluation of the incubation qualities of eggs of laying hens who consumed probiotic with and without food showed the highest fertilization of eggs of chickens who consumed the probiotic with food. The results of biological control carried out during incubation indicate that in the eggs of chickens that consumed probiotic, embryonic development took place more intensively and contributed to a decrease in the level of incubation waste.

Due to the strengthening of competitive principles in the domestic poultry industry of the country, the stability of the company's position in the poultry products market, competitiveness, financial efficiency and efficiency come to the forefront. The constant search for a rational model of survival and further development of a poultry enterprise in the conditions of changing market conditions in terms of consumer demand and the development of profitable product niches in the poultry market determines the search for new technologies for keeping and feeding poultry (Table 8).

Table 8. Effectiveness of feeding probiotic to SUB-PRO laying hens.

Indicator	Group control	Group experienced
Livestock at the beginning of the experiment, heads	364	364
Average number of laying hens, heads	339	350
Egg production per average laying hen, pieces	266,6	291,0
Gross production of eggs, pieces	97415	106300
incl. incubation	75984	85040
food	21431	21260
Feed costs per 10 eggs, kg	1,452	1,378
Total feed consumed, kg	14145	11718
For the amount, rubles	113160	93748
Including the cost of probiotic, rubles	-	4
Production costs, total, rubles	161657	133926
Eggs sold in the amount of rubles	539904	594240
incl. incubation	455904	510240
Profit, rubles	378247	460314
Profitability level, %	2,4	3,4

4 Discussion of the results

In our research, we studied the effect of a probiotic drug
SUB-PRO on the productive qualities of laying hens and carried out a calculation of economic efficiency.

Calculations of economic efficiency have shown the feasibility of using probiotics from an economic point of view.

In the experimental group, feed costs for production decreased. With the same cost of 1 kg of feed, in the control group, the cost of purchasing feed was higher than in the experimental group by 19412 rubles.

In the experimental group, a larger number of hatching eggs were obtained and the cost of implementation was higher.

The profitability level in the experimental group was 3.4%.

5 Conclusions

Feeding SUB-PRO probiotic to the repair young had a positive effect on the live weight of the bird.

With almost the same staged live weight at the daily age, the chickens of the experimental group exceeded this indicator when transferring the young to the adult herd by 3.3%.

The introduction of a probiotic into the diet when raising chickens up to 13 weeks of age ensured a higher safety of young animals in the experimental group.

The addition of a probiotic reduced feed costs. During the growing period of 1-13 weeks, feed costs per 1 kg of growth were lower in the experimental group, by 3.3% for 14-21 weeks and by 3.9% during the experiment period.

When the studied drug was introduced into the diet, an increase in egg production was noted for the initial and average laying hen, respectively, by 9.12 and 5.69%. In the experimental group of chickens, the intensity of egg laying was 52.84%, compared to 45.4% in the control group of chickens.

Evaluation of the incubation qualities of eggs of laying hens who consumed probiotic with and without food showed the highest fertilization of eggs of chickens who consumed the probiotic with food.

The results of biological control carried out during incubation indicate that in the eggs of chickens that consumed probiotic, embryonic development took place more intensively and contributed to a decrease in the level of incubation waste.

To increase the level of realization of the biological potential of repair young and laying hens, a probiotic SUB-PRO should be used. Up to 17 weeks of age, carry out drinking through water at the rate of 20 g per 1000 heads from 18 weeks of age, OR + 50 g per 1000 heads for an adult bird 1 time for 5 days.

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