Comparative use efficiency of the same type feed additives in the diet of replacement stock and laying hens of the parent herd

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Abstract. The use of two similar feed additives Sorbitox and Probitox in the diet of replacement stock and subsequently in the diet of laying hens, at a dose of 0.50 kg/t of feed allowed to increase the poultry survival rate at 18 weeks of age by 1.4% with the addition of Sorbitox and 6.4% - with Probitox, the group uniformity by 5.3 and 7.3%, respectively, in comparison with the control group. At the same time, the culling of birds in the experimental groups decreased due to endoenteritis and necrotic enteritidis, and the antibody titer to Gumboro disease increased in the blood. During the productive period of laying hens, the difference in the antibody titer was significantly higher, as was the livestock survival rate. The tested feed additives contributed to a better development of ovogenesis organs. As a result, the egg productivity of chickens with Sorbitox was higher than the control group by 6.5%, with Probitox – by 11.6%. The study of the egg incubation qualities showed that the young stock hatching rate from an average egg size in the group with Sorbitox was 6.9% higher than the control group, with Probitox – by 11.0%, and the hatchability of eggs was 1.1 and 1.6% higher than in the average one. In laying hens at the beginning and at the end of egg laying, the number of infertile small eggs decreased in the group with Sorbitox by 0.60%, with Probitox - by 1.0%, large eggs – by 1.23 and 2.45%, respectively. The chicken hatching rate from small and large eggs in poultry of the experimental groups exceeded the control by 2.9-5.9% at the beginning of egg laying, by 10.0-14.8% - at its completion at the age of 56 weeks. The addition of Sorbitox in the diet of replacement stock allowed to reduce feed costs for growing one head of service pullet by 6.9%, with Probitox – by 12.6%, to increase the production profitability by 5.5 and 7.8%, and in laying hens of experimental groups, feed costs decreased by 4.4 and 10.0%, profitability increased by 2.0 and 5.3%, respectively.

1 Introduction

The success of poultry farmers in the Russian Federation in recent years is mainly connected with the intensive development of this industry [6, 12]. The private sector and small farms cannot meet the population need for eggs and poultry meat. Only large

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holdings on a regional scale solve this problem, as a result of which the proportion of poultry meat is the highest and approaches 50% of the gross meat production in the country.

Nevertheless, industrial technology is not free from shortcomings, both in terms of technology and veterinary services. First of all, it is the prevention of epizootics that occur by contact, through imported feed, feed additives, migratory, birds and other ways. Technologically, the bird's body is negatively affected by the cellular content and bird rate of stocking, stressful situations, human factor, which share in the modern process is among the leaders for all known reasons.

In one case or another, the first link of the body exposed to a foreign pathogen or technological factor is the body's immune system. Intestinal immunity, according to A.A. Grozina [1], T.A. Egorova, and T.N. Lenkova [4] is the main trigger mechanism of the pathological process in the body. Violation of the microbiome ratio and composition of the bird gastrointestinal tract is an important issue of modern industrial poultry farming. Various probiotic additives with lacto- and bifidobacteria offered as feed additives are effective only if they successfully transit to their destination – the small intestine for lacto- and the thick intestine for bifidobacteria. Given that these cultures are easily vulnerable to the acidic reaction of the environment, their protection should be very high. Not so is the spore-forming cultures of Bac. subtillis and lichiniformis. At present, this is the most promising group, various strains of which have formed the basis of many probiotic feed additives from mono- and several forms of bacterial cultures [8, 11, 13].

In many complex feed additives various sorbents are successfully used for the transit of bacterial forms. On their surface, they "purify" and remove from the body many toxins, non-oxidized metabolic products, viruses trapped in the crystal lattice pores. Such complex feed additives, including enzymes, are widely used as part of the complete feed of all poultry production groups in egg and meat production [5, 7, 9]. At the same time, the yeast cell membrane is of great interest, on the basis of which many additives of sorption-probiotic action are produced [10].

Nevertheless, no matter what effective feed additive is used in the diet of poultry without routine livestock vaccination from major infectious diseases, it is impossible to achieve high safety of livestock, its productivity and cost-effective management of the industry. At the same time, it is important for the veterinary service to determine by the antibody titer the effect of a certain composition of the biologically active complex on the immune status of the body. Studying this issue in the production cycle dynamics, the optimal timing of poultry revaccination is determined, it is possible to trace the effect of previous and subsequent vaccinations on the immune state of the body, as well as the effect of feed additives on it [2, 3].

In our research, the task was to study the effect of Sorbitox and Probitox feed additives on poultry productivity, livestock safety, egg incubation qualities, culling causes, immune status of the body to certain infectious diseases, economic indicators of the industry on the replacement stock and laying hens of the parent herd.

2 Materials and Methods

The livestock of the meat cross "Ross-308" of the agroholding LLC "Ravis-poultry farm Sosnovskaya", a second-order pedigree breeding unit for the cultivation of replacement stock and obtaining incubation eggs from laying hens of the parent herd, was chosen as the object of research. The cultivation of replacement stock and the maintenance of laying hens was carried out by floor method, in sections of 320 heads each. Throughout the entire production cycle, the main feed was a compound feed balanced in all nutrients, to which the I experimental group additionally received the Sorbitox feed additive, and the II experimental group received Probitox in the amount of 0.50 kg/t of feed. In matters of feeding, we were guided by the recommendations for this cross and the data of the VNITIP.

The poultry maintenance corresponded to the required zoohygienic parameters, watering was carried out through centralized water supply through drip drinkers, the distribution of feed was carried out under a feeding program in group feeding poultry feeders.

The change in the live weight of the replacement stock, according to which the group homogeneity was calculated, it was recorded by weekly weighing of the entire livestock, followed by the calculation of the absolute and average daily increase.

The safety of chickens and laying hens during the entire production cycle was considered every day with a pathoanatomic diagnosing, which allowed to diagnose the cause of culling.

The incubation qualities of eggs of laying hens were evaluated according to the generally accepted VNITIP method. At the same time, the hatching and hatchability of eggs at the beginning, middle, and end of the productive cycle of chickens were calculated.

Egg productivity of laying hens was considered in accordance with the age of the bird for each group separately.

To determine the effect of the studied feed additives on the immune status of the body, blood was taken to establish the antibody titer to a particular infectious disease of the poultry.

At the end of the production cycle, the calculation of feed costs for pullet growing and egg productivity of laying hens was carried out.

The digital material of the above-listed zootechnical studies was processed by the method of variation statistics on a personal computer with the determination of a reliable difference in the table of values of the reliability criterion (P).

3 Results and Discussion

Growth and development, characterizing quantitative and qualitative indicators of changes in the poultry body, largely depend on proper feeding. Especially on the amount and biological full-value of protein, energy security, availability of balancing additives and compliance with the required EPO. In contrast to meat in egg poultry farming, the dynamics of the live weight of the growing replacement stock is of great importance. An overestimated mass relative to the cross standard leads to the deposition of internal fat in the body, insufficient – to the underdevelopment of organs and tissues. In the feed used for the replacement stock, the concentration of metabolic energy in various age periods was at the level of 282 kcal and 260 kcal, crude protein – 17.03 and 13.51%, crude fiber – 4.57 and 3.51%, calcium – 1.06 and 0.95%, phosphorus – 0.71 and 0.69%, EPO was 165.6 and 192.5 kcal.

The consumption of such compound feed by chickens from daily to 18 weeks of age had a difference: in the control group it was 42.0 g in the first growing period up to the age of 5 weeks, 39.2 g in the I experimental group, 38.8 g in the II experimental group, 76.9 g, 71.6 g, and 66.2 g respectively in the second growing period.

In laying hens in the complete compound feed PK-1, the energy concentration was at the level of 280 kcal, crude protein – 19.0%, fiber -3.95, calcium – 1.05, phosphorus – 0.45%, EPO – 147 kcal. The average consumption of compound feed by chickens was 180-182 g per head.

Summing up the cultivation of replacement stock with the studied feed additives (Table 1), it can be seen that by the time the birds were transferred to the "young" group, their live weight in the two groups was close in value, while in the I experimental it was 2.7% inferior to the control ($P \leq 0.001$).

Table 1. Live weight of replacement stock for the growing period, g ($X \pm m_x$, n=320).

Age	Group		
	control	I	II
1 day	46.90±0.21	46.89±0.20	46.92±0.19
18 weeks	2062±8.79	2007±9.03***	2064±12.10
Absolute increase, g	2015.1±11.77	1960.1±13.5	2017.1±13.8
in % to the control group	100.0	97,3	100.1
Average daily live weight gain, g	16.52±0.20	15.72±0.27	15.90±0.20
Group uniformity, %	80.0	85.3	87.3
Livestock safety, %	89.7	91.1	96.6

The significant difference was considered when: *- P≤0.05; **- P≤0.01; ***- P≤0.001.

Data on the available weight of poultry at 18 weeks of age showed that the uniformity of the experimental groups in comparison with the control group was higher by 5.3 and 7.3%.

The use of Sorbitox and Probitox as part of compound feed for replacement stock increased the safety of poultry stock by 1.4 and 6.9% in comparison with the control group. This difference is explained by the higher resistance of poultry to viral and bacterial infections. Analysis of the causes of the replacement stock culling shows that the main cause was endoenteritis and necrotic enteritidis (Fig. 1). If in the control group culling was carried out almost every week until the age of 14 weeks, then in the I experimental group - in the 2nd and 10th week of cultivation, in the II experimental group – in the 3rd and 8th week.

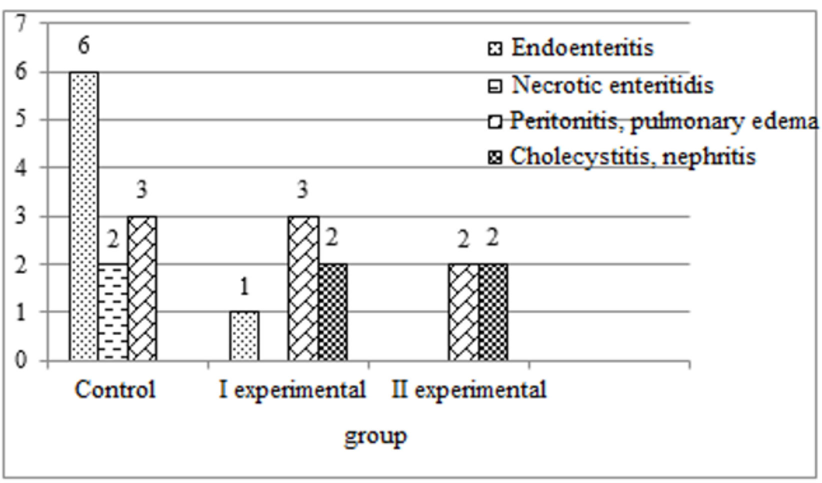

Fig. 1. The reason for replacement stock culling during the growing period, head.

The share of diseases such as peritonitis, pulmonary edema, cholecystitis, and nephritis in all groups accounted for isolated cases associated with individual characteristics of poultry. At the same time, poultry vaccination against major infectious diseases showed that an increase in the antibody titer was noted in the blood of young animals in experimental groups. This is most clearly observed on the example of Gumboro disease in the study of chicken blood during the entire production cycle (Table 2, Fig. 2).

Table 2. Antibody titer of Gumboro disease (X±m_x, n=15).

Age, weeks	Group		
	control	I experimental	II experimental
4 days	5493±431.8	5493±431.8	5493±431.8
5	4295±386.6	5083±509.6	5111±398.7
8	5048±548.7	6798±603.8	7002±641.8
11	6355±678.4	7108±661.0	7266±659.4
15	6570±809.2	7377±739.0	7444±743.8
22	10281±1316.7	13823±1174.2	14709±1211.5**
25	9731±1316.6	12775±1283.1	13997±1087.8**
39	7366±806.1	8227±877.3	12021±959.1***
43	7018±876.6	7790±838.9	10646±857.2**
46	5393±878.6	7073±732.3	8619±765.5**
51	5101±721.8	6681±686.6	8099±746.5**
54	5082±737.4	6007±639.0	7833±746.3**

There were no significant differences in the antibody titer between the groups in replacement stock up to the age of 11 weeks, although there is a tendency for their increase from the age of 5 weeks by 18.3% in the I and 19.0% in the II experimental group, by 12.3-13.3% at 11 weeks of age. During the productive period of laying hens, the antibody titer of poultry of the experimental groups in comparison with the control group was as high as possible with fluctuations from 34.5 to 63.2% (P≤0.01-0.001). In all probability, this is due to the main active component of feed additives – the yeast cell wall, which exhibits a probiotic and sorption effect in a living organism.

One of the important production indicators characterizing sufficient nutrition of replacement stock during the formation of the main organs and tissues is the degree of development of ovogenesis organs. The control slaughter of the experimental bird allowed to establish the existing difference between these organs (Fig. 2).

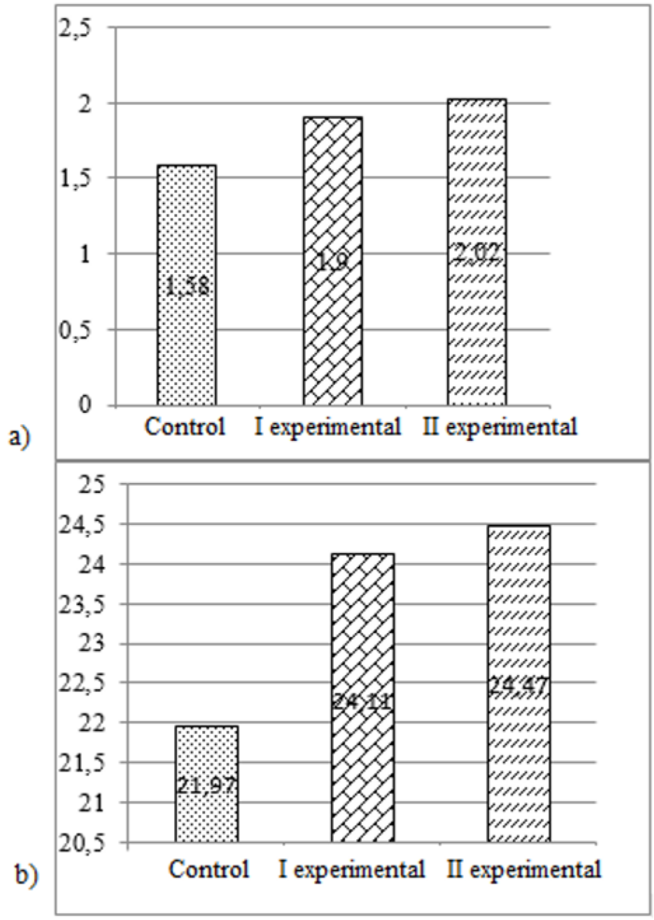

Fig. 2. Ovarian mass (g, fig. a) and the length of the oviduct (cm, fig. b) of replacement stock at the age of 18 weeks.

Thus, in terms of ovarian mass, the bird of the I experimental group exceeded the control group by 20.3% ($P \leq 0.01$), the II experimental group – by 27.8% ($P \leq 0.001$), in terms of oviduct length - by 9.7 and 11.4% ($P \leq 0.05$). This difference was reflected in the egg productivity of laying hens, the results of which are presented in Table 3 and Figure 3.

Table 3. Egg productivity per average laying hen, pcs. ($X \pm m_x$, n=320).

Age, weeks	Group		
	control	I experimental	II experimental
21-25	4.33±0.9	4.67±0.96	5.97±1.10
26-29	21.68±0.42	22.60±0.46	23.51±0.40**
30-33	23.74±0.08	24.44±0.06***	25.52±0.07***
34-37	22.85±0.06	23.29±0.07***	24.38±0.09***
38-41	21.75±0.10	22.28±0.06***	23.15±0.06***
42-45	20.12±0.09	20.93±0.10***	22.00±0.09***
46-49	18.10±0.10	19.17±0.08***	20.41±0.08***
50-53	16.38±0.11	17.78±0.12***	19.15±0.08***

54-56	4.28±0.55	4.73±0.60***	7.04±0.03***
On average	17.03±2.52	18.14±2.50	19.01±2.45
in % to group I	100.0	106.5	111.6

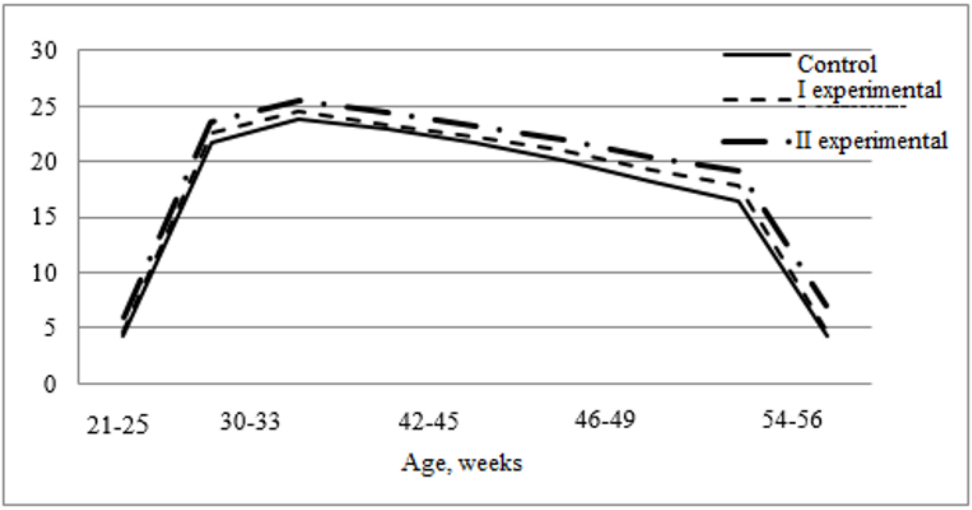

Fig. 3. Egg productivity of chickens during the productive cycle, pcs. (based on the average laying hen).

A four-week grouping of egg productivity data of chickens showed that the poultry of the experimental groups was superior to the control group with a significant difference starting from the age of 26 weeks (4.2 and 8.4%, P<0.01). At the peak of chicken productivity (30-33 weeks), the difference in the number of eggs obtained was 2.9% in the I experimental group compared to the control group, 7.5% in the II experimental group (P≤0.001), by the end of the productive cycle (54-56 weeks) it was at the level of 10.5% and 64.5 (P≤0.001). On average, over the entire period, laying hens with the addition of Sorbitox exceeded the analogues of the control group in egg productivity by 6.5%, with the use of Probitox - by 11.6%.

Nevertheless, an important issue in meat poultry farming when receiving eggs for incubation is not only its quantity, but also the qualitative characteristics of their incubation properties. Incubation of 13 batches of eggs from each group, 300 pieces each, allowed to establish qualitative indicators and identify the culling cause (Table 4).

Table 4. Results of incubation of laying hens eggs at peak productivity ($X \pm m_x$).

Indicator	Group		
	control	I experimental	II experimental
Batches laid	13	13	13
Eggs laid for incubation, pcs.	3900	3900	3900
Chickens bred, pcs.	3175	3444	3604
Hatch of fertile, %	94.5	95.6	96.1
Young stock hatching, %	81.4	88.3	92.4
Culled for a reason, pcs.:			
- clear egg	216	170	154
- early dead	57	52	55
- blood-ring	17	20	22
- black rot	-	-	1

- dead-in-shell	246	117	42
- addle egg	189	97	42
Total culled, pcs.	726	456	316
in % to group I	100.0	62.8	43.5

Thus, if the hatchability of eggs in the control group was at the level of 94.5%, then in the I experimental group it was 1.1% higher, and in the II experimental group it was 1.6%, which is due to the culling of eggs, the number of which in the experimental groups decreased by 37.2% in the I and 56.5% in the II experimental group.

At the same time, the hatch of young animals from the eggs of the experimental groups was 6.9% higher in the I and 11.0% higher in the II experimental group. This indicator is influenced by the number of unfertilized eggs in each batch. If there were 216 of them in the control group, then in the I experimental group they decreased by 46 pcs., in the II experimental group – by 62 pcs., amounting respectively to 170 and 154 pcs.

The studied feed additives did not have a noticeable effect on reducing such a culling cause as "early dead". In all groups, the number of eggs with this defect was the same – 52-57 pcs. At the same time, the number of "dead-in-shell" embryos in the experimental groups decreased markedly from 246 in the control group up to 117 pcs. in the I and up to 42 pcs. – in the II experimental group. A similar pattern was observed in the number of "addle eggs", the number of which was two times less in the I experimental group and more than four times in the II experimental group.

Similar studies conducted with small and large eggs (Fig. 4-5), that is, at the beginning and at the end of egg laying of laying hens, showed that the number of unfertilized small eggs decreased.

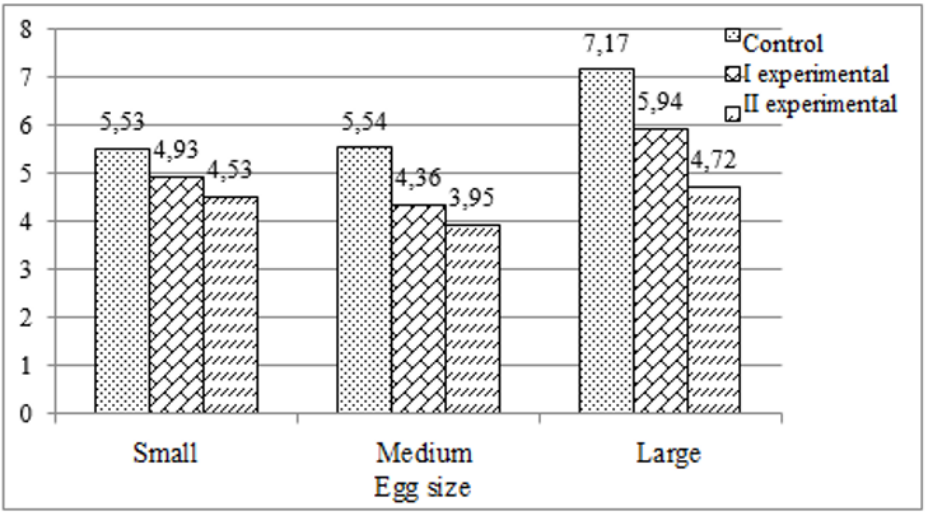

Fig. 4. The number of unfertilized eggs of laying hens during the reproductive cycle, % in the I experimental group, compared with the control group, by 0.60%, in the II experimental group – by 1.0%, in large eggs – by 1.23 and 2.45%, respectively.

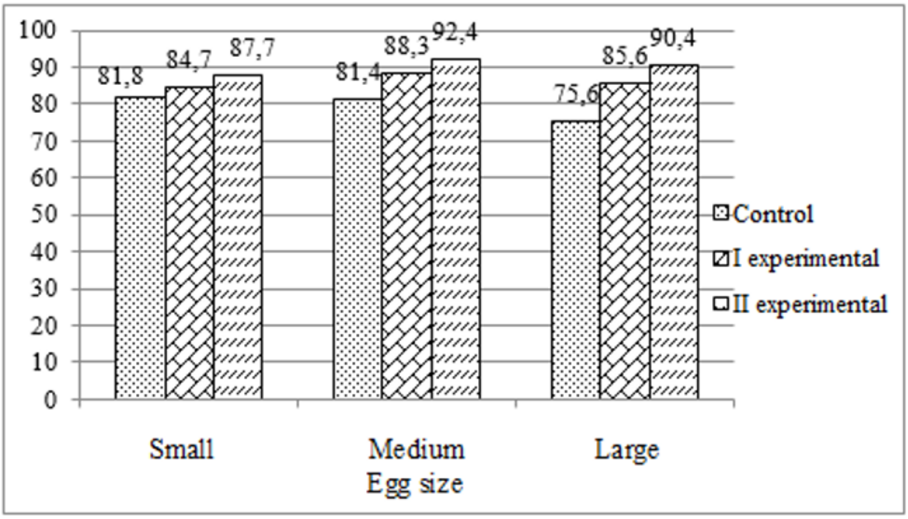

Fig. 5. Hatching of chickens from laying hens' eggs during the reproductive cycle, %.

In turn, the hatching of chickens from small and large eggs in the poultry of the experimental groups exceeded the control group. At the same time, the difference was 2.9-5.9% for small eggs, 10.0–14.8% for large eggs.

The final stage in the research was the calculation of indicators reflecting the production activity of the enterprise.

Table 5 shows the calculation of feed costs for growing one head of replacement stock, as well as obtaining a dozen eggs from laying hens.

Table 5. Feed costs for the cultivation of replacement stock and egg production of laying hens (group average).

Indicator	Group		
	control	I experimental	II experimental
Fed for the cultivation of replacement stock: - compound feed, kg	2569.06	2431.74	2290.94
- crude protein, kg	363.07	343.69	324.64
Pullets grown, head	309	314	316
Spent on growing 1 head:			
- compound feed, kg	8.31	7.74	7.25
- crude protein, kg	1.17	1.09	1.03
in % to group I	100.0	93.1	87.4
Consumed by laying hens, total: - compound feed, kg	13721.6	13707.8	13705.0
- exchange energy, kcal	3842048	3838184	3837400
- crude protein, kg	2607.10	2604.48	2603.95
Eggs produced, pcs.	51137	53447	56771
Spent on 10 eggs:			
- compound feed, kg	2.68	2.56	2.41
- exchange energy, kcal	751	718	676
- crude protein, g	510	487	459
in % to group I	100.0	95.6	90.0

The inclusion of the complex sorption-probiotic additive Sorbitox in the composition of a full-fledged compound feed for poultry of the I experimental group allowed to reduce the cost of service pullet growing by 6.9%, with the addition of Probitox in the II experimental group – by 12.6%.

In laying hens, these feed additives reduced feed costs for obtaining a dozen eggs by 4.4% in the group with Sorbitox and by 10.0% - with the addition of Probitox.

Nevertheless, in addition to feed costs, an additional calculation of the cost of fed feed is necessary, as well as total costs, that is, accounting for all cost price items. The data of the calculations performed are presented in Table 6.

Table 6. Economic indicators of rearing replacement stock and laying hens of the parent herd (on average for the group).

Indicator	Group		
	control	I experimental	II experimental
Compound feed fed, kg	2569.06	2431.74	2290.94
When growing replacement stock: - feed additives fed, kg	-	1.22	1.15
- total cost of the fed feed and additives, thousand rubles	32.55	31.02	29.29
Pullets produced (heads) for every fed:			
- 1000 kg of compound feed	12.0	12.9	13.8
- for each fed 1 thousand rubles of feed	9.5	10.1	10.8
The cost of the entire replacement livestock, thousand rubles	46.35	47.10	47.40
Additionally produced products, thousand rubles	-	0.75	1.05
Profitability of the replacement stock production, %	26.0	31.5	33.8
Feed additives fed to laying hens, kg	-	6.85	6.85
The total cost of feed and feed additives, thousand rubles	161.64	162.64	162.44
Eggs received, thousand pcs.	51137	53447	56771
Eggs produced (pcs.) per calculation: - for each fed 100 kg of compound feed	373	390	414
- for each fed 1 thousand rubles of feed	316	329	349
Additional products received, thousand pcs.	-	2310	5634
Cost of additional products, thousand rubles	-	42.74	104.23
Profitability of production, %	23.1	25.1	28.4

The payment of feed products based on each 1000 kg of feed fed with Sorbitox additive increased this indicator by 7.4% in comparison with the control group, with Probitox - by 14.7%, and in value terms this difference was 6.6 and 13.7%, respectively. Due to the increase in the safety of the livestock of the experimental groups, the additional profit in the I experimental group was at the level of 0.75 thousand rubles, in the II experimental group - 1.05 thousand rubles, and the production profitability increased by 5.5 and 7.8%, respectively, compared with the control group.

The increase in egg productivity in laying hens of the experimental groups in comparison with the control group increased the payment of feed products in kind (for every 1000 kg of fed feed) by 4.6% in the I and 11.2% - in the II experimental group, in value terms - by 3.9 and 10.5%, respectively. At the same time, the cost of additional products from egg production in poultry of the II experimental group was 2.5 times higher compared to the I experimental group, and the profitability exceeded the control group by 5.3%, in the I experimental group – only by 2.0%.

4 Conclusions

Consequently, of the two feed additives of sorption-probiotic action compared in the diet of replacement stock and laying hens, the greatest biological effect on the safety of livestock, the effect on the poultry body immune status and subsequent egg productivity was made by the feed additive Probitox. When it is added to the composition of full-fledged compound feed for poultry of the parent herd, in comparison with Sorbitox in a similar dosage, the feed costs for growing service pullet, obtaining an incubation egg are reduced to a greater extent, the production profitability is higher.

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