Enzyme preparations in compound feed for ducklings

V S Sherne\textsuperscript{1, 2}, A Y Lavrentev\textsuperscript{1}, N V Evdokimov\textsuperscript{1}, N S Petrov\textsuperscript{1}, E Y Nemtseva\textsuperscript{1} and N V Danilova\textsuperscript{1}

\textsuperscript{1}Federal State Budgetary Educational Institution of Higher Education "Chuvash State Agricultural Academy", K. Marx street, 29, Cheboksary, 428003, Russia

E-mail: v.sherne@mail.ru

Abstract. The paper presents the results of the enzyme preparations in various combinations influence on the dynamics of growth, development and slaughter quality of ducklings. Scientific and economic experiment was held in the Chuvash Republic. For the experiments, the control and 2 experimental groups of ducklings (50 animals each), were selected and formed. Ducklings of the 1st experimental group received enzyme preparations amilosubtilin in the amount of 0,05 kg/t and protosubtilin in the amount of 0,05 kg/t during the entire period of cultivation in combination with the feed. Ducklings of the 2nd experimental group of feed got enzyme preparations amilosubtilin in the amount of 0,1 kg/t and celloviridin in the amount of 0,075 kg/t. It was established that ducklings, who received enzyme preparations in addition to animal feed had increased growth energy throughout the experiment. By the end of the experiment, the live weight of the ducklings control group was - 3,424 kg, the first experimental group, who received enzyme preparations amilosubtilin in the amount of 0,05 kg/t and protosubtilin in the amount of 0,05 kg / t in addition to feed – 3,712 kg. In the second experimental group, live weight by the end of the experiment was - 3,804 kg, where ducklings received enzyme preparations amilosubtilin in the amount of 0,1 kg/t and celloviridin in the amount of 0,075 kg/t in addition to feed. The average daily gain in live weight of animals in the control group was 53,52 g, and in the first experimental group – 58,10 g, in the second – 59,56 g. The inclusion of a mixture of enzyme preparations in animal feed in experimental animals contributed to an increase in body length compared with the control by an average of 0,9 cm and 1,6 cm, the tarsus length by 2,5 cm and 4,3 cm, and the chest girth by 1,8 cm and 2,5 cm, respectively. Based on the measurements, body indexes were calculated and had similar values, but with a slight increase in the experimental groups: in terms of massiveness - by 3,16 % in the first and 7,12 % - in the second, in the wide-body index - by 3,84 % in the first and 4,54 % - in the second and by erisomia, respectively - by 2,51 % and 2,66 % compared to the control. Increasing the productivity of ducklings during the cultivation has affected the reduction of feed costs and the unit cost of production, which contributed to an increase in profits in the experimental groups. Thus, the cost of 1 kg of gain in the second experimental group compared with the control group decreased by 7.9 rubles. The profit per 1 kg of gain in the second experimental group compared with the control was more by 7.9 rubles or 22,6%. Compared with the first experimental group at 2.88 rubles, or by 8,3 %.
1. Introduction
Poultry farming is one of the most important branches of agriculture, designed to provide the population with dietary food: eggs and poultry meat, characterized by a high content of animal protein with low caloric content. Farmers and private farms can make a great contribution to the increase in poultry meat production. Depending on the available conditions in such farms, it is possible to contain from several birds to several hundred and even thousands. Birds, when feeding compound feed, give 3-5 times more gain in live weight per unit of consumed feed than other farm animals.

The main goal in the poultry industry at the present stage is the efficient production of the industry, with the lowest cost and high quality. This goal can be achieved by increasing the productivity of birds, which is now extremely important [1, 2, 3].

In the poultry industry, one of the early maturity sectors is duck breeding, which in recent years, like other branches of the poultry industry, have been gradually increasing production. Duck meat in its chemical composition is characterized by a high content of protein, mineral elements, and vitamins. Due to the comparative simplicity of ducks to the conditions of detention and feeding, it is easy to breed them in any climatic zone of the country. Production of duck meat is recognized as one of the promising areas. The current level of duck breeding in Russia and countries with market economies is characterized by a continuous process of concentration of production, deepening its specialization, improving the technology of keeping and feeding conditions of poultry, as well as mechanization and automation of labor-intensive processes. The issues of improving the technology of growing and maintaining poultry, rational use of feed, saving material and labor resources are also relevant [4, 5, 6].

In order to reduce the cost of its production, the poultry farmers are set the task of increasing the body weight at the end of cultivation with a relative reduction in their terms. It is necessary to include components of local production to reduce the cost of production throughout the composition of animal feed, such as grain cereals, bagasse, and meal pellets and many others. However, due to the significant content of fiber and non-starchy polysaccharide they have low nutritional value and poor digestibility. Studies by a number of authors show that this problem is solved by incorporating biologically active substances (BAS) into the compound feed, and enzymes play a large role in this, which contributes to an increase in the efficiency of nutrient use of feed [7, 8].

In poultry farming, as in other livestock industries, there is some experience in the use of enzymes, but a number of issues on their use in duck breeding are currently insufficiently studied. Therefore, the need arises to study them to increase the gain in live weight and meat productivity, and it is an actual problem of modern zoo-technical and practice [9, 10].

The purpose of this work is to study the effect of the use of a mixture of enzyme preparations of domestic production in feed for ducklings on their productive qualities.

2. Material and methods
The experimental part of the work was carried out on true-breeding young ducks "Agidel" farm. The material was normally developed healthy ducklings. Three groups of young ducklings were formed for experiments, on the principle of groups of analogs.

The age of the ducklings was 1 day. The duration of the experiment was 60 days. The birds of the control group from day 1 to day 20 received compound feed PC 21-2, from 21 to 56 days – PC 22-2 and from 57 to 63 days – PC-23-1. The formula and nutritional value of feed for ducks are presented in Table 1.

The parameters of the microclimate in the poultry house during the scientific and economic experiments met the established zoohygienic standards. The experimental bird was fed with loose full-feed, twice a day (morning and evening).

Monitoring of productivity was carried out by studying live weight and average daily gains, by individual weighing them at the beginning, at the end and during the experiment at every certain interval.

In order to better understand the proportionality of physique, mutual development relative to each other different parts of the body, typical birds use the method of analysis and comparison of body
indices, which are the ratio of one measurement to anatomically associated with it another measurement, expressed as a percentage.

Biometric processing of digital data obtained in the studies was carried out using the variational-statistical method described by N. A. Plokhinsky.

The ducklings of the 1st experimental group received amylosubtilin enzymes in the amount of 0.05 kg/t and protosubtilin in the amount of 0.05 kg/t during the entire growing period along with the compound feed. For the 2nd experimental group, the feed was enriched with amylosubtilin enzymes in the amount of 0.1 kg/t and cellobiridin in the amount of 0.075 kg/t.

**Table 1.** Composition and nutritional value of feed for ducklings by age, in %.

| Components             | Ducklings age in weeks |
|------------------------|------------------------|
|                        | 1-3 (PC-21-2) | 4-8 (PC-22-2) | 9-22 (PC-23-1) |
| Corn                   | 15.0        | 40.8        | 20.5       |
| Wheat                  | 45.0        | 30.0        | 15.0       |
| Barley                 | 17.45       | 9.50        | 25.0       |
| Oat                    | -           | -           | 4.0        |
| Pea                    | -           | -           | 3.0        |
| Wheat bran             | -           | -           | 15.0       |
| Meal pellets           | 7.0         | 5.0         | 3.6        |
| Yeast, hydrolytic      | 3.0         | 3.0         | 2.0        |
| Fish meal              | 7.0         | 5.0         | 1.0        |
| Bone tankage           | -           | 2.0         | 2.0        |
| Herbal fertilizer      | 4.0         | 3.0         | 5.0        |
| Alpha phosphate        | -           | -           | 0.8        |
| Chalk                  | 1.4         | 1.5         | 2.6        |
| Table salt             | 0.15        | 0.2         | 0.5        |
| To 1 ton of feed, the following is added, g: | | |
| Lysine                 | 1200        | -           | 250        |
| Meteonin               | 500         | 400         | 800        |
| Antioxidants           | 150         | 150         | 150        |
| Antibiotics            | 20          | -           | -          |
| 100 g of feed contains, %: | | |
| Metabolizable energy (MJ) | 1,197      | 1,241       | 1,240      |
| Crude protein          | 18,09       | 16,47       | 14,62      |
| Crude fiber            | 4.6         | 3.8         | 6.0        |
| Calcium                | 1,17        | 1,16        | 1,44       |
| Phosphorus             | 0.84        | 0.76        | 0.78       |
| Sodium                 | 0.39        | 0.35        | 0.36       |
| Lysine without additives (mg) | 888.7   | 776.8       | 628.7      |
| Methionine+cystine without supplements (mg) | 685.0   | 567.9       | 450.7      |

Amylosubtilin G3h contained amylolytic enzymes (activity 600 u/g) and a small amount of proteolytic ones. The overall effect was associated with the combined effect of all its constituent enzymes, including beta-glucanase, xylanase and cellulase, catalyzing the cleavage of hard-to-digest polysaccharides of barley, wheat and rye.

Protosubtilin G3h (with proteolytic activity of 70 u/g) was characterized by proteolytic action, which provide neutral and alkaline proteases against proteins.
Celloviridin (cellolux) is a complex of cellulases (2000±200 u/g), xylanase (up to 8000 u/g) and glucanase (up to 1500 u/g). This drug catalyzes the breakdown of cellulose, xylans, beta-glucans of plant cells to readily available sugars.

3. Research results
Accounting for the consumption of specified feeds and their residues, the research showed that during the experimental period, the experimental ducks did not have a difference in the amount of feed eaten, they willingly ate the specified feed.

During the entire growing period, the safety of ducklings in the control group was 94,0 %, in the I experimental group — 96,0 %, and in the II experimental group — 98 %.

The dynamics of changes in live weight and average daily gains are shown in Figures 1 and 2. The live weight of the ducklings when fed up was almost the same and ranged from around 52 g. The highest gain in live weight in all study groups was observed at the 6th week of the experiment. In the control group, an average head gain of 680 g was obtained during this period. In 1 experimental group - 706 g, which is 103,8 % of the control group. In 2 experimental group, 714 g of gain for the same period, that in relation to control group makes 105% and respectively 101,1 % in comparison with 1 experimental group is received.

Upon the completion of the experiment, the live weight of ducks in the control group was 3,424±4,6 kg, the first experimental group was 3,712±4,9 kg, and the second experimental group was 3,804±4,9 kg (P<0,05). At the end of the growing, the live weight of the ducklings of the experimental groups was higher compared to the control by 8,4 and 11,27%.

![Figure 1. Dynamics of live weight changes of ducklings in groups, kg (P<0,05).](image-url)

For the first week of farming (3,5 weeks of age), all groups of experimental birds showed a sharp increase in average daily weight gain, the next 2 weeks were more stable (a slight increase from 3,5 to 4,5 weeks and a slight decrease from 4,5 to 6, 5 weeks) (Figure 2).
After that, there is a sharp decrease in productivity, which is clearly reflected in the diagram in Figure 2. In general, for the growing period, the average daily gain in live weight of animals in the control group was 53,52±4,6 g, and in the first test group 58,10±4,9 g, in the second 59,56±4,9 g (P<0,05).

In the scientific and economic experience, the body parameters development at the age of 63 days in the studied groups corresponded to the cross standard and were better in the ducks of the second experimental group with respect to control and the first experimental group. The results of exterior measurements of ducklings are presented in Table 2.

Table 2. Exterior measurements of ducklings (on average per 1 head in groups), cm.

| Indicators            | Control          | I experimental | II experimental |
|-----------------------|------------------|----------------|-----------------|
| Body length           | 43,4±0,61        | 44,3±0,49**    | 45,0±0,52**     |
| The width of the pelvis | 9,7±0,32        | 11,6±0,44      | 12,1±0,50       |
| Length of the keel bone | 16,8±0,29       | 17,4±0,4**     | 17,7±0,44**     |
| Tarsus length         | 11,9±0,21        | 14,4±0,33      | 16,2±0,34       |
| Leg length            | 17,4±0,33        | 20,3±0,41      | 21,9±0,38       |
| Chest Girth           | 38,8±0,51        | 40,6±0,51      | 41,3±0,49       |

at **P≤0,01

The inclusion of a mixture of enzyme preparations in animal feed in experimental animals contributed to an increase in body length, compared with the control by an average of 0,9 cm in the 1st experimental group and 1,6 cm in the 2nd experimental group, the length of the tarsus by 2,5 cm and 4,3 cm, chest girth 1,8 cm and 2,5 cm, respectively. A similar pattern occurred in the nature of
changes in the pelvis width and leg length of birds of the compared groups. Consequently, the introduction of enzyme preparations to animal feed of ducklings had positive impact on their growth and development.

Based on the measurements taken, body indexes were calculated. The results of the indexes of the constitution in ducks are presented in Table 3. Each of these indices allows us to estimate the particular productivity of a bird.

**Table 3.** Indexes of the constitution in ducklings (on average per 1 head in groups), %.

| Indicators                                      | Control        | I experimental | II experimental |
|------------------------------------------------|----------------|----------------|-----------------|
| Massiveness (The torso weight / Body length)    | 78.85±0.52     | 83.71±0.51*    | 84.47±0.53*     |
| Breadth (The pelvis width x 100 / Body length) | 22.35±0.33     | 26.19±0.31*    | 26.89±0.34*     |
| Underpinning (Keel length x 100 / Body length) | 38.70±0.42     | 39.28±0.43*    | 39.33±0.43*     |
| Long-legged (The shank length, thigh (tibia) x 100) | 68.39±0.55     | 70.93±0.54*    | 73.97±0.55*     |
| Aresome (chest girth / body length x 100)      | 89.40±0.58     | 91.65±0.57*    | 91.78±0.56*     |

at *P*≤0.01

The massiveness index characterizes compact build and fatness of the bird. Index of erisomomy - the development of the front of the torso. These indices give an idea of the poultry compactness, indirectly - the development of pectoral muscles in thickness, and had similar values, but with a slight increase in the experimental groups: in terms of massiveness - by 3.16 % in the first and 7.12 % - in the second, in the wide-body index - by 3.84 % in the first and 4.54% - in the second and by erisomia, respectively - by 2.51 % and 2.66 % compared to the control.

The research results of the ducklings slaughter qualities are given in Table 4. It was found that the use of a mixture of enzyme preparations in compound feed in experimental birds contributed to the increase in the killing qualities of ducks. Pre-slaughter live weight in the first experimental group was higher by 8.4 %, and in the second experimental group by 11 % than in the control group.

**Table 4.** Killing quality of ducklings, g.

| Indicators                                      | Control        | I experimental | II experimental |
|------------------------------------------------|----------------|----------------|-----------------|
| Pre-slaughter live weight                       | 3424±4.6       | 3712±4.9*      | 3804±4.9*       |
| The weight of the unviscerated carcass          | 3111.0±4.4     | 3378.6±4.6*    | 3465.8±4.6*     |
| Unviscerated carcass yield, %                   | 90.86          | 91.02          | 91.11           |
| The weight of semi-viscerated carcass           | 2968.9±4.3     | 3229.0±4.3*    | 3331.9±4.5**    |
| Semi-unviscerated carcass yield, %              | 86.71          | 87.26          | 87.59           |
| The mass of the eviscerated carcass             | 2320.1±4.1     | 2671.5±4.2*    | 2751.4±4.3**    |
| Eviscerated carcass yield, %                    | 67.76          | 71.97          | 72.33           |
| The yield of eviscerated carcasses by grade, %  |                |                |                 |
| Grade 1                                         | 92             | 94             | 96              |
| Grade 2                                         | 8              | 6              | 4               |

at * P*≤0.05, ** P*≤0.01
The mass of the uneviscerated carcass exceeded in the first experimental group, the amylosubtilin and protosubtilin enzymes with analogous indicators in the control by 267.6 g, i.e. by 8.6 %, in the second experimental group, treated with the enzymes amylosubtilin and celloviridin at 354.8 g, respectively, by 11.4 %. A similar pattern occurred in the nature of changes in the mass of viscerating carcass and the release of viscerating carcasses by grade.

As a result of carcass boning, it was found (table 5) that the absolute yield of muscle tissue of the carcass of ducklings of the 1st experimental group was higher than in the control group by 228.6, (11.47 %) and in the 2nd experimental group by 297.3 g (11.92 %) (P<0.05-0.01), and the yield of skin with fat, respectively – by 35.0 and 45.3 g. the yield of edible parts in the second experimental group was higher than in the control group by 15.0 %, and in the first experimental group by 11.0 %. Output of non-edible parts (bones) in the control group made up 9.05 % in 1 experimental group of 9.31% and in the 2nd experimental group of 9.49%.

### Table 5. The ratio of edible and inedible parts of the carcass.

| Indicators                      | Group          |
|--------------------------------|----------------|
|                                | Control        | I experimental | II experimental |
| Edible parts:                  |                |                |
| Muscles, g.                    | 1547.6±14.7    | 1776.2±16.3*   | 1844.9±17.1**  |
| %                              | 45.20          | 47.85          | 48.50          |
| skin with subcutaneous fat, g. | 681.3±4.6      | 716.3±4.7     | 726.6±4.8     |
| %                              | 19.90          | 18.30          | 19.10          |
| Kidneys,+fat+lungs             | 104.4±1.3      | 110.2±1.5     | 111.0±1.45    |
| %                              | 3.05           | 2.97           | 2.92           |
| Total, g.                      | 2335.2         | 2592.8         | 2685.6         |
| %                              | 68.20          | 69.85          | 70.60          |
| Inedible parts:                |                |                |
| Bones, g.                      | 309.8±3.2      | 345.6±3.4*     | 360.9±3.6**   |
| %                              | 9.05           | 9.31           | 9.49           |
| Waste, g.                      | 0              | 0              | 0              |
| The ratio of edible parts to inedible parts | 7.54 | 7.50 | 7.44 |
| Muscle mass to bone mass ratio | 4.99           | 5.14           | 5.11           |

* P<0.05, ** P<0.01

Due to the fact that the accounting of the given forages was carried out as a whole on group, instead of individually, and statistical processing of indicators on use of forages wasn't possible. Since the highest gains in live weight were observed in the first 6 weeks of cultivation, respectively, and in these periods of cultivation, the lowest feed costs per 1 kg of growth are observed (Figure 3). At the end of the growing period, when there was a decrease in the average daily growth, feed costs increase.

In total, over the period of the experiment, 9,835 kg of feed was spent in each group. In the first group, on 1 kg of gain, 2,91 kg of compound feed was spent in the control group, and in the first experimental group, 2,64 or 9,28 % less than in the control group and in the second experimental group, 2,62 kg or 9,97 % less than in the control group and by 2,26 % than in the first experimental group.
Figure 3. Feed costs by growing periods by groups, kg.

4. Conclusion
Thus, the analysis of the results of the study shows that the use of enzyme preparations in feed for ducklings contributes to the achievement of a higher absolute and average daily growth of live weight and increase the economic efficiency of its production. Since ducklings after 7 weeks of age reduces the intensity of growth, the optimal period of their cultivation, in our opinion, should not exceed 8 weeks. The results of studies suggest that the choice of enzyme preparations preference should be given to a mixture of amylosubtilin and celloviridine.

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