

Growth, development and safety of quails while using the enzyme preparations "protosubtilin g3x" and "cellolux-f" in their diets

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Abstract

During the first 6-9 weeks of life, quails produce insufficient amounts of their own proteinases, lipases and amylases, cellulases are not synthesized at all. In this regard, it is relevant to study and determine the mechanism of such enzyme medicaments as "Protosubtilin G3x" and "Cellolux-F", acting on the body of quails. To achieve this goal the scientific and economic experience on young quail grown for meat lasting 42 days was held in the conditions of LLC Small Innovative Enterprise "EcoDom" at Federal State Budgetary Educational Institution of Higher Education "Gorsky GAU" in the period from 2015 to 2018. It was important to follow the growth dynamics of young poultry raised for meat, under the influence of the introduction of "Protosubtilin G3x" and "Cellolux-F", both individually and in combination. At simultaneous application of enzyme medicaments "Protosubtilin G3x" and "Cellolux-F", in the III- rd experiment group the live weight was more by 6,14% in comparison with analogs from the control group. Introduction of enzyme medicaments "Protosubtilin G3x" and "Cellolux-F" into mixed fodder based on wheat, corn and soybean meal together allowed meat poultry of the III-rd experiment group to reliably ($P \leq 0,05$) outstrip analogues from the control group in gross growth by 11,81% and average daily growth of live weight-by 11,81%. At the same time, according to the indicator of feed consumption per 1 kg of live weight gain, the birds of the III-rd experiment group had an economy of 11,04% in comparison with the control group. Analyzing the conducted studies, it can be concluded that such enzyme medicaments as "Protosubtilin G3x" and "Cellolux-F" together had a positive impact on the safety of poultry, live weight gain and feed payment products in young quails.

Key words: enzyme preparations "protosubtilin g3x" and "cellolux-f"; non-starch polysaccharides; increase in body weight; safety; measurements; Quail.

Introduction

The most economically-effective branch of animal husbandry in Russia is poultry farming, which first embarked on the path of industrialization, and made it possible to provide the population with such dietary foods as meat and eggs. Among the directions in poultry farming quail farming can be considered relatively new, it has recently become popular and in demand among the population (Gogaev et al., 2016d; Gogaev et al., 2017a; Gogaev et al., 2017b; Choniashvili et al., 2017; Gogaev et al., 2018; Choniashvili et al., 2019). Nowadays, there is a surge in demand for quail products which meet high dietary and environmental indicators. But the main deterrent to the realization of genetic potential is feeding. In recent past turmeric rhizome powder (Kennedy et al 2020) and nigella sativa seeds (Shokrollahi and Sharifi, 2018) were used to improve growth and meat quality of Japanese quails.

The organization of full-fledged feeding on energy and nutrients is of great importance for the successful realization of meat and egg productivity of poultry, including quails. It is possible to achieve high productivity of quails only in the conditions of providing them with a full-fledged feed, including all the necessary nutrients.

However, in the areas of the intensive cultivation of cereals and legumes forage crops, as well as oilseeds in the market economy in recent decades there has been a persistent tendency to use feed grains of cereals and legumes in large quantities as the main ingredients, as well as by-products of oil extraction production. This is done to reduce the cost of feed.

The consequence of this in the South of Russia, including North Caucasus Federal District (NCFD), is an increase in the standard composition of complete feed for poultry meat and egg soluble polysaccharides cellulose, hemicellulose, pentosans, hexosans etc., which greatly degrade the availability of other organic nutrient compounds for enzymes of the digestive system. As a result, poultry productivity decreases, and consumer properties of meat and eggs deteriorate (Gogaev et al., 2016 a,b &c; Gogaev et al., 2017a; Gogaev et al., 2019).

Enzyme preparations that break down non-starchy polysaccharides are widely used to reduce negative impact on the body of a bird and its productivity, in the composition of feed, at the same time, they have a positive effect on the formation of beneficial microflora in the intestine, the processes of hydrolysis of nutrients in the diet and assimilation of their metabolites (Cozannet et al., 2012; Owen et al., 2001; Han et al., 2017; Ravindran et al., 2013). This is important for increasing the meat and egg productivity of young birds, as in the first 6-9 weeks they produce insufficient amounts of their own proteinases, lipases and amylases, and cellulases are not synthesized by animals at all.

In this regard, it is relevant to study and determine the mechanism of action of enzyme preparations "Protosubtilin G3x" and "Cellolux-F" on the body of quails, grown for meat and production of dietary eggs.

"Protosubtilin G3x" is obtained by drying the culture liquid after deep cultivation of *Bacillus subtilis* culture. It is a hygroscopic homogeneous powder of light beige color, soluble in water. It contains a complex of enzymes (neutral and alkaline proteinases, alpha-amylase, beta-glucanase, xylanase and cellulase), table salt, chemically precipitated chalk, and corn flour. Produced with a proteolytic activity of 7.0 u/g and 70 u/g (in agreement with the consumer, the drug is manufactured with a higher proteolytic activity) (www.sibbio.ru/upload/iblock/399/39910fcd999ca00e4b1d285501196df1.pdf).

"Cellolux-F" is a complex enzyme preparation of a new generation, balanced by xylanase, β -glucanase and cellulase activity. A complex of enzymes that provides step-by-step splitting of cellulose, xylans, and β -glucans of the plant cell. Increases the availability of protein, starch, and fat for the action of digestive tract enzymes, improves the digestibility of food and the absorption of nutrients in the small intestine. The microbiological environment of the intestine is improved by reducing the viscosity and increasing the level of monosaccharides (www.sibbio.ru/upload/iblock/399/39910fcd999ca00e4b1d285501196df1.pdf).

Material and methods

To achieve this goal, we performed a scientific and economic experiment on young quails, reared for meat lasting 42 days in the conditions of LLC Small Innovative Enterprise "EcoDom" at Federal State Budgetary Educational Institution of Higher Education "Gorsky GAU" in the period from 2015 to 2018. The scheme of setting is presented in table 1.

Four groups of 50 heads each (25 males and 25 females) from the daily chickens of the breed "Pharaon" were formed on the principle of groups-analogues, while carrying out scientific and economic experience on young quails, grown for meat. The experiment birds were kept in cell type batteries BVM-F-4TS for growing the youngsters.

The width of the chest is measured by a compass between the lateral points of the shoulder joint. The chest circumference is determined by measuring tape. The base of the wings was measured along the line passing through the last vertebra of the neck and along the anterior end of the keel. The distance from the anterior to posterior end of the thorax is called the keel length. The keel is characterized by a large amount of muscle tissue and due to this fact is important when we evaluating the fatness of the bird.

The width of the pelvis is measured with a compass.

Feeding of experimental young animals and quail laying hens was carried out with full-size standard compound feeds based on wheat, corn and soy meal, prepared according to the following recipes, taking into account age periods:

- from the first day of life to the 4th week – a full-fledged starting compound feed according to the formula PK 5-41(table 2);

- from the 5th to the 6th week of life – complete feed according to the formula PK 3-8 (table 3).

Table 1- The Scheme of Two Scientific and Economic Experiments

Group	No of Quails	Feeding Features	Additive Dose, % by the Weight of Feed	
			Protosubtilin G3x	Cellolux-F
Control	50	Complete feed based on wheat, corn and soybean meal (CF)	-	-
I experiment	50	CF	0.03	
II experiment	50	CF	-	0.01
III experiment	50	CF	0.03	0.01

Table 2-Composition and nutritional value of full-size compound feed according to the formula PK 5-41 for young quail

Ingredients, %	Group			
	control	I experiment	II experiment	III experiment
Wheat	41.5	41.5	41.5	41.5
Maize	19.5	19.5	19.5	19.5
Soybean meal	21.0	21.0	21.0	21.0
Triticale	3.9	3.9	3.9	3.9
Sunflower oil cake	6.2	6.2	6.2	6.2
Linseed oil	2.9	2.9	2.9	2.9
Fish flour	1.4	1.4	1.4	1.4
Tricalcium phosphate	1.5	1.5	1.5	1.5
Stern chalk	0.9	0.9	0.9	0.9
Table salt	0.1	0.1	0.1	0.1
Methionine	0.1	0.1	0.1	0.1
Premix P5-1	1.0	1.0	1.0	1.0
Additives per 100 g feed: "Protosubtilin 3x"	-	3.0	-	3.0
"Cellolux-F"	-	-	1.0	1.0

Table 3-Composition and nutritional value of full-size compound feed according to the formula PK 3-8 for young quail

Ingredients, %	Group			
	control	I experiment	II experiment	III experiment
Wheat	43.0	43.0	43.0	43.0
Maize	17.5	17.5	17.5	17.5
Soybean meal	22.7	22.7	22.7	22.7
Triticale	1.8	1.8	1.8	1.8
Sunflower oil cake	5.9	5.9	5.9	5.9
Linseed oil	2.8	2.8	2.8	2.8
Fish flour	1.6	1.6	1.6	1.6
Tricalcium phosphate	1.4	1.4	1.4	1.4
Stern chalk	1.1	1.1	1.1	1.1
Table salt	0.1	0.1	0.1	0.1
Methionine	0.2	0.2	0.2	0.2
Premix P5-1	1.0	1.0	1.0	1.0
Additives per 100 g feed: "Protosubtilin 3x"	-	3.0	-	3.0
"Cellolux-F"	-	-	1.0	1.0

Results and Discussion

When growing quails for meat, the main task is to realize the genetically inherent growth potential in order to obtain maximum muscle mass. For this purpose, enzyme preparations' feeding of young meat poultry is quite an effective method, as it is possible to achieve a significant increase in the growth rate, due to exogenous enzymes, especially in the first 5-6 weeks of life. It was important to follow the growth dynamics of young poultry raised for meat, under the influence of the introduction of MEK "Protosubtilin G3x" and MEK "Cellolux-F", both individually and in combination (table 4).

During the application of Additives per 100 g of feed: in the I experiment group, on the 7th day the live weight index was greater by 7.15% compared to the control group. In the II experiment group, this figure is higher by 5.27% after adding enzyme medicaments "Cellolux-F", in comparison with the control group.

And at simultaneous application of enzyme preparations "Protosubtilin G3x" and "Cellolux-F", the live weight of the III experiment group was more by 6.14% in comparison with the analogs from the control group. At 14 days of age, the live weight of the III experiment group was higher, and amounted to 74.93, which is higher by 11.5 % compared to the control group. In the I and II experiment groups, this figure is higher by 10.25 and 6.49%. At 21 days of age, the live weight index was 108.7; 101.97; 108.88, which is higher by 12.26; 5.30 and 12.44% than that of analogues from the control group. At the age of 28 days – 13.09; 5.75 and 13.56%.

It was established that by the age of 42 days, that is, by the end of the I scientific and economic experiment, young quails from the III experiment group by body weight significant to ($P \leq 0,05$) outstripped the birds from the control group by 25.35 g or 11.41%, and young quails from the I and the II experiment groups occupied an intermediate position by this indicator.

Along with this, the dynamics of the average daily weight gain of fattened young quails was followed, the results are shown in fig. 1.

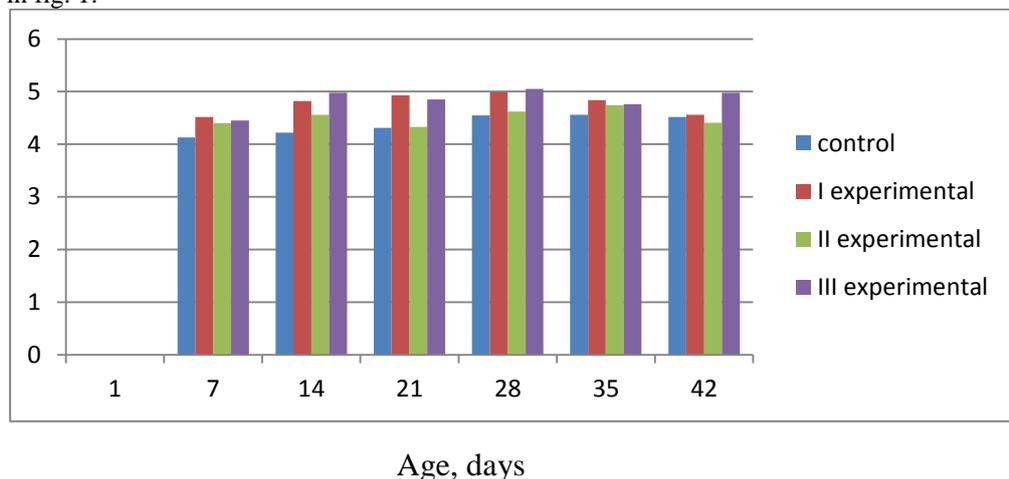


Fig 1. The Dynamics of Average Daily Growth of Quails

The analysis of the data reflected in picture 1 indicates the most favorable effect of additives in the diets of enzyme preparations "Protosubtilin G3x" and "Cellolux-F" on the growth rate of young animals of the III experiment group due to the activation of digestive processes.

The quantitative increase of an organism in the course of its existence is called "growth". Along with the growth, qualitative changes are made in cells, organs and their functions. This process is called "development". These two concepts are judged by the increase in measurements in individual parts and by the living mass. Basic zootechnical measurements were removed from all groups of quails. The length of the torso, the width of the pelvis, the width and girth of the chest were also measured (table 5).

According to table 5, the length of the trunk, i.e. the distance between the last cervical vertebra and the end of the coccyx, on the 14th day was greater in quails from the I the II and the III experiment groups compared with quails from the control group by 2.3; 1.9; 1.6%, respectively. On the 28th day, this distance was higher in quails of the I, the II and the III experiment groups by 0.7; 0.4; 1.2% compared to analogues from the control group. On the 42nd day, the body length was higher by 0.33; 0.13; 0.46%, respectively.

The development of the chest and pectoral muscles in quails at the age of 14 days, was higher in quails of the I, the II and the III experiment groups compared with analogues from the control group by 1.6; 0.9; 2%, at the age of 28 days-by 0.9; 0.4; 1%, at 42-day age was respectively 0.3; 0.16; 0.4%.

Thus, at the age of 14 days, the breast girth in the control group was 12.32, and this indicator is 0.4% less than in quails from the I experiment group, 0.6% of the II experiment group and by 0.3% lower than in the III experiment group. At the age of 28 days, this indicator in the control group was less than that of the analogues of the I, the II and the III experiment groups, respectively, by 0.34; 0.2; 0.6%, at the age of 42 days, the chest girth was higher by 0.3; 0.16; 0.5%.

Table 4 - The Dynamics of Young Quails' Growth per a Year n=50

Age, days	Group of Quails							
	Control		I experiment		II experiment		III experiment	
	Live wt, g	Average daily growth, g	Live wt, g	Average daily growth, g	Live wt, g	Average daily growth, g	Live wt, g	Average daily growth, g
1	8.84±0.095		8.81±0.098		8.94±0.11		8.92±0.12	
7	37.75±0.96	4.13	40.45±0.99	4.52	39.74±1.01	4.40	40.07±0.99	4,45
14	67.29±1.68	4.22	74.19±1.61**	4.82	71.66±1.55	4.56	74.19±1.61**	4,98
21	96.83±1.91	4.31	108.7±1.94***	4.93	101.97±1.79	4.33	108.88±1.88***	4,85
28	158.85±2.76	4.56	177.51±2.73***	4.84	167.99±2.81*	4.74	177.55±2.73***	4,76
35	190.77±3.05	4.56	209.43±3.11*	4.56	200.96±3.02*	4.71	212.41±3.12*	4,98
42	222.2±3.33	4.49	243.66±3.61***	4.89	242.16±3.53**	5.88	247.55±3.58***	5,02

Note: * the difference is valid at $P \leq 0.05$, ** $P \leq 0.01$, *** $P \leq 0.001$.

Table 5- The Exterior Measurements of Young Quails in Dynamics n=50

Group of Quails	Observation period, days	Measurements, cm			
		Body Length	Chest Width	Chest Girth	Pelvis Width
control	14	8.26±0.002	6.36±0.029	12.32±0.09	3.03±0.008
	28	10.21±0.07	9.58±0.05	14.48±0.15	4.18±0.019
	42	15.26±0.15	12.26±0.09	18.41±0.25	5.08±0.022
I experiment	14	8.45±0.01***	6.46±0.033**	12.37±0.09	3.11±0.012***
	28	10.28±0.09	9.67±0.05	14.53±0.19	4.21±0.016
	42	15.31±0.23	12.3±0.08	18.47±0.34*	5.11±0.023
II experiment	14	8.42±0.017***	6.42±0.027	12.34±0.08	3.08±0.011***
	28	10.25±0.08	9.62±0.04	14.51±0.18	4.2±0.02
	42	15.28±0.21	12.28±0.1	18.44±0.29	5.10±0.022
III experiment	14	8.39±0.011***	6.49±0.035**	12.36±0.1	3.12±0.014***
	28	10.33±0.11	9.68±0.06	14.56±0.21	4.22±0.019
	42	15.33±0.25	12.32±0.11	18.51±0.36*	5.12±0.025

Note: * the difference is valid at $P \leq 0.05$, ** $P \leq 0.01$, *** $P \leq 0.001$

Table 6-The Main Economically-useful Indicators of Young Quails

n = 50

Investigated Indicator	Group			
	control	I experiment	II experiment	III experiment
Safety, %	90.0	94.0	94.0	96.0
Live weight of a bird, g:				
at the age of 1 day	8.84±0.095	8.81±0.098	8.94±0.11	8.92±0.12
at the age of 42 days	222.2±3.33	243.66±3.61***	242.16±3.53**	247.55±3.58***
Live weight gain, g:				
gross	213.36±3.15	234.85±3.11***	233.22±2.75**	238.63±2.86***
on average per a day	5.08±0.11	5.59±0.07***	5.55±0.09**	5.68±0.14***
in % to control	100.00	110.04	109.25	111.81
the feed spent on 1 kg of gain, kg	3.26	2.94	2.96	2.90
in % to control	100.00	90.23	90.72	88.96

Note: * the difference is valid at $P \leq 0.05$, ** $P \leq 0.01$, *** $P \leq 0.001$

The distance is measured between the outer surfaces of the hip joint. The width of the pelvis indicates the development in width at the back of the body, and also shows how the internal organs are developing. The pelvic width of quails from the I, the II and the III groups at the age of 14 days was greater by 2.6; 1.6; 2.9% than that of the control group. On the 28 day the width of the pelvis in the experiment groups was 4.21; 4.20; 4.22, which is 0.7; 0.5; 0.9% more than in the control group. On the 42 day this figure was also higher by 0.6; 0.4; 0.8% respectively.

On the basis of the aforesaid, we established the influence of the studied enzyme medicaments on the main economic and useful indicators of young quails, reared for meat (table 6).

As it can be seen from table 4, the safety of livestock in the control group was 90.0%. To the greatest extent, the increase in the safety of young quail was promoted by the addition of two enzyme medicaments "Protosubtilin G3x" and "Cellolux-F". Thus, according to this indicator, the birds of the III-rd experiment group were ahead of the control by 6.0%.

The introduction of enzyme medicaments "Protosubtilin G3x" and "Cellolux-F" into mixed fodder based on wheat, corn and soybean meal together allowed meat poultry of the III-rd experiment group to reliably ($P \leq 0.05$) outstrip analogues from the control group by gross growth at 11.81% and average daily growth of live weight - by 11.81%.

At the same time, according to the indicator of feed consumption per 1 kg of live weight gain, the birds of the III-rd experiment group had an economy of 11,04% in comparison with the control group. The same data were obtained in their studies: Ravindran et al., 2013; Gogaev et al., 2019.

Conclusion. Analyzing the conducted studies, it can be concluded that the enzyme medicaments "Protosubtilin G3x" and "Cellolux-F" together had a positive impact on the safety of poultry, live weight gain and payment of feed by the products from young quails.

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