

Effect of probiotic additive in Quail diet on nutritional quality of meat

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Abstract

Probiotics are distinguished by their synergistic action with a wide range of biologically active additives (BAA). Antioxidants accelerate the regeneration of damaged cells, increase the body's resistance to nitrate-nitrite loads, improve protein metabolism and the biological value of poultry meat. The aim of the research was to clarify the effect of the probiotic Provitol at the rate of 1250 g/t and phospholipid lecithin at the rate of 1000 g/t should on meat productivity, ecological food, as well as the biological value of quail (a genus of birds from the pheasant family, in Latin - about Phasianidae) meat when they are added to the compound feed formulation with a subtoxic dose of nitrates. The objects of research were quails of the Pharaoh breed, raised for meat for 42 days. It was found that in the course of the experiment, combined additives in mixed feed with a subtoxic dose of nitrates of probiotic and phospholipid provided in meat poultry of the 3 experimental group versus analogs from the control group there was an increase in the mass of semi-gutted bird carcasses by 14.20%, the mass of the femoral muscles - by 13.45%, the mass of the pectoral muscles - by 13.37%, as well as slaughter yield - by 1.28%. Quail of the 3 experimental group relative to their control analogs had significantly more dry matter in the composition of the pectoral muscles by 1.12% and protein – by 1.15%. Combined additives in the compound feed formulation of Provitol and lecithin provided in poultry of the 3rd experimental group versus their counterparts in the control group a significant increase in the protein-quality index (PQI) of the pectoral muscle by 12.80%. In quails of the 3rd experimental group, in the samples of this muscle there was a significant decrease in the level of nitrates by 1.87 times and 2.10 times than in the control.

Key words: quail; antioxidant; phospholipid; nitrates; meat; nutritional value; biological value

Introduction

In the southern regions of Russia, intensive technologies are used for the cultivation of cereals, legumes and oilseeds. They are the main ingredients of compound feed for poultry, including quail (a genus of birds from the pheasant family (in Latin - about Phasianidae). To increase their yield, specialists of the agronomic service very often introduce excessive doses of nitrogen fertilizers into the soil. Taking into account the high moisture content of the soil, nitrates and nitrites are formed from them, which accumulate in the fodder grain. When these toxic nitrogen compounds get into the digestive tract of the bird with the grain ingredients of the compound feed, the body becomes intoxicated. This is accompanied by a decrease in meat productivity and environmental safety of quail meat (Titarenko et al., 2017; Gadzaonov et al., 2009).

When taken in higher doses, nitrates in the alimentary canal are partially reduced to nitrites, which are more toxic. The latter, entering the bloodstream, causes methemoglobinemia, that is, hemoglobin in the lungs is not able to effectively bind oxygen, which leads to hypoxia. In addition, in the presence of amines, N-nitrosamines are formed from nitrites, which are carcinogenic. Intoxication with these xenobiotics in poultry is accompanied by a general weakness, a decrease in productivity and a deterioration in the sanitary and hygienic properties of products (Buglenko & Ktsoeva, 2016; Kononenko et al., 2012; Titarenko et al., 2018). Various feed additives like *Nigella sativa* seeds and turmeric rhizome powder have been tried to improve the meat quality of Quail (Shokrollahi et al, 2018; Kennedy et al, 2019).

To optimize the biological-productive potential of a bird under nitrate loads on the body, adsorbents are selected that can eliminate the negative consequences of various poisonings, including nitrate-nitrite, by entering and binding toxicants in the digestive system. By adsorbing the molecules of toxic compounds, they effectively remove them from the body of the bird. For the prevention and treatment of nitrate and other poisoning in poultry, a larger list of new generation probiotics is used, the selection and determination of the dosage of which are carried out in the course of various studies. At the same time, with the engraftment of beneficial microorganisms that make up the probiotic, digestion processes are optimized in the gastrointestinal tract (GIT) and toxins are eliminated, which is accompanied by an improvement in the nutritional value of meat (Angas et al, 2019; Kairov et al., 2020; Temiraev et al., 2016; Titarenko et al., 2017; Gadzaonov et al., 2009).

Along with this, probiotics are distinguished by their synergistic action with a wide range of biologically active additives (BAA), including phospholipids, which neutralize free radicals in the body, prevent membrane damage, and preserve the youth of the cells of organs and tissues of poultry. Antioxidants accelerate the regeneration of damaged cells, increase the body's resistance to nitrate-nitrite loads, improve protein metabolism and the biological value of poultry meat (Farnieva et al., 2016; Temiraev et al., 2019; Titarenko et al., 2016; Sukhanova et al., 2016; Tedtova et al., 2017).

In this regard, the aim of the research was to clarify the effect of the probiotic Provitol and phospholipid lecithin on meat productivity, ecological food, as well as the biological value of quail meat when they are added to the compound feed formulation with a subtoxic dose of nitrates.

Material and methods

This goal was achieved in the course of setting up a research and production experiment according to the technological scheme shown in Table 1, in the conditions in a poultry farm of LLC MIP «EcoDom» on the basis of the Federal State Budgetary Educational Institution of Higher Education «Gorsky State Agrarian University» (Vladikavkaz, Republic of North Ossetia – Alania) (Longitude: 44° 40'04 " East, Latitude: 43° 02'12 "North. Altitude: 671 m).

The objects of research were quails of the Pharaoh breed, raised for meat for 42 days. In the course of the experiment, 4 groups (each with 50 heads) were formed from quails at one day of age (taking into account the origin, live weight at birth and general condition) using the method of analog groups.

Taking into account the fact that during the experiment all the ingredients of the compound feeds of the experimental quail were safe in the presence of nitrates and nitrites, for the purity of the experiments, sodium nitrate was additionally introduced into the rations of poultry of all groups at a dosage of 40 g/t of feed in order to ensure the presence of nitrates in a subtoxic dose.

Provitol is a multifunctional feed additive manufactured by OOO Biotrof (St. Petersburg, Russia), which has a strong zootechnical effect, while performing the functions of two drugs: a natural substitute for antibiotics and a probiotic with enzymatic activity. The basis of Provitol (phytobiotics) is made up of cellulolytic bacteria strains of heat-resistant cellulolytic bacteria *Bacillus pantothenicus* B1-85c and *Ruminococcus albiis* in combination with a strain of bacteria *Lactobacillus plantarum* 53H isolated from the rumen of ruminants with probiotic activity. The composition and nutritional value of compound feed for experimental quails is shown in table 2. The control slaughter of experimental quails was carried out at the age of 42 days, in strict accordance with GOST R 52837-2007. For this purpose, from each group of compared birds, 5 quails were selected, typical in live weight with the indicators for the group. In accordance with the requirements of state standard (GOST R 53597-2009), we have established the mass of carcasses in semi-gutted, gutted form and the value of the slaughter yield, chemical composition, biological value of meat.

The results of our research were processed step by step by the method of variation statistics according to the analyzed Student's criterion.

Table 1 – Feeding scheme for experimental quails (n=50)

Group of birds	Standard compound feed (SCF)	Additives of preparations, g/t feed		
		sodium nitrate	Provitol	lecithin
Control	SCF	40,0	-	-
1 Group	SCF	40,0	1250	-
2 Group	SCF	40,0	-	1000
3 Group	SCF	40,0	1250	1000

Table 2 – Compound feed recipe for quails

Components, %	Content
Corn	51.0
Barley	2.0
Herbal flour	3.0
Sunflower meal	24.0
Feed yeast	7.0
Fish flour	6.5
Fodder fat	3.6
Table salt	0.3
Tricalcium phosphate	1.6
Premix P6-1-89	1.0
100 g of compound feed contained, g:	
Exchange energy, mJ	1.215
Crude protein	21.92
Raw fat	6.52
Crude fiber	4.68
Calcium	1.12
Phosphorus	0.76
Lizina	1.09
Methionine + cystine	0.73

Results and discussion

When setting up the experiment, we studied the effect of the preparations Provitol and lecithin on the slaughter indicators of quails fed on meat (Table 3).

It was found that in the course of the experiment, combined additives in mixed feed with a subtoxic dose of nitrates of probiotic and phospholipid provided in meat poultry of the 3 experimental group versus analogs from the control group there was an increase in the mass of semi-gutted bird carcasses by 14.20% ($P < 0.05$) – by 15.20% ($P < 0.05$), the mass of the femoral muscles – by 13.45% ($P < 0.05$), the mass of the pectoral muscles – by 13.37% ($P < 0.05$), as well as slaughter yield – by 1.28% ($P < 0.05$), respectively.

In an experiment conducted by a number of researchers (Farnieva et al., 2016), when feeding the antioxidants Hadox and vitamin E in the diet, they achieved an increase in the slaughter indicators of quail and the nutritional value of meat. But at the same time, these drugs have a weak ability for denitrification. An effective criterion for assessing the nutritional characteristics of poultry meat is the study of the chemical composition of pectoral muscle samples (Table 4).

It was found that the joint inclusion of Provitol and lecithin in the compound feed formulation made it possible to note a higher level of their stimulating effect on the processes of muscle mass formation. Due to this, quail of the 3 experimental group relative to their control analogs had significantly more dry matter in the composition of the pectoral muscles by 1.12% ($P < 0.05$) and protein – by 1.15% ($P < 0.05$), while reducing the concentration fat – by 0.71% ($P < 0.05$).

In the course of the experiment, we studied the changes in the biological value and ecological safety of the meat of experimental quails, assessed in the pectoral muscle by the protein-quality indicator (PQI) and the presence of nitrates and nitrites (Table 5).

Combined additives in the compound feed formulation of Provitol and lecithin provided in poultry of the 3rd experimental group versus their counterparts in the control group a significant ($P < 0.05$) increase in the protein-quality index (PQI) of the pectoral muscle by 12.80%, in the first place, due to an increase in the concentration of tryptophan in the studied muscle and a decrease in the level of hydroxyproline.

Our research results are consistent with the experimental data of the authors (Titarenko et al., 2017; Titarenko et al., 2018) who were able to achieve an increase in the biological value of quail meat by introducing the adsorbent ecosil and the antioxidant epofen into the feed.

Table 3 – Lethal indicators of experimental quails, g (n= 50)

Index	Group of birds			
	Control	I	II	III
Pre-slaughter weight of 1 head	290.88±3.12	319.04±2.79	320.11±3.31	329.43±3.11
Half-gutted carcass weight, g	262.81±2.71	289.46±2.43	290.50±2.65	300.14±2.56
In% to the pre-slaughter weight	90.35	90.73	90.75	91.11
Gutted carcass weight, g	216.44±2.42	240.14±2.11	241.07±2.32	249.35±2.22
Lethal output,%	74.41	75.27	75.31	75.69

Table 4 - Data on the chemical composition of the pectoral muscle of a bird (n=50)

Index	Group of birds			
	Control	I	II	III
In the pectoral muscle				
Dry matter,%	24.55±0.26	25.09±0.29	25.13±0.27	25.67±0.30
Protein, %	20.65±0.12	21.25±0.19	21.30±0.20	21.80±0.21
Fat,%	2.91±0.04	2.44±0.02	2.42±0.05	2.20±0.02

Table 5 - Ecological and biological assessment of the usefulness of the meat of experimental quails (n=50)

Index	Group of birds			
	Control	I	II	III
Tryptophan,%	1.91 ± 0.007	1.97 ± 0.006	1.98± 0.007	2.01± 0.009
Oxyproline,%	0.45 ± 0.003	0.44 ± 0.004	0.44 ± 0.003	0.42 ± 0.004
PQI	4.244 ± 0.09	4.477± 0.07	4.500 ± 0.08	4.786± 0.05
Nitrates, mg / kg	4.51±0.21	3.10±0.18	3.05±0.25	2.41±0.23
Nitrite, mg / kg	0.42±0.02	0.29±0.01	0.28±0.02	0.20±0.03

Along with this, under the influence of probiotic and phospholipid in the samples of pectoral muscles in the body of the bird, the denitrification processes proceeded better. Therefore, in quails of the 3rd experimental group, in the samples of this muscle there was a significant decrease in the level of nitrates by 1.87 times ($P<0.05$) and 2.10 times ($P<0.05$) than in the control.

The results of our studies are consistent with the results of an experiment conducted by a number of authors (GA Buglenko and II Ktsoeva, 2016; Temiraev et al., 2016), who, due to the combined use of the probiotic Provitol and ascorbic acid, were able to successfully remove nitrates and nitrites from the body and meat of broilers.

Conclusion Therefore, in the presence of a subtoxic dose of nitrates for a stimulating effect on economically useful features, indicators of an increase in meat productivity, ecological food and biological value, the probiotic Provitol at the rate of 1250 g / t and phospholipid lecithin at the rate of 1000 g / t should be jointly included in the quail compound feed.

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