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Way to Increase Digestibility and Accessibility of Mixed Feed Nutrients through Antioxidants and Probiotic Supplementation

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Abstract.

In biochemical processes, selenium and vitamin E play the role of antioxidants, increasing the immunobiological reactivity in the body. Their use serves to increase the poultry productivity. There is a positive experience of combined use of antioxidants and probiotics in poultry diets. **The research aims** to study the effect of sodium selenite and vitamin E in combination with probiotic Bifidum SHG on nutrients digestibility and accessibility in mixed feed of replacement young and layers. **Research methods.** The objects of research were young and layers of cross "Smena-7". During the first stage of scientific experiment using the replacement young the day-old chicks by the analogue scale were divided into 5 groups of 200 birds each. After 22-23 weeks of growing, the experimental poultry was relocated to the layers workshop. During the second stage the same as in the first stage of the experiment flock was used. **Research results.** In the course of the first physiological experiment the young of the fourth test group feeding the mixture of these preparations has provided the best digestion of organic matter for 2,90%, crude protein – 3,10%, crude fiber – 3,40% and nitrogen-free extractives – 3,10%. Inclusion of the same supplement mixture into the mixed feed allowed during the second exchange experiment the layers of the fourth test group regarding the control to increase the digestibility coefficient of organic matter by 5,00%, crude protein – by 4,80% and nitrogen-free extractives – by 5,00%. Probiotic supplementation along with tocopherol and sodium selenite provided for the young of the fourth test group greater by 16,2% nitrogen deposition per day in their bodies. Feeding antioxidants in combination with probiotic had a stimulating effect on the transformation of feed nitrogen into egg mass nitrogen. The most effectively these preparations influenced the ovogenesis process of layers in the fourth test group, who contained 26, 92% more nitrogen in their eggs.

Keywords: young, layers, antioxidants, probiotic, digestibility and accessibility of nutrients.

The relevance of the problem. To strengthen the protective system of poultry there is often a need to introduce additional antioxidants into feed. They are necessary for growth and reproduction, regulate metabolism, take part in protective reactions of the body, etc. In recent years, the use of selenium compounds is of particular interest. The main source of selenium for poultry is feed of plant origin [1, 2].

However, the poultry feed provision with selenium in Russia is not optimal. It is impossible to cover the existing selenium deficiency with the usual diet. Therefore, in recent years, many scientists work to assess the effectiveness of feed additives that allow obtaining poultry products with specified dietary and therapeutic properties, for example, meat, eggs with the increased content of vitamin E and selenium [3, 4].

In biochemical processes the microelement selenium and vitamin E play a role of antioxidants, increasing the body immunobiological reactivity. Their use serves to improve the poultry health and productivity. There is a positive experience in combined application of antioxidants and probiotics in diets of farm animals [5, 6].

Probiotics are widely used in poultry farming. They are necessary to form normobiocenosis and improve the overall body resistance to adverse factors. Most often, there is a decrease in the number of intestinal bifidobacteria, which protect the intestinal mucosa from the penetration of pathogenic and conditionally pathogenic microorganisms into the blood [7].

The research aims to study the effect of feed additives sodium selenite and vitamin E in combination with probiotic Bifidum SHG on nutrients digestibility and accessibility in mixed feed the replacement young and layers.

Material and research methods. The experimental part of the work was carried out on the poultry farm LLC "Iraf-Agro", RNO – Alania according to the scheme presented in table 1. The research objects were the replacement young and layers of meat cross "Smena-7". The research experiment consisted of two stages. During the first stage of the scientific experiment using the replacement young the conditioning day-old chicks by the analogue scale were divided into 5 groups of 200 heads each. The replacement young growing lasted 22-23 weeks, after which the experimental bird was relocated to the layers workshop.

During the second stage of the scientific experiment the same as in the first stage flock was used as during the first stage of the experiment, however, due to their safety and the results of the young control slaughter, the number of layers in groups was reduced to 160 birds.

Two physiological experiments on 90 days old young and 350 days old hens were carried out according to the standard methods using an inert indicator of chromium oxide in an amount of 0,5% by the feed weight to determine the digestibility and use of nutrients in diets [8].

The research results were processed by Student's method of variation statistics using the software package "Microsoft Excel".

The results of our own research. Complete dry feed was prepared at the feed plant of the poultry farm. Differentiated feeding of experimental birds, according to the "Recommendations for poultry feeding" [9], were carried out depending on the age of replacement young and layers.

During physiological experiments the digestibility coefficients of nutrients in the replacement young and layer' diets, which included probiotic and antioxidants were calculated (table. 2

).

Table 1 – Scheme of scientific experiment using birds

Group	Feeding habits
I stage of the scientific-production experiment using the replacement young	
Control	Basic diet (BD) – standard mixed feed
1 test	BD + Bifidum SHG at the rate of 5 doses per 200 birds (BD_1)
2 test	BD_1 + sodium selenite at a dose of 0,2 mg/kg feed
3 test	BD_1 + vitamin E at a dose of 25 тыс. IU/t feed
4 test	BD_1 + sodium selenite at a dose of 0,2 mg/kg + vitamin E at a dose of 25 thousand/ IU/t feed
II stage of the scientific-production experiment using layers	
Control	Basic diet (DB) – standard mixed feed
1 test	BD + Bifidum SHG at the rate of 5 doses per 200 birds (BD_1)
2 test	BD_1 + sodium selenite at a dose 0,2 mg/kg feed
3 test	BD_1 + vitamin E at a dose of 25 thousand IU/t feed
4 test	BD_1 + sodium selenite at a dose of 0,2 mg/kg feed + vitamin E at a dose 25 thousand IU/t feed

Table 2 – Digestibility coefficients of nutrients in diets, %

Indicator	Group				
	control	1 test	2 test	3 test	4 test
I physiological experiment					
Organic matter	78,90±0,43	80,40±0,40*	81,50±0,37*	81,50±0,48*	81,80±0,44*
Protein	76,20±0,38	78,60±0,46*	79,50±0,47*	78,80±0,46*	79,30±0,54*
Fiber	17,80±0,44	19,80±0,31*	20,20±0,51*	21,50±0,58*	21,20±0,47*
Fat	78,40±0,36	77,50±0,45	78,70±0,53	77,80±0,39	79,00±0,37
Nitrogen-free extractives	84,10±0,46	86,20±0,41*	87,00±0,54*	86,90±0,50*	87,20±0,42*
II physiological experiment					
Organic matter	78,70±0,44	81,80±0,52*	83,00±0,50*	82,20±0,43*	83,70±0,58*
Protein	77,00±0,38	80,30±0,42*	80,90±0,54*	81,70±0,37*	81,80±0,49*
Fiber	25,20±0,51	28,00±0,47*	25,50±0,53	24,40±0,67	26,00±0,52
Fat	79,00±0,33	78,50±0,63	76,70±0,44*	77,00±0,45*	76,60±0,47*
Nitrogen-free extractives	84,30±0,49	87,40±0,49*	88,90±0,39*	88,00±0,58*	90,00±0,59*

* P>0,95

The results of physiological experiments showed that the introduction of biologically active additives into feed had a positive effect on the digestibility of nutrients of experimental birds' diets, but a higher stimulating effect provided the combined supplementation of probiotic with tocopherol and sodium selenite.

In the course of the first physiological experiment feeding the mixture of these preparations to the young in the fourth test group provided versus the control significantly (P>0,95) better 2,90% of organic matter digestion, crude protein – 3,10%, crude fiber – 3,40% and nitrogen-free extractives – 3,10%.

During the second metabolism experiment the inclusion of the mixture of the same feed additives into the mixed feed allowed the layers in the fourth test group relative to the control significantly (P>0,95) to increase the digestibility coefficients of organic matter by 5,00%, crude protein – by 4,80% and nitrogen-free extractives – by 5,00%.

It is necessary to pay attention to the fact that only layers of the control group relatively the birds in 2nd, 3rd and 4th test groups had significantly (P>0,95) 2,00-2,40% higher coefficients of fat digestibility. This indicates that the antioxidants sodium selenite and tocopherol in the 2nd, 3rd, and 4th test groups with age inhibited fat metabolism and processes of free radical lipid oxidation.

Based on the results of metabolism experiments, the effect of the applied preparations on using diet nitrogen by experimental birds was determined (table 3).

In the course of the first physiological experiment it was found that the combined supplementation of probiotic with tocopherol and sodium selenite provided for the replacement young in the fourth test group significantly (P>0,95) 16,2% more nitrogen deposition in the body per day and also better by 5,70% used it of the taken with feed amount, which is consistent with the average daily replacement young's gains in the compared groups.

Table 3 – Use of diets nitrogen by experimental birds, g

Indicator	Groups				
	control	1 test	2 test	3 test	4 test
I physiological experiment					
Taken with feed	2,01±0,017	1,99±0,016	2,00±0,010	2,01±0,014	2,02±0,017
Excretion:fecal	0,48±0,001	0,42±0,001*	0,41±0,002*	0,42±0,001*	0,42±0,002*
urinary	0,79±0,003	0,80±0,004	0,75±0,005	0,77±0,003	0,74±0,001*
Balance	0,74±0,001	0,77±0,002*	0,84±0,003*	0,82±0,003*	0,86±0,004*
Used of taken, %	36,80±0,39	38,50±0,40*	42,00±0,37*	40,70±0,54*	42,50±0,55*
II physiological experiment					
Taken with feed	3,40±0,018	3,42±0,016	3,42±0,026	3,41±0,029	3,41±0,032
Excretion: fecal	0,78±0,003	0,70±0,001*	0,65±0,003*	0,62±0,004*	0,62±0,004*
urinary	1,31±0,001	1,34±0,004	1,33±0,003	1,38±0,004	1,36±0,003
egg	0,78±0,004	0,89±0,003*	0,97±0,005*	0,95±0,004*	0,99±0,004*
Balance	0,53±0,001	0,49±0,001*	0,47±0,002*	0,46±0,002*	0,44±0,001*
Used of taken, %	38,60±0,28	40,35±0,35*	42,10±0,40*	42,23±0,53*	41,93±0,50*
Including egg excretion	23,00±0,49	26,02±0, 44*	28,36±0,47*	27,86±0,52*	29,03±0,57*

*P>0,95

Table 4 – Content of selenium and vitamins A and E in the blood and liver of the experimental birds

Indicator	Groups				
	control	1 test	2 test	3 test	4 test
I stage of the scientific experiment					
Vitamin A					
Blood, μmol/l	62,67 ± 1,1	65,33 ± 0,9*	66,92 ± 0,6*	67,58 ± 1,2*	68,42±1,2*
Liver, μg/kg	106,31±1,3	111,44±1,1*	112,18±1,2*	113,46±1,8*	114,74±1,1*
Vitamin E					
Blood, μmol/l	75,85 ± 0,34	80,29 ± 0,53*	81,26 ±0,45*	85,56±0,27*	87,56±0,33*
Liver, μg/kg	274,13±0,14	289,32±0,12*	290,91±0,15*	297,06±0,14*	297,06±0,24*
Selenium					
Blood, μg/kg	1,85 ± 0,04	2,29 ± 0,03*	2,66 ± 0,05*	2,36±0,07*	2,85 ± 0,04
Liver, μg/kg	14,13±0,14	18,32±0,12*	22,91±0,15*	19,06±0,14*	24,13±0,14
II stage of the scientific experiment					
Vitamin A					
Blood, μmol/l	69,61 ± 0,5	72,30 ± 0,8*	73,92 ± 0,7*	75,08 ± 0,6*	77,40±0,7*
Liver, μg/kg	109,34±0,8	117,40±1,0*	118,98±0,7*	121,36±1,1*	124,70±1,0*
Vitamin E					
Blood, μg/kg	78,89± 0,32	83,49 ± 0,44*	84,26 ±0,45*	89,51±0,37*	92,56±0,37*
Liver, μg/kg	278,10±0,66	294,39±0,56*	295,90±0,44*	301,06±0,53*	305,44±0,51*
Selenium					
Blood, μg/kg	2,09 ± 0,03	2,47 ± 0,03*	2,96 ± 0,03*	2,57±0,07*	3,15 ± 0,04
Liver, μg/kg	19,10±0,14	23,32±0,12*	28,89±0,25*	25,06±0,20*	33,57±0,11

*P>0,95

In layers, in contrast to young, a great part of the digested nitrogen is excreted within the egg mass. Feeding the mixture of antioxidants in combination with probiotic had a stimulating effect on the conversion of feed nitrogen into egg mass nitrogen. Moreover, these preparations lot more affected the ovogenesis process of hens in 4 of the fourth test group, who had 26,92% (P>0,95) more nitrogen content in the egg than the control.

According to the deposited amount of nitrogen in the body, the layers of all test groups were significantly (P>0,95) inferior to their control counterparts, which is consistent with changes in the live weight of the experimental birds, that is, after the relocation to the main workshop for the body weight increase, the hens of the test groups were inferior to their control counterparts.

It is known that bifidobacteria are producers of vitamins A and E. In this regard, the content of selenium and vitamins A and E in the blood and liver of experimental birds was studied (table 4).

The main depo of vitamin A is the liver, where feed β-carotene is converted into retinol, the physiological value of which is to regulate the permeability of biological membranes. It was found that the combined supplementation of probiotic and antioxidant mixtures significantly (P>0,95) increased this vitamin concentration in the replacement young and layers of the 4th test group compared to the control by 9,1 and 11,2% in the blood, as well as by 7,9 and 14,0% in the liver, respectively.

Along with retinol, bifidobacteria contributed to the significant (P>0,95) increase of vitamin E concentration in the replacement young and layers of the 4th test group compared to the control by 5,4 and 17,3% in the blood, as well as by 8,3 and 9,8% in the liver, respectively. This indicates that the combined supplements of these preparations provided synergistic effect in tocopherol accumulation in the liver.

It was also found that the use of probiotic in combination with the mixture of sodium selenite and vitamin E provided a higher degree of selenium absorption from gut, so in the replacement young and layers of the 4th test group compared to the control its content was significantly (P>0,95) higher by 54,0 and 50,7% in the blood, as well as by 70,8 and 75,7% in the live, respectively.

CONCLUSIONS.

In the course of scientific experiment it was found that the most positive impact on digestibility and accessibility of nutrients in the replacement young and layers' diets had additives in feed enriched with probiotic Bifidum SHG at the rate of 5 doses per 200 birds, the mixture of preparations sodium selenite at a dose of 0,2 mg/kg feed and vitamin E at a dose of 25 thousand IU/t.

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