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Response Of Broiler Chickens To Phytase Supplementation: Effect On Growth, Phosphorus Digestibilities, Energy Metabolism, Conversion Of Chemical Elements.

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ABSTRACT

The article presents studies of the effect of phytase on growth and energy metabolism in broiler chickens. It has been established that phytase has a growth-stimulating effect, which is confirmed by the analysis of growth dynamics of live weight. The inclusion of phytase in the broiler diet leads to better digestion and accumulation of phosphorus. Analysis of the effectiveness of intermediary exchange showed that when the level of total phosphorus decreases and phytase is introduced into the diet, the concentration of metabolizable energy increases, which positively correlates with an increase in conformity factor. It is noted that the energy deposited in the body of birds in experimental groups was spent on growth against the background of the lowest energy loss with excrement. An increase in the conversion of Mn, Zn, Cu, Mg, Fe, Se, Ca, P, Na was observed on the background of a decrease in the conversion of Co, Ni, Cd, Sn, Sr, Pb when phytase was introduced into broiler diets.
Keywords: Phytase, “Ronozyme NT (CT)”, Growth, Energy metabolism, Chemical elements, Broilers

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INTRODUCTION

Rational use of fodder and obtaining ecologically pure livestock products presupposes normalization of nutrition across a wide range of nutrients. Poultry farms widely use biologically active feed additives, which promote better digestion and assimilation of basic nutrients [1-2]. The study of use of enzymatic preparations as feed additives in the poultry production is relevant and of particular interest for science and production [3-4]. Variety of enzyme preparations and unreasonable use of them is the reason for the absence of their expected high productive effect [5-6]. Along with many enzymatic preparations used in poultry farming, phytase-containing preparations are of widespread use, one of their general activities is to increase availability of phosphorus and microelements [7].

The existing experimental material on this issue, as well as theoretical notions, are contradictory. Until now, questions remain unanswered that determine metabolic processes taking place in body of birds when phytase is introduced into their diet against a background of different nutritional availability, which does not allow fully to predict the changes in its productivity [8].

From this perspective, further improvement of approaches to optimal nutrition is required taking into account the accumulated information on the role of phytase in various nutritional provision of the organism. The foregoing was the reason for this study [9].

The study of the effect of phytase on growth, the exchange of energy and nitrogen in the body of broiler chickens at different levels of total phosphorus in diet [10].

MATERIALS AND METHODS

Animals and feed

The experimental part of work was carried out in accordance with the protocols of the Geneva Convention and the Principles of Good Laboratory Practice (National Standard of the Russian Federation GOST R 53434-2009) [11]. The research was conducted in accordance with standard procedures for the use of bio-objects. Care of animals was carried out according to the rules of laboratory practice at preclinical studies in the Russian Federation (GOST 3 51000.4-96) [12]. The experiments were carried out in accordance with the requirements of humane treatment of animals [13].

Characteristics of enzymatic preparation

The enzyme preparation Ronozym NT (CT) was used, its active substance is represented by phytase (10,000 U/g), obtained from Peniophora lycii by deep fermentation of modified microorganisms Aspergillus oryzae. The preparation is represented by coated beige granular particles. The product is fully compatible with other components of feed. The granular particles have an average size of 500 µm; the product does not form dust. In the IUB system (International Biochemical Union), Ronozyme NT (CT) (DSM Nutritional Products Inc., Parsippany, NJ) is classified as phytase (No. 3.1.3.26) [14].

Animal and dosage

Research was performed on model of broiler chickens «Smena-7» in experimental biological clinic (vivarium) of Orenburg State University. For the experiment, 7-day chickens were selected. Room for keeping experimental birds was equipped with a ventilation system. The temperature regime was carried out with the help of a thermostat for internal premises RTR-B to maintain the set temperature, with an accurate temperature adjustment from +15 to +25 ° C (error - no more than 1 ° C). Lighting regime - 12 hour on and 12 hours off. The humidity of the room was 60%. The air quality was assessed by several components: oxygen content - 18%, carbonic acid - 0.15%, ammonia - 7 mg / m3 and hydrogen sulfide - 2 mg / m3. The microclimate in the room met the requirements of VNITIP (2004) [15].

To conduct the research KUN-05 cages with effective area of 4050 cm^2 made of galvanized welded mesh and galvanized iron sheet were used. Cages are equipped with automatic 2 nipple waterer with polypropylene hose, feeder (length - 90 cm), galvanized pallet. Experimental birds were fed 2 times a day.

There was a plenty of drinking. Compiling diets with different levels of total phosphorus in experiments on broiler chickens, calculations were made taking into account the set objective, according to methodological guidelines on the calculation of recipes for feed products of VNITIP (2008) [16]. Dosage of enzymatic preparation was determined in accordance with the recommendations of the producer.

For this research, 6 groups of broiler chicks weighing 160-180 grams were formed from 180 animals of 7-day age by method of pair-analogues (n=30): control and 5 experimental. In the first week of experiment, birds was kept in the conditions of the preparatory period.

Chickens of the control group (C) received the basic diet (BD) balanced by all nutrients, with a level of total phosphorus 7 g/kg and an available phosphorus of 4 g / kg. Group I received BD, with total phosphorus level of 7 g / kg and an available phosphorus of 4 g / kg with phytase Ronozyme NT (CT) included in dosage of 150 mg / kg. Group II - BD, with total phosphorus level - 6 g / kg and available phosphorus - 3 g / kg. Group III - BD with total phosphorus level - 6 g / kg and available phosphorus - 3 g / kg with phytase Ronozyme NT (CT) included at a dosage of 150 mg / kg. Group IV - BD with a total phosphorus level of 5.8 g / kg and available phosphorus of 2.8 g / kg. V group - BD with total phosphorus - 5.8 g / kg and available phosphorus - 2.8 g / kg, with phytase Ronozyme NT (CT) included at a dosage of 150 mg / kg (Table 1).

Table 1: Composition of Experimental Diets (g/100g)

	Diets					
	1	2	3	4	5	6
	Phytase inclusion					
Ingrediens	Control diet	+	-	+	-	+
Wheat	52,810	52,795	53,210	53,195	53,310	53,295
Sunflower meal	10,5	10,5	10,4	10,4	10,3	10,3
Soyabean meal	14,5	14,5	14,6	14,6	14,7	14,7
Fishmeal	6	6	6	6	6	6
Vegetable oil	5,33	5,33	5,33	5,33	5,33	5,33
Maize	7,5	7,5	7,5	7,5	7,5	7,5
Salt	0,12	0,12	0,12	0,12	0,12	0,12
Fodder chalk (limestone)	1,31	1,31	1,31	1,31	1,31	1,31
Mono calcium phosphate	0,5	0,5	0,1	0,1	0	0
Lysine	0,33	0,33	0,33	0,33	0,33	0,33
Methionine	0,1	0,1	0,1	0,1	0,1	0,1
Premix	1	1	1	1	1	1
Phytase (Ronozim NT (CT))	0	0,015	0	0,015	0	0,015
	100	**100**	**100**	**100**	**100**	**100**
Proximate analysis						
Exchange energy, MJ	12,88	12,88	12,86	12,86	12,90	12,90
Crude protein	23,13	23,13	23,15	23,15	23,15	23,15
Crude fat	8,39	8,39	8,27	8,27	8,21	8,21
Crude fiber	3,86	3,86	3,80	3,80	3,79	3,79
Phosphorus	0,70	0,70	0,60	0,60	0,58	0,58

Observation and autopsy

Broiler chickens were observed daily during the whole period of experiment. Control over the growth of birds was carried out daily. Species were weighed in the morning before feeding (± 2 g). Based on weighing, absolute and average daily growth were calculated, the dynamics of growth in experimental animals was studied. On the appointed day of termination (day 35), experimental birds were slaughtered by electrocution (voltage 550 or 950 V, not more than 5 s) followed by bleeding. Then post-slaughter carcass cutting was performed according to VNITIP method (2008), during which absolute and relative weight of internal organs were measured.

The exchange of phosphorus

Phosphorus content of samples was determined using Vanadomolybdate method (AOAC 1995).

Analysis of indicators of metabolic processes (Energy metabolism)

Influence of nutritional provision of the body on the effectiveness of intermediary metabolism of experimental bird was assessed comparing the intake data of the metabolizable energy from fodder, its costs for survival and with deposition of net energy into production. For this purpose, on the basis of the daily poultry weighing data and taking into account the recommendations of VNITIP (2004), net and metabolizable energy necessary to sustain life on each day of the experiment were calculated using the following formula (1):

$$NEm = 347 \times M0{,}75 \ ,$$
$$MEm = 1{,}22 \times NEm, \ (1)$$

where M – average live weight of birds on the day of determination, kg.

The value of metabolizable energy of supermaintenance is calculated as the difference between the metabolizable energy that has entered the body and the amount spent for maintaining life. The amount of net energy in live weight gain of chickens is established by method of comparative slaughter. For this purpose, in the course of control slaughter, the body of bird was divided into separate tissues and organs. Whereas weight of tissues and organs at slaughter, chemical composition of samples, and energy content in them were taken into account. This allowed us to calculate the energy content in body of animals first, then, the amount of net energy in weight gain as the difference between the energy content in body of birds at the end and the beginning of the estimated period. Conformity with feeding conditions to the needs of body cells in the digested metabolites was considered on the example of dependence proposed by Blazter [17], according to which (2):

$$P\ ME = K \times C\ ME, \ (2)$$

being P ME – metabolizable energy productivity index; K – conformity factor; C ME – concentration of metabolizable energy in diet, mJ/head. DM. Whereas P ME and C ME were empirically ascertainable values; P ME was determined as a dependence of net energy in production to metabolizable energy of supermaintenance. C ME was found in the process of digestible trial. The adequacy of plastic and energy metabolism was assessed according to the value of protein/energy ratio (PE ratio) by the following formula (3):

$$PE\ ratio = ME\ 17{,}84*DP \ , \ (3)$$

being DP – digestible protein from fodder, g/head.; ME – fodder metabolizable energy, kJ. Energy metabolism was assessed with due regard to the recommendations.

Gross energy was calculated according to the following formula (4):

$$GE = 23{,}95*CP+39{,}77*CF+20{,}05*CF+17{,}46*CNFES, \ (4)$$

being GE – gross energy of diet, mJ; CP – crude protein, kg; CF – crude fat, kg; CF – crude fiber, kg; CNFES – crude nitrogen-free extractive substances, kg. metabolizable energy – according to the formula (5):

$$ME=17{,}84*DP+39{,}78*DF+17{,}71*(DFb+DNFES), \ (5)$$

where ME – metabolizable energy of diet, mJ; DP, DF, DFb, DNFES – digestible protein, fat, fiber, nitrogen-free extractive substances, kg.

Analysis of chemical elements

The elemental composition of biological substrates has been studied using atomic emission and mass spectrometry (ICP-AES and ICP-MS) in the test laboratory ANO «Center for Biotic Medicine», Moscow. The investigation was fulfilled by the ICP-AES and MS- ICP methods, biosubstrates ashing was carried out using microwave decomposition system MD-2000 (USA). Evaluation of the content of elements in the resulting ash was performed by a mass spectrometer Elan 9000 (Perkin Elmer, USA) and atomic emission spectrometer Optima 2000 V (Perkin Elmer, USA). In total, the content of 25 chemical elements was determined, including Cu, Fe, Li, Mn, Ni, As, Cr, Zn, I, V, Co, Se, Si, B.

Statistical processing

Statistical processing of the data was carried out using the Statistica 10.0 software package and the MS Excel 2000 software package. Data are presented as: mean (M) ± standard error of mean (m). Reliable results were considered at P≤0,05.

EXPERIMENTAL

Growth and development of the experimental birds. The results of the experiment showed that adding phytase to diets with different levels of total phosphorus directly changed the intensity of growth of the experimental bird (Figure.1).

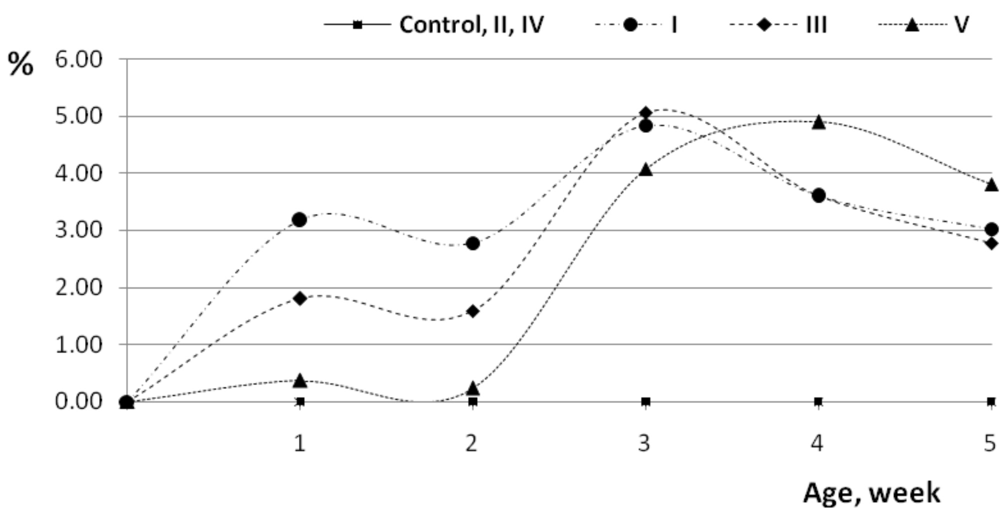

Figure 1: Dynamics of the difference in live weight between the compared groups: control-I, II-III, IV-V of trial groups, %

Analysis of growth and development indicates the superiority of live weight of chickens in group I relative to the control group by 6.8% after the 2nd week of the study period (p≤0.05). In addition, live weight of chickens in the experimental group III increased in this period by 1.6% relative to group II. Growth stimulating effect on the background of phytase introduction was traced by the end of the accounting period. At the end of the experiment, the broilers of group I exceeded the control animals by 3.0% (p≤0.05), birds from experimental groups III and V advanced animals of the same age from groups II and IV by 2.7 and 3.67% (P≤0.05), respectively (Table 2).

Table 2: Dynamics of live weight gain, g/head

Week of study	Group					
	Control	I	II	III	IV	V
1	175,0±5,10	192,5±6,60	169,3±4,10	175,1±6,31	168,0±7,40	169,1±5,13
2	285,1±9,60	309,9±10,1*	281,8±11,1	285,6±10,3	279,6±12,0	279,8±11,1
3	334,8±12,0	338,9±15,4	301,8±16,5	338,5±14,9	293,3±12,1	328,8±15,8
4	455,1±21,0	459,5±23,3	448,7±21,3	451,4±23,9	421,0±26,6	449,0±21,7
5	520,5±49,8	528,2±45,6	515,0±50,7	518,1±46,3	514,8±43,3	519,4±45,7

Note: *- p≤0,05, comparing К and group I; **- p≤0,05, comparing groups II and III; ***- p≤0,05, comparing groups IV and V.

It was found that at 2-week age birds of the group I advanced over animals of the control group by 8.7% (p≤0.05). During the same period, this indicator in the III group significantly increased in relation to group II by 1.3%. This superiority remained until the end of the study period and amounted to 1.5% in the group I, 0.6% in III, and 0.9% in V, compared with the control group, groups II, IV, respectively. The revealed dynamics of live weight gain of broiler chickens in groups I, III and V showed the most eloquent balance of the diet.

The exchange of phosphorus

The consumption, accumulation and digestibility of phosphorus by a bird under the influence of various diets (with and without phytase inclusion) are presented in Table 3.

Table 3: Phosphorus digestibility of broiler finisher fed experimental diets

Parameters	Group					
	Control	I	II	III	IV	V
	Diets					
	1	2	3	4	5	6
	Phytase inclusion					
	Control diet	+	-	+	-	+
Phosphorus Intake (g/d)	0,74±0,01	0,75±0,01*	0,70±0,03	0,72±0,01*	0,69±0,02	0,73±0,01*
Phosphorus Retention (g/d)	0,62±0,00	0,63±0,01*	0,58±0,00	0,60±0,04**	0,57±0,01	0,62±0,02*
Apparent Phosphorus Digestibility (%)	83,78±0,01	84,0±0,02*	82,85±0,01	83,33±0,02	82,60±0,01	84,93±0,04**

Note: *- p≤0,05, comparing К and group I; **- p≤0,05, comparing groups II and III; ***- p≤0,05, comparing groups IV and V.

Consumption and accumulation of phosphorus in diets with inclusion of phytase (diets 2, 4 and 6) were significantly (p <0.05) high in groups. These indicators in diets without the inclusion of phytase (Control diet, 3 and 5) were characterized by low values. The digestibility of phosphorus in groups whose diets included phytase had statistically similar values and were significantly (p <0.05) higher than in groups without phytase inclusion in the diet.

Energy metabolism in experimental birds

Studies of the effect of phytase on energy and plastic metabolism against the background of different levels of total phosphorus in diet are of particular interest. Analyzing the overall efficiency of intermediary metabolism, we proceeded from the indicators of metabolizable energy of super-maintenance. As follows from the obtained results, the synthesis of product and its efficiency were moving indicators. In particular, with the decrease in the level of total phosphorus and the introduction of phytase in the diet, an increase in concentration of metabolizable energy by 0.2-0.3 mJ /g was observed, which was associated with an increase in the conformity factor. The introduction of phytase to the diet promoted an increase in the level of compliance of metabolites with the needs of birds, while the protein-energy ratio in all experimental groups did not exceed 0,24 (Table 4).

Table 4: Peculiarities of intermediary metabolism in body of broiler chicken for the period of experiment

Indicator	Group					
	Control	I	II	III	IV	V
Metabolizable energy of super-maintenance, mJ/head	30,0	31,0	29,1	29,9	28,5	29,2
Metabolizable energy efficicency	0,513	0,519	0,509	0,512	0,515	0,527
Nutritional level	0,93	0,96	0,90	0,96	0,89	0,99
Concentration of metabolizable energy, mJ/kg DM	14,9	15,1	14,6	14,7	14,6	14,7
Conformity factor	0,034	0,034	0,035	0,035	0,035	0,036
Protein-energy ratio	0,244	0,242	0,237	0,236	0,239	0,238

Thus, the level of nutrition in groups I, III and V was 0.96; 0.96 and 0.99, which is by 3.2; 6.7 and 11.2% more than in the control, II, IV experimental groups, respectively. To determine the transformation of feed energy into body of bird, energy metabolism in the body of broiler chickens was analyzed. As shown by the studies, 16.1 mJ/head of net energy was deposted in body of birds of group I during the experiment, which amounted to 24.6% of gross energy volume received with feed during this period. The superiority of this indicator in group I relative to the control group was 4.5%. In addition, net energy of growth in III and V groups was higher by 3.4 and 4.8% relative to groups II and IV, respectively.

As result, energy entering the body of experimental birds was consumed more on heat production against the background of the lowest energy loss with excrement. Thus, energy loss with excrements decreased on the background of an increase in ME efficiency and commodity factor. It attests to a more rational use of energy for tissue synthesis in groups with a phytase-containing diet.

Analysis of chemical elements

The analysis of the intake of elements with food, their accumulation allowed us to calculate the conversion rates of individual macro- and microelements from feed to the body of the experimental bird (Table 5).

Table 5: Conversion rates of feed of the chemical elements in the organism of broilers

Elements	Group					
	Control	I	II	III	IV	V
Essential and conditionally essential trace elements						
As	0,324	0,258	0,123	0,117	0,194	0,178
B	0,009	0,006	0,019	0,012	0,018	0,016
Co	0,015	0,014	0,012	0,01	0,014	0,012
Cr	0,053	0,035	0,083	0,052	0,081	0,075
Cu	0,013	0,015	0,014	0,015	0,015	0,017
Fe	0,031	0,043	0,039	0,041	0,052	0,055
I	0,116	0,117	0,115	0,118	0,119	0,121
Li	0,02	0,016	0,015	0,015	0,015	0,014
Mn	0,002	0,003	0,001	0,0015	0,002	0,0022
Ni	0,129	0,099	0,129	0,115	0,101	0,09
Se	0,182	0,24	0,198	0,244	0,213	0,264
Si	0,005	0,005	0,005	0,0045	0,0046	0,003
V	0,0175	0,0168	0,0198	0,0198	0,020	0,019
Zn	0,0663	0,0711	0,0496	0,0537	0,0492	0,0543
Toxic trace elements						
Al	0,003	0,002	0,005	0,002	0,004	0,002
Cd	0,001	0,0009	0,013	0,010	0,016	0,011

Hg	0,006	0,006	0,015	0,014	0,007	0,006
Pb	0,050	0,043	0,053	0,044	0,069	0,056
Sn	0,028	0,025	0,049	0,046	0,075	0,061
Sr	0,085	0,075	0,061	0,055	0,097	0,079

When assessing the efficiency of conversion of elements, it was found that this indicator changes directly when included in the diet of phytase. So, against the background of the conversion factors of Ca and P in the control group - 25.0 and 16.0%, the same indices in the 1st test group were 39.7 and 23.9%, relatively. In addition, the conversion factors of calcium and phosphorus from feed in II; IV experimental groups left 20.2 and 14.6; 13.1 and 11.0%, relatively, similar indicators in III; V group were 31.6 and 22.0; 19.3 and 12.1%, relatively.

The use of phytase in broiler chickens in the I experimental group led to an increase in the conversion of Cu - by 15.4; Fe - by 38.7; Mn - by 50,0; Se = 31.9; Zn - by 7.20% against the background of a decrease in the use of As - by 20.4; B - by 33.3; Ni - by 23.3%, relative to the control. In the II and IV experimental groups, a decrease in Co conversion was recorded - by 23.1 and 14.3%, Ni - by 10.9 and 10.9%, Zn - by 8.27 and 10.4%, relative to III and V experimental groups, relatively.

The conversion factors of Pb, Sn and Sr in the third test group were 0.044; 0.046 and 0.055, which is 17.0; 6,10 and 9,80%, relatively, lower than in the II trial group. Consideration of conversion values of toxic elements when comparing control and I; II and IV; IV and V experienced groups did not reveal such significant changes. Comparison of the three combinations of the conversion rates of chemical elements in the control and I, II and III, IV and V experimental groups made it possible to construct an elemental profile of the organism of broiler chickens:

$$\text{Ration + Phytase} = \frac{Se, Cu, Zn, Ca, P, Mg, Na, Fe, K \uparrow}{Co, Ni, Pb, Sn, Sr, Cd \downarrow}.$$

DISCUSSION

The results obtained by us regarding the live weight of the bird when phytase is included in the diet agree with the studies [18], which indicate that the addition of an enzyme to a diet with a low level of phosphorus leads to an increase in the final weight of the bird. The data obtained in this study confirm the results of the works [19], in which it is said that the addition of phytase contributes to an increase in the consumption [20] reported an increase in feed intake when phytase was included in the diet of a single-stomach poultry.

Weight gain is observed in birds consuming phytase in the diet. It can be associated with increased feed intake and the release of nutrients from the phytase-mineral complex [21]. In addition [22] received similar results of the effect of phytase-containing enzymes on the background of phosphorus deficiency of mixed fodders.

Consumption of poultry feed in groups with phytase-containing diets was higher than in groups whose diets did not include phytase. This indicates that the inclusion of the enzyme increases feed intake, which leads to an increase in the availability of feed for digestion and absorption of nutrients that promote growth and development of the poultry.

The consumption, accumulation and digestibility of phosphorus by a bird is greatly enhanced by the inclusion of phytase in the diet. It means that a bird whose diet includes an enzyme uses phosphorus better than a bird kept on a phytase-deficient diet. The index of the efficiency of digestibility of phosphorus in birds whose rations included phytase was higher than that of birds kept on a non-enzyme diet.

It can be postulated that phytase releases phosphorus from the complex, which makes it more accessible to the body of birds. Accumulation and digestibility of phosphorus in groups with phytase-containing diets were better relative to the groups contained on rations without phytase inclusion. Hence, there has been an increase in the bioavailability of the nutrients present in the feed ingredients. This result confirms the ability of phytase to increase the use of inaccessible phosphorus in the body of birds. The results on the digestibility of phosphorus by the bird showed that phytase was effective in increasing the bioavailability of phosphorus.

These results are confirmed by previous studies using microbial phytase in the diet. This is consistent with the data that adding phytase to the diet of a diet helps increase bioavailability of phosphorus and reduce phosphorus excretion [23-26]. The results obtained by confirm the benefits of diets that include phytase, such benefits are associated with improved nutrient digestibility and a decrease in nutrient quality fluctuations in feed ingredients [27].

The addition of exogenous phytase to avian diets is reported to improve the assimilation of phosphorus for some herbal ingredients and the general use of feed components by broilers. Adding phytase to the diet promotes the hydrolysis of phytates and a decrease in the excretion of phosphorus, which helps to reduce the environmental load and helps to correct possible environmental problems [28].

Due to data, feeding balance and efficiency is determined by the degree of approximation of the feed composition to the desired composition of metabolites, as theoretically for more rational feeding, the amount of metabolites must correspond to the optimal level, for the internal environments of organism [29-30]. As a result, studies of the effect of phytase on energy and plastic metabolism against the background of different levels of total phosphorus in the diet are of particular interest. Analysis of the effectiveness of interchange in our studies showed that the introduction of phytase in the diet leads to an increase in the concentration of exchange energy, which was associated with an increase in the coefficient of compliance. This circumstance testifies to the correspondence of the set of metabolites to the needs of the experimental bird [31].

Recently, the solution of problems of high nutritional value of diets is often associated with possible increase of available phosphorus in them using specific enzyme preparations, in particular phytases. The addition of phytases is accompanied by a whole series of positive effects, among which is an increase in the digestibility of protein and some amino acids, dry matter of feed, an increase in the level of nutrition, bioavailability of some trace elements. This fact is confirmed in our studies.

The widespread use of biologically active substances (enzymes, probiotics, by-products of production, etc.) in feeding led to significant shifts in the "elemental portrait" of a living organism. Primary screening, which is aimed at detecting metabolic disturbances and their correction, should become one of the directions of the modern science of feeding [32].

In this regard, one of the tasks of our studies was to evaluate the effect of phytase on the elemental status of the organism of broiler chickens against a background of different nutritional security. According to Oberleas [33], on the intracellular mechanisms of the deposition of chemical elements, there is a frequent coincidence of the distribution of chemical elements among the existing groups: the first (positive conversion and deposition) characterized by extranuclear deposition (B, Si, V, Fe, Cu, As, Se, Sr) and the second group - with intranuclear accumulation (Al, Cr, Mn, Co, Ni). As follows from our data, the introduction of phytase in the diet of broilers affects the exchange of chemical elements in the body.

Confirmation of this was obtained in a series of experiments. In particular, the dependence of the conversion of chemical elements from feed to body under the action of phytase was revealed. When evaluating the conversion efficiency of elements, an increase in the conversion of Mn, Zn, Cu, Mg, Fe, Se, Ca, P, Na was observed against the background of a decrease in the conversion of Co, Ni, Cd, Sn, Sr, Pb when phytase was introduced into the broiler diet. Based on the data obtained, we once again proved that the mineral metabolism directly depends on the body's supply with macronutrients, which determine the body's need for chemical elements [34].

In this case, the exchange of certain chemical elements is largely a reflection of the exchange of other elements because of their lability and the ability to form bonds. In support of this statement are the information accumulated by modern science [35]. At the same time, in the system "the body is a chemical element", in addition to changes in the growth and development of the organism, under different nutritional conditions, changes occur, manifested as a strain of adaptive reactions of the organism and metabolic disorders [36].

CONCLUSION

The effect of enzymatic preparation Ronozyme NT (CT) on growth and energy metabolism was demonstrated on the model of "Smena-7" crosses. The study of growth characteristics confirms the growth-stimulating effect of phytase, as evidenced by the dynamics of live weight gain. Thus, the most pronounced effect of phytase on energy of growth was found in the groups receiving enzymatic preparation Ronozyme NT (CT). The inclusion of phytase in the bird's diet is accompanied by an increase in such indicators as the accumulation and digestibility of phosphorus.

The analysis of the effectiveness of intermediary metabolism showed that when the level of total phosphorus decreases and phytase is introduced into the diet, the concentration of metabolizable energy increases by 0.2-0.3 mJ/head, which was associated with an increase in the commodity factor. This circumstance attests to the correspondence of set of metabolites to the needs of the experimental bird. As result, the energy deposited in the body of experimental birds was consumed on the gain against the background of the lowest energy loss with excrements. Introduction of phytase in the diet promoted an increase in the level of compliance of metabolites to the needs of birds in groups I, III and V, while the protein-energy ratio in all experimental groups did not exceed 0.24. Consideration of conversion values of toxic elements when comparing control and I; II and IV; IV and V experienced groups did not reveal such significant changes. Comparison of the conversion rates of chemical elements in the groups made it possible to construct an elemental profile of the broiler organism.

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