CHANGES OF THE COMPOSITION OF THE BLOOD IN BROILER CHICKENS UNDER THE INFLUENCE OF BIOPRODUCTS BASED ON STREPTOMYCETES

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Abstract. Due to the shortage of feed, in particular a permanent deficit increasing protein feed with sufficient content of essential amino acids for feeding purposes are widely used microbial synthesis. The aim of our research was conducted to study the influence of drugs on the basis of *Streptomyces fradiae* 19 to change the composition of blood of broiler chickens during their growth. For obtaining biomass and complex of exometabolites, the strain was grown on complex medium R, comprising as main sources of carbon and nitrogen – corn flour, starch and a number of mineral salts. According to results the quantity of total proteins and albumins increase essential by administration in drink water of cultural liquid in concentration 1 ml / l compare with control by 32.6% and 29.2% respectively. The cholesterol decrease significantly only in first two groups (control and with use of biomass), but in the third is practically unchanged (cultural liquid). Best results according to quantity of triglycerides were obtained by using of cultural liquid, too (increased by 2.6 times more). Compare with control and group where was administrated in feed ratio 0.1% of biomass, after adding of cultural liquid the quantity of monocytes is more by ~30%; but according to values of lymphocytes, they are preserved on the same level after use of biomass in feed and significantly decrease in groups of control and where is use cultural liquid. In values of leukocytes, for all three groups there are not significant changes. Obtained results show the perspective of the direction of using products of microbial nature.

Keywords: *Streptomyces fradiae*; broiler chickens; drugs; biological products; proteins; albumen; cholesterol; triglyceride; lymphocytes; monocytes; leukocytes; non-segmented neutrophils.

INTRODUCTION

The advantages of the development of biotechnology and the use of its products do not cause any doubt: the low cost, environmentally friendly methods and specificity of biological reactions. Therefore, more and more products in the coming years will be from biotechnology with application of new active strains of microorganisms. Due to the shortage of feed, in particular a permanent deficit increasing protein feed with sufficient content of essential amino acids for feeding purposes are widely used microbial synthesis. All of the new feed and feed additives produced by biotechnology should be well studied on the harmlessness and effectiveness of their application for animals and poultry farming, and even humans. Today has demands on the quality of feed is determined not only by their nutritious, but also the composition of ingredient products. Formation of Technical Microbiology, allows expanding the list of raw materials used for production, containing a wide range of biologically active substances that have not been used in feeding farm animals and poultry. In developing the feed formulation into account has to be including polyfunctionality of active compounds of microorganisms. For example amphipathic compounds like the phospholipids in aqueous medium can form traps for specific hydrophobic substances mixtures, which showed a high feed efficiency [9, 17, 18, 27, 30].

Recent years active work on the production of new drugs with antimicrobial, immunomodulating effects as well as new, more potent adjuvants, enhancing the immunogenicity of a new generation of vaccines, immunostimulatory complexes with lipid particles as well as oligonucleotides, probiotics, combining them with prebiotics, enzymes, trace elements, vitamins and other biologically active substances of microbial origin [1, 3, 18, 29, 32]. It has not lost its relevance and application of biological products on the basis of weight or microbial antibiotic production wastes, which are recommended for use in animal husbandry and poultry farming as growth promoters of farm animals and poultry. A small concentration of antibiotics used as feed additives, does not adversely affect the organism and product quality. Although the mechanism of stimulatory action of these substances is not fully elucidated, it is assumed that, most likely, the stimulatory effect associated with two factors: 1 – effect on the intestinal microflora of the animal; 2 – a direct impact on the body of an animal. A specific feature of these physiologically active substances still have to consider those effects on the microbial metabolism of the digestive tract, but the effectiveness of antibiotics and other microbial metabolism products due to specific substances or growth stimulants. These drugs are used to enhance the organism has nonspecific resistance of the bird, the stimulation of growth and weight gain [2, 10, 11, 14, 19-21].

It is known that on the basis of metabolites of actinomycetes, obtained not only antibiotics, enzymes and other drugs, but also various feed supplements for animals and poultry. Available in high-performance products: vitamin B_{12} terravit, multi-enzyme preparations, tylosin, tylosin tartrate, fradizin-40 and fradizin-50; fradifur and biofrad.

These drugs, especially tylosin is not used in medical practice, but with perspective for veterinary, in particular as additives to animal feed for the prevention and control

of gastroenteritis and other diseases of young farm animals and as a growth stimulant [11, 24, 28, 35].

The aim of our research was conducted to study the influence of drugs on the basis of streptomycetes to change the composition of blood of broiler chickens during their growth.

MATERIALS AND METHODS

From the soil of the Central Part of Moldova was isolated strain, which is cultural-morphological and biochemical properties was identified by collaborators of Danylo Zabolotny Institute of Microbiology an Virology of National Academy of Science of Ukraine as *Streptomyces fradiae* 19 [33]. The culture was kept on agarized media Czapek with glucose, agarized oatmeal and medium Gause, as well as freeze-dried form. For inoculum cultivation was used classical medium Dulaney. For obtaining biomass and complex of exometabolites the strain was grown on complex medium R, comprising as main sources of carbon and nitrogen – corn flour, starch and a number of mineral salts. After cultivation on agitator in conical flasks for 5 days, the biomass was separated from the culture liquid by centrifugation. Investigations were conducted on three groups of 25 chickens of race Rhode Island, a day-old under identical conditions. Group I served as control group. The chicks in Group II received the feed ration of 0.1% of the biomass produced by some streptomycetes, chicks of group III, which was administered in drinking water 1 ml / l of culture fluid produced by streptomycetes. Aim was followed by analyzing variation of hematological and biochemical indices under the influence of metabolites synthesized by streptomycetes.

The chicks were nourished with food appropriate to qualitative and quantitative ethologic requirements. Also have complied with the requirements of appropriate microclimate, making available the first week of life is a temperature control 33 - 35.5ºC under the brooder, relative humidity of 70% and a speed of air masses from 0.2 to 0.3 m / s, the respective indicators were later adapted to the requirements of animal welfare.

Therefore the interpretation of the indices obtained in the experimental groups were compared to the values obtained in the control group, and the indices described in the specialist literature of avian.

RESULTS

The biological active substances of different chemical nature are widely used in the poultry farming industry. Particular attention as a source of these substances attached to microorganisms. Practice has shown that the proper use of microbial metabolites in poultry farming enhances poultry productivity, survival and reproduction. The active compounds can be used as part of the biomass or in purified form, but remains a priority over the use of biomass which contains the necessary complex of physiologically active substances, and the cost of such dietary supplements are much lower than the cost of purified preparations. The search for new active producers of biologically active substances necessary for living growing organism, including poultry, to study the possibility of using these microbial metabolites remain relevant [4, 6-8, 13, 16, 31, 34]. For example, isolated from the soil of Kazakhstan strains of streptomycetes used to produce new bioproducts, which increased weight gain of chickens by 11.8-15.9%, and save them by 8.0-12.5%, improving the characteristics of meat and blood [23].

As a result of the experiment conducted were obtained hematologic and biochemical data reported in Tables 1-5.

On the first day of life, the values of total protein average was 28.96±0.14 g/l, which later increased with age in all groups at research (Table 1).

Analysis of results received on the first day of life presented in the table above, talk about physiological values which reflect the obvious good health of the chickens from the onset of the study. Similar hematological results of chickens during the first days after hatching reported and other authors [15].

Reporting the data received on the first day of life the chicks with those registered during the course of subsequent experience presented in Table 1 may be mentioned that the total protein in the control group decreased by 0.44% from 15 days of life and then increased by 6.45% at 55 days of life, then fall to 19.09% from 70 days of life. At chickens of group II at 15 and 55 days was increased by 7.83% and 4.67%, subsequently to fall to 70 days of life by 10.11%. In group III positive percentage values were registered throughout the experiment yielding values 15, 55 and 70 days: 5.42%, 18.43% and 7.28% respectively. At the same time, the level of albumin in the control group decreased starting with the 15th day by 5.58%, 2.98% and 21.27% respectively, and increased in group II at 15 days of life with 4.67 % and 26.33% at 55 days of life, and subsequently decreases to 70 days by 19.14%. In Group III was registered the increase of albumin from the 15th day of life by registering with 2.37% and a decrease from 55 days by 23.28% as subsequently to register a slight increase to 70 days by 1.6%.

The results achieved show that the metabolites produced by streptomycetes have a positive effect on liver function and especially on protein metabolism.

The importance of evaluating cholesterol levels may be considered as a function of the liver sample. The metabolic processes involved in the metabolism of cholesterol to form bile acids, cholesterol esters, involved in the transport of cholesterol esters of unsaturated fatty acids, important sources for the synthesis of biologically active substances (prostaglandins, thromboxanes and leukotrienes).

Such reporting data from Table 2, or percentage values obtained that shows a decrease in cholesterol

levels at 15, 55 and 70th day of life by 0.66%, 18.98% and 18.98% respectively. In Group II was increased by 2.2% to subsequently fall to 55 and 70 days with 18.98%. In Group III values thus obtained or performed in a continuous decrease by 5.07% at 15 days and 4.41 respectively at 55 and 70 days.

Triglycerides showed values upward, so the group I at 15, 55 and 70 days was registered values of 24.52% and 2226.42%. In Group II also to 15 days triglycerides increased 26.41% and 1598.11% respectively at 55 and 70 days of life, and in group III on 15 days, higher values of 7.54% and 2101.88% at 55 and 70 days. Thus metabolites produced by streptomycetes help balance lipid levels in the body.

Research has shown that the lymphocyte count registered in the control group at day 15 is by 2.04% lower as the first day and continue to decline by 12.09% respectively at the 55th and 70th day of life, also a decrease is registered in group III where the data obtained reaching values lower percentage compared to the first day by 1.22%, stressing it further 10.49% on 55th and 70th days of life. The best values were obtained in group II where at 15 days was increased by 2.03% and then 2.57% at 55 and 70 days of life.

Distributions of small basic segmented neutrophils were reported by following values compared to the control group: Table 4 and groups II and III shown in Table 5.

Significant differences in values are not recorded.

Table 1. Values of serological proteins of the chickens subjected to research

Group	First day		15 day		55 days		70 days	
	Lymphocytes, %	Monocytes, %	Lymphocytes, %	Monocytes, %	Monocytes, %	Lymphocytes, %	Monocytes, %	Lymphocytes, %
I	28.96±0.14	13.06±0.14	28.83±1.44	12.33±0.62	30.83±0.15	12.67±0.06	23.43±0.12	10.27±0.05
II	28.96±0.14	13.06±0.14	31.23±1.56	13.67±0.68	31.23±0.16	16.50±0.08	26.03±0.13	10.56±0.05
III	28.96±0.14	13.06±0.14	30.53±1.53	13.37±0.67	34.30±0.27	10.50±0.05	31.07±0.16	13.27±0.07

Table 2. Values of lipaemia of the chickens subjected to research

Group	First day		15 day		55 days		70 days	
	Total Cholesterol, mmol/l	Triglyceride, mmol/l	Total Cholesterol, mmol/l	Triglyceride, mmol/l	Total Cholesterol, mmol/l	Triglyceride, mmol/l	Total Cholesterol, mmol/l	Triglyceride, mmol/l
I	4.53±0.02	0.53±0.0	4.50±0.23	0.66±0.03	3.67±0.36	12.33±0.02	3.67±0.36	12.33±0.02
II	4.53±0.02	0.53±0.01	4.63±0.23	0.67±0.03	3.67±0.42	9±0.01	3.67±0.42	9±0.01
III	4.53±0.02	0.53±0.01	4.30±0.23	0.57±0.03	4.33±0.37	11.67±0.02	4.33±0.37	11.67±0.02

Table 3. Values of lymphocytes of the chickens subjected to research

Group	First day		15 day		55 days		70 days	
	Lymphocytes, %	Monocytes, %	Lymphocytes, %	Monocytes, %		Lymphocytes, %	Monocytes, %	Lymphocytes, %
I	81.67	4.66	80	4.33	71.13	12.67	71.13	10.27
II	81.67	4.66	83.33	10.33	83.77	16.50	83.77	10.56
III	81.67	4.66	80.67	10	73.1	10.50	73.1	13.27

Table 4. Values of leukocytes of the chickens subjected to research (control)

Group	First day			
	Leukocytes, 10^9/l	Non-segmented neutrophils, %	Segmented neutrophils, %	Eosinophils, %
I	54.83±0.27	1.33	1.33	1
II	54.83±0.27	1.33	1.33	1
III	54.83±0.27	1.33	1.33	1

Table 5. Values of leukocytes of the chickens subjected to research

Group	15 day				55 days				70 days			
	Leukocytes, 10^9/l	Non-segmented neutrophils, %	Segmented neutrophils, %	Eosinophils, %	Leukocytes, 10^9/l	Non-segmented neutrophils, %	Segmented neutrophils, %	Eosinophils, %	Leukocytes, 10^9/l	Non-segmented neutrophils, %	Segmented neutrophils, %	Eosinophils, %
I	63.53±0.04	1.33	11.33	1.53	71.13±0.36	3.67	12.33	30.83	71.13±0.37	3.67	12.33	23.43
II	67.46±0.04	0.67	4.28	0.33	83.77±0.42	3.67	9	31.23	83.77±0.33	3.67	9	26.03
III	65.76±0.3	1	10.66	1.33	73.1±0.37	4.33	11.67	34.30	73.1±0.37	4.33	11.67	31.07

Therefore, interpretation of these results, in the recent scientific data are not detrimental to the product indicates that the decrease in peripheral blood of monocytes can be a consequence of their migration in the tissue, processing and maturation into macrophages [15].

DISCUSSIONS

The studies conducted previously indicated that substances produced by streptomycetes, increase growth of lactic acid bacteria that significantly increase carotenoid carotenogenesis in yeast by adding in nutrient medium cultural liquid of streptomycetes intensified growth of paramecium [26]. Lipid formulations of actinomycetes introduced into the diet of fattening pigs, contributed to getting 10-15% more production and lower feed costs by 10-12%, the drug has a high anabolic effect (up to 33%), without conceding a known anabolic steroids - nerobolil. When checking phospholipid preparations of live weight gain of pigs the highest (31.4%) have been reported with administration of the drug from *Streptomyces canosus* 89, and from yeast - the lowest (14.6%) [5]. Our investigations have shown that, depending on the culture conditions studied, biomass of streptomycetes may contain up to 45% protein, lipids 4.0-29.0% and substances with antimicrobial properties. The culture broth and the biomass of these strains showed a significant amount of essential amino acids, enzymes, B vitamins, phospholipids, sterols, polyunsaturated fatty acids and other physiologically active substances [4, 6, 25, 34]. Therefore, studies were carried out by us, aimed at developing ways to use of biomass and extracellular metabolites formed by these streptomycetes, as biological stimulants in the diet of agricultural poultry - broiler chickens. In the experimental group chickens received a diet in addition to the main number of different bioproducts, prepared on the basis of biomass and complex of exometabolites of strains of *Streptomyces*, also selected by us from the soil of Moldova, *Streptomyces massasporeus* CNMN-Ac-06. Determining the influence of drugs on the body weight gain of the chickens showed that the drug was more effective on the basis of this strain of biomass (116.8% of control) than the drug on the basis of the complex of exometabolites (107.1% of control) [6, 34]. Like in the case of investigations conducted, it was established biochemical and hematological indices influencing positively. Investigated index values show an intense anabolic process of chicken bodies subject to research [12].

Regarding the dynamics of the total protein and protein fractions in the blood serum of birds, it was observed that under the influence of bioproducts are not radically changed, whereas for the experiment conducted previously, total serum protein increased on average by 6.5% compare with the control group and also was recorded a significant increase in serum albumin in groups II and III. So, if chickens in experimental group of total protein was 2.46-2.85 g / 100g (50 day of growth), and the control chicks - 2.36 g / 100g, which can be explained by an increase in nitrogen metabolism in the body. It has been observed decrease in albumin with age. Number of globulins in blood serum is amended as follows: the first 54 days the content of alpha-globulins decreased slightly, but returned to normal by the end of the experiment, whereas the beta and gamma globulins remained at the control level. Practically remained unchanged ratio of albumin, globulins. In the experimental group reported a significant increase in bactericidal and lysozyme activity, which confirms the role of microbial agents in stimulating the body has overall resistance of birds [6, 22, 34].

Thus provides novel strains of streptomycetes isolated from soils of Republic of Moldova, differ by presence in biomass of substances of lipid nature, comprising a physiologically active fractions (phospholipids, sterols, acylglycerides) and unsaturated fatty acids, an increased amount of the basic essential amino acids, stimulants of growth and substances with antimicrobial activity. On the basis of complex of metabolites of these strains could be produce bioproducts as additives to the diet of broiler chickens that enhance safety, increase the weight of poultry and the economy of feed, as well as influence the process of hematopoiesis and immune status of the body has system of chickens.

Additionally it has to be mention, that after researche were found out that the metabolites produced by streptomycetes isolated from soils of the Republic of Moldova helps to optimize lipid metabolism during periods of intensive development and favors chicken has protein synthesis in the liver.

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