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Editor

Komarytskyy M.L.

Ph.D. in Economics, Associate Professor

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AGRICULTURAL SCIENCES

УДК 636.087.72

ECO-FRIENDLY BIOTECHNOLOGY FOR BIOGENIC NANOSELENIUM PRODUCTION AND ITS USE IN COMBINATION WITH PROBIOTICS IN POULTRY FEEDING: INNOVATIVE FEEDING CONCEPTS

Bityutskyy Volodymyr

Dr. s.-g. Sciences, Professor

Tsekhmistrenko Svitlana

Dr. s.-g. Sciences, Professor

Tsekhmistrenko Oksana

doctor of agricultural sciences Sciences, Associate Professor,
Bila Tserkva National Agrarian University, Ukraine

Demchenko Alexander

Cand. s.-g. Sciences, Senior Researcher

Institute of Microbiology and Virology

them. D. K. Zabolotny National Academy of Sciences of Ukraine
Kyiv, Ukraine

Annotation. There is a general increase in demand for poultry meat on the market today. This is especially true in developing and densely populated countries. The sector is expected to expand significantly in the near future. Due to high productivity, short fattening period and efficient conversion of feed into broiler chickens, poultry meat can be produced relatively easily and quickly, even in suboptimal conditions. Effective and innovative feeding concepts can ensure high productivity as well as maintaining the health of the bird's gut.

One of the main reasons for the departure of young animals and poultry are diseases associated with disorders of the gastrointestinal tract, the causative agents of which are pathogenic microflora. However, the widespread use of chemotherapeutics of various origins, including the latest antibiotics, has led to the artificial formation of

reservoirs of opportunistic pathogens. In order to ensure the environmental safety of food in the European Union, the use of antibiotics in poultry and poultry products is prohibited. In veterinary practice, antibiotics have been widely used as growth stimulants, which were used in subtherapeutic doses throughout the breeding broiler. However, convincing data indicate that antibiotics have contributed to the development of resistance in pathogenic strains. The emergence of resistant strains on poultry farms is a matter of serious concern. Reports have shown not only harm to animal health, but also to humans due to trophic interactions.

Finding alternative sources of supplements that could be potential substitutes for antibiotics in broiler chickens is becoming a crucial issue for many researchers. Therefore, in order to find an acceptable and reliable alternative to antibiotics to ensure the safety of poultry products without compromising productivity, various studies are being conducted.

Key words: nanoparticles, “green” synthesis, selenium, oxidative stress, application of nanoparticles.

Introductions. At the present stage of development of the livestock and feed industry, alternatives to antibiotics are increasingly used: probiotics, prebiotics, synbiotics, phytobiotics, natural growth stimulants, immunostimulants, bacteriophages, antimicrobial peptides, specific enzyme preparations, acidifiers [1; 2; 5]. Recently, antibiotics have been the main weapon in the fight against bacterial infections [13; 14]. However, due to the widespread excessive and irrational use of antibiotics for humans and animals, bacteria are becoming increasingly resistant to them [11]. The WHO has recognized antibiotic resistance as one of the greatest threats to health, food security and development in the world. Antibiotic resistance occurs when bacteria change under the influence of drugs. Therefore, antibiotics stop working and infectious diseases cannot be treated. Antibiotic resistance threatens the effective prevention and treatment of any infections. The level of antibiotic use in animal husbandry and crop production is growing every year [3; 4; 8]. The main threat to health is not antibiotics in the meat, but the persistent bacteria which are in it.

Today, antibiotics are regularly used to raise pigs, poultry, laying hens, beef cattle and dairy cows, as well as fish [6; 10; 12]. Antibiotics are usually used in part to treat animals, but many are used to promote growth and prevent disease. According to the World Health Organization (WHO), more than half of all antibiotics produced in the world are used in animal husbandry not to treat but to stimulate growth. Therefore, excessive use of antibiotics in livestock is one of the reasons why basic drugs are often ineffective or ineffective in the treatment of human diseases. The result of such overuse is that a bacterium resistant to a particular antibiotic in one direction (eg, broiler chickens) may be resistant to antibiotics used in a completely different direction, such as human medicine. As an alternative to antibiotics, special attention should be paid to pro- and prebiotics, the action of which is adequate to the mechanisms of protection of the macroorganism from the pathogenic influence of the external environment, which have developed in the process of evolution [9].

Probiotics are living microorganisms, the intake of which in adequate quantities has a positive effect on human health. Prebiotics are selectively fermented ingredients that are formed by specific changes in the composition and / or activity of the gastrointestinal microbiota, and thus have a positive effect on animal and human health.

Bacteria from the genera *Lactobacillus* and *Bifidobacterium* are most often used as probiotics [9]. Probiotics in animals and humans perform various functions, including participation in immunological reactions: activate macrophages (cellular immunity), increase the production of immunoglobulins (humoral immunity), optimize the formation of cytokines, adapt to food antigens [2; 3; 7]. In the conditions of industrial poultry farming there are technological stress factors, which cause excessive stress, the development of oxidative stress, reduced productivity and resistance of birds. Therefore, there is a need for additional support of the antioxidant system in poultry. One of the important elements that play a significant role in the regulation of redox processes in the cell is the metalloid Selenium. Its inorganic forms have toxic effects and limited properties, so there is a need to develop new compositions, in particular in nanoform [5; 6; 13]. The introduction of "green

chemistry" and "nanotechnology" is one of the revolutionary developments in science that has influenced research on environmental safety and reducing the size of objects. Combining these two fields has paved the way for a new "green" and nanoscale science called "green nanotechnology". The advantage of nanostructures synthesized by the green approach is that specific bioobjects contain a wide variety of biomolecules that transform inorganic forms of selenium into nanoseleniums and cover the surface of synthesized nanoparticles, forming coating layers that further provide stability and biocompatibility the unique specificity of their action.

Among biogenic sources, fungi and bacteria predominate not only because of their ability to produce higher levels of the enzyme reductase, which can effectively reduce the cost of large-scale production [9]. Selenium nanoparticles synthesized by probiotic bacteria can be effectively used as an alternative to other forms of selenium as a feed additive for prebiotic action due to the synergistic action of Se and probiotics to reduce oxidative stress, increase resistance and productivity of birds [15]. So the aim of the current research was studying the use of prebiotics and selenium nanoparticles in poultry to correct productivity and bird's saving.

Materials and methods. The experimental part and approbation of research results were performed on strains of *L. plantarum* cultures provided from the collection of microorganisms of the D.K.Zabolotny Institute of Microbiology and Virology of the NASU, white rats, mice and quail breed Pharaoh. The research was conducted in the laboratories of the Research Institute of Ecology and Biotechnology of Bila Tserkva National Agrarian University (BNAU), the Department of Interferon and Immunomodulators of the Institute of Microbiology and Virology. D.K. Zabolotny National Academy of Sciences of Ukraine. Laboratory and technological studies have been used that combine the biotechnology of production and application of selenium nanoparticles from the class of metalloids.

Cultivation of lactobacilli was performed in vials (500 cm³) on a rotary shaker (220 rpm), at the optimum temperature (30°C). The period of cultivation on nutrient medium MSS Broth (Conda) was 2 days. Sodium selenite was additionally added to the medium in various concentrations from 1 to 30 ppm by Se. The number of viable

bacterial cells in 1 ml of suspension was determined by the method of limiting dilutions when sowing aliquots on nutrient media with 0.2% agar-agar. Cultures of *L. casei* II B-7280 were grown in liquid pH MPC Broth (Conda) low pH in the presence and absence of Na_2SeO_3 . Physicochemical analysis was used, the stability of the drug was assessed, acute and chronic toxicity in laboratory animals were studied. Characteristics of the nanopreparation were performed using transmission electron microscopy (TEM) and UV spectra were obtained. Acute toxicity parameters of sodium selenite with probiotic and bionanoselen were studied in white mice 2-3 months of age, weighing 19-22 g and white rats, aged 2-3 months, weighing 180-200 g. The studied feed additives were administered intragastrically, once. The research followed the general principles of bioethics, legislation and requirements under the provisions of the European Convention for the Protection of Vertebrate Animals for Research and Scientific Purposes (Strasbourg, 1986), the General Ethical Principles for Animal Experiments (Ukraine, 2001).

In the case of studying the biological action of various forms of selenium at the age of 24 days were selected 240 quail breed Pharaoh and by the method of analogues formed 4 groups – control and three experimental 60 heads each. Experimental studies were conducted in the vivarium of Bila Tserkva National Agrarian University. The bird of the control group (1st group) received a complete feed. Probiotic (*L. plantarum*) (2nd group), sodium selenite (3rd group) and biogenic nanoselen (4th group) were added to the compound feed of the experimental groups of birds by multistage mixing. The dosages of probiotics and selenium preparations correspond to the established effective amounts according to previous scientific studies and amounted to 108 CFU / cm³ and 0.3 mg / kg of feed. Probiotic and biogenic nanoselen were synthesized together with scientists from the Department of Interferon and Immunomodulators of the Institute of Microbiology and Virology of D.K.Zabolotny Institute of Microbiology and Virology of the NASU.

Blood and tissue samples were taken from 5 birds from each group. Philiclit Diagnostics test kits (Ukraine) were used for biochemical research. The experiment studied the body weight of the bird, feed consumption, livestock safety, calculated

weight gain and feed consumption per 1 kg of gain. The results of the research were processed according to standard statistical methods in Microsoft Excel.

Results of the research and discussion. The most integral and informative indicator of the highly effective action of probiotic drugs is the growth rate of quail, which, first of all, determines the profitability of the industry and the competitiveness of products. Studies have shown that the drugs used in the diet of quail lead to a predominance of poultry experimental groups on the body weight of control analogues. The use of sodium selenite (group 2) showed the smallest increase in quail weight, and the use of bionanoselenium in combination with probiotics showed the largest increase, which significantly exceeded the control at the end of the experiment by 7.4%.

Increase in protein, albumin, tendency to decrease the activity of aminotransferases, decrease in the concentration of total bilirubin, indicates that the addition of various selenium compounds to the diet had a positive effect on metabolic processes and had no negative effect on liver cells, as evidenced by marker liver enzymes like AlAT and AlAT. The tendency to decrease the concentration of uric acid and creatinine in the experimental groups indicates the absence of adverse effects on renal function. To determine the effect of probiotic strains of microorganisms on the quantitative composition of lactobacilli in the intestines of birds from the obtained samples was isolated content and an empty fragment of the intestine. The largest number of lactobacilli was observed both in the washout from the large intestine and in the intestinal contents of quails of the 4th experimental group, where probiotic and nanoselen were fed. It has been shown that pro- and prebiotics have immunomodulatory activity in relation to the intensity of phagocytic function of macrophages obtained from experimental quails. The best indicators of immune status in quails of the 4th experimental group. Analysis of the content of lipid peroxidation index (TBA-active products) revealed a decrease in its content in quails of experimental groups relative to the control group. According to the results of biochemical studies of broiler blood, it was noted that the indicators of antioxidant protection were higher in the blood of quails of the 4th group with the introduction of

a complex of probiotics and biogenic nanoselenium. Preservation of the broiler population during the experiment ranged from 96.0 to 99.0%. The data obtained by us are the basis for the use of a complex of probiotics in order to increase productivity in the production of broiler meat.

Conclusions. A study was conducted to determine the effectiveness of new probiotic drugs. The "green" synthesis of selenium nanoparticles has been carried out, which has a wide prospect of application in agriculture. production. The use of quail probiotics and nanoselenium leads to the activation of metabolic parameters, increases the profitability of production.

Thus, investing in high-quality feed solutions that include alternatives to antibiotics is the only and highly effective way to ensure human health, animal welfare, productivity and consumer demand.

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