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The Influence Of The Animal Feed Components And Biologically Active Substances Into The Intestinal Microbiota State Of The Bird.

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ABSTRACT

The review is devoted to the study of the role of microorganisms of the gastrointestinal tract of broiler chickens in digestion and metabolism. It is shown that metagenomic studies expand knowledge of the relationship between diets, microflora, physiology, and productivity of broilers, and in the future will help to create a range of additives that effectively modulate the intestinal microflora of poultry and improve its productivity.
Keywords: probiotics, intestinal microbiota, immunity, broilers, feed additives

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SHORT REVIEW

Over the past decades, the study of the role of the microorganisms of the gastrointestinal tract of broiler chickens in digestion and metabolism has aroused the increased interest of both scientists and practitioners of poultry farmers, since the results of these studies help to organize more rational and complete feeding and other activities needed to increase productivity and improving the health of poultry [2, 24]. The structure of the diet can influence the composition of the intestinal microbial populations, and its grain (carbohydrate, energy) part is the most important in this regard since it supplies the intestinal chyme with the main substrates necessary for the microflora for vital activity. The so-called "viscous" grains are characterized by high concentrations of non-starch polysaccharides (LPS), including water-soluble, which are poorly digested by the bird itself, but serve as a substrate for microflora, especially in the blind intestines, which hydrolyzes them and then breaks down into low molecular weight metabolites, such as SCCC. (acetate, propionate, butyrate, lactate, etc.). For such transformations, entire cascades of sequential enzymatic reactions and the simultaneous presence of a number of microbial enzymatic activities are required [22]; however, the initial substrates for these cascades, i.e. NPS rations are extremely complex systems where components can vary in molecular weight, length, and structure of side chains, types of bonds between molecules, etc. [14]. NPS, even of the same type, can vary greatly in structure and properties in different types or varieties of grain [7], so ideally they can choose different combinations and concentrations of enzymes and/or probiotic supplements that will effectively break down this option NPS to beneficial for the body of the final metabolites of the bird.

Currently, 6 types of micro-components of the diet (feed additives) are used in practice to modulate the composition of the intestinal microflora of the bird: antibiotics, exogenous enzymes, prebiotics, probiotics, synbiotics, phytobiotics[21]. In some countries, the ban on the use of feed antibiotics (in EU countries since 2006), which were previously the main modulating microflora supplement [4], has aroused keen interest in other types of these additives, which are being intensively studied all over the world. Interest is also fueled by the growing international concern about the problem of resistance to pathogens for antibiotics [11].

The most studied today are probiotic preparations. Probiotics are now understood as live microbial feed additives that improve the health and productivity of farm animals [20]. Currently, as a probiotic additive used species of the genus *Lactobacillus (bulgaricus, plantarum, acidophilus, salivarius, lactis, helveticus, casei), Bacillus subtilis, Enterococcus faecium and faecalis, Streptococcus thermophilus*, species of the genus *Bifidobacterium*, some strains of *E. coli* [8, 9, 10], some species of the genera *Bacillus* and *Lactococcus* [21]. A variety of fungal species are also used: *Aspergillus oryzae, Saccharomyces cerevisiae* and *acidophilum* [11, 12].

The positive effect of probiotic cultures is associated with the production of SCFA, which lower the pH of the chyme and thereby reduce the growth of pathogenic microorganisms that do not tolerate relatively high acidity of the environment (clostridia, Salmonella, pathogenic strains of *E. coli*) [13]; with competition with pathogens for adhesion sites to the intestinal walls [14]; with the stimulation of a number of aspects of the host organism's own immunity [19]; with a decrease in intestinal activity of various microbial toxin-producing enzymes, such as β-glucuronidase[13].

Currently, the most widely used probiotics are based on *Bacillus* species, primarily *B. subtilis* and *B. licheniformis*. The probiotic effect of these bacilli is not least related to their secretion into the lumen of the intestine of a number of enzymatic activities, such as amylase, lipase, cellulase, protease, xylanase and phytase, which cleave various substrates in the chyme and thus increase digestibility and use of dietary nutrients [15, 16].

In experiments with probiotics based on *Bacillus*, an increase in the number of lactobacilli and bifidobacteria in the small intestine and in the intestines, as well as a decrease in the size of *E. coli* populations, is usually observed. Thus, in the experience of Chinese scientists, bacillary probiotic significantly increased the number of lactobacilli in populations of the 12-duodenal and blind intestines and reduced the number of Escherichia [16]. In terms of broiler productivity, there was a decrease in live weight gain and a significant increase in feed conversion in the period of 21-42 days of life.

However, this effect on lactobacilli is not always noted; For example, in the experience of Hungarian scientists, 4 different doses of probiotic based on *B. subtilis* also significantly reduced the population of *E. coli*, but had no effect on the *Lactobacillus* populations in the ileum and the blind intestines; at the same time, there was a significant improvement in both feed conversion and live weight gain, regardless of the level of input into the ration of a probiotic [1].

A lot of research is devoted to probiotics based on various types of *lactobacilli*. In a study by Thai scientists [17], a probiotic based on the *Lactobacillus*reuteri strain (at a dose of 105 CFU / g feed) in a corn-soy diet increased the lactobacillus population and reduced the population of campylobacter in the early postnatal period of growth of broilers. It is interesting to note that the total size of the intestinal microbial population, determined by PCR, did not differ between the control and the group receiving the probiotic at 21 days of life, whereas at 42 days of life, this indicator was 5 times larger in the experimental group than in the control group. In another recent experience, a probiotic based on a mixture of *L. agilis* and *L. reuteri* also significantly increased the concentration of lactobacilli in the *chyme* of the caecum of broilers at 35 days of age, however, the concentration of CCFA in the *chyme* of the caecum was significantly decreased ($p <0.05$) [5].

In the study on broilers under conditions of cold stress, who received a probiotic based on the strain *Lactobacillus salivarius*, the effect of the additive on the concentration in the cecum of enterobacteria, *E. coli* and lactic acid bacteria was not detected; at the same time, probiotics reduced the mortality of chickens and improved feed conversion throughout the 6 weeks of cultivation [3].

Complex multi-strain probiotics are also used, including not only different species of the same genus, but also species of different genera of microorganisms, or from bacterial and yeast components.

Such mixtures of probiotic cultures are also used to improve the competitive displacement of pathogens by expanding the range of "competitor" species. In a study by Greek authors, the efficacy of *Salmonella enteritidis* repression was investigated by a multi-strain probiotic in experimentally induced *salmonellosis*. It is shown that probiotic has about the same effect on the *salmonella* population as the feed antibiotic (avilamycin), reducing its size by 2-7 orders of magnitude, and if the positive control (infected with *Salmonella*, but not receiving supplements) at 42 days of life, the pathogen was detected in the *chyme* of the cecum in 100% of individuals, then in groups that received a probiotic or antibiotic - only 50%. At the same time, *Salmonella-specific* immune responses of IgA and IgG (both at the level of the intestine and the whole body of broilers) were significantly enhanced only in the positive (infected) control [2].

CONCLUSION

Summarizing the above, we can conclude that studies of the effect of the structure of animal feed on broiler intestinal microflora are relevant, and metagenomic studies that give a more complete picture of microbial populations compared to classical methods of microbiology are particularly relevant. These studies will expand knowledge about the relationship of diets, microflora, physiology, and productivity of broilers, and in the future will help expand the range of additives that effectively modulate the poultry intestinal microflora and improve its productivity.

Further research will also help in the development of precision solutions to the question of what additives and in what dosage should be used with a different structure of the diet of broilers, to ensure a more effective interaction of microflora with the host organism.

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