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# Effects of the Strain *Lactobacillus plantarum* ATCC 8014 on the Zootechnical Indicators of the Broiler Chickens' Growth

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## Abstract

This article presents the results of studying the effect of the strain *Lactobacillus plantarum* ATCC 8014 on the zootechnical indicators of growing broiler chickens. The strain was the basis of a probiotic preparation for the prevention of zoonotic infections. In experiments on broiler chickens (cross "Cobb-500"), three concentrations of lactic acid bacteria were used: $10^4$ CFU, $10^5$ CFU, $10^6$ CFU per 1 g of feed, respectively. It was found that the introduction of lactobacilli into the diet of poultry had a positive effect on the productive performance of broiler chickens in all experimental groups. The best results were shown by the titer of the *Lactobacillus plantarum* ATCC 8014 strain at a dose of $10^6$ CFU per 1 g of feed.

**Discipline**: Farm Animal Feed & Nutrition.



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## 1 Introduction

Industrial poultry products are among the most common in economically developed countries. These foods are the main source of human infection with Campylobacter. In chickens grown in industrial poultry farming, there is no intestinal colonization resistance against commensals - Campylobacter. These organisms cause diarrhea and numerous serious complications in humans.

Gastroenterocolitis caused by bacteria of the genus Campylobacter is the most common acute infectious zoonotic disease with the foodborne transmission. The main transmission factors for campylobacteriosis are poultry and products from it (up to 70% of the total number of cases),

drinking water (8%), and raw milk (5%). Campylobacter can be transmitted vertically through infected eggs. Methods are being developed to reduce the contamination of birds with campylobacter using probiotics, bacteriophages, and even vaccination. An important risk factor for the spread of this emerging pathogen is its ability to persist in aquatic ecosystems [1–2].

The sporadic nature of the occurrence of campylobacteriosis, associated with cross-contamination of poultry products, increases the complexity of detecting Campylobacter spp. Even a small number of cells that enter the gastrointestinal tract can cause serious diseases. Campylobacteriosis monitoring in Europe officially counts approximately 200,000 cases per year. However, the actual number of cases is believed to be around 9 million each year [3-6].

The causative agents of intestinal campylobacteriosis include thermophilic bacteria of the genus Campylobacter, species C. jejuni, C. coli, C. lari, C. upsaliensis and C. helveticus. C. jejuni is of the greatest epidemiological significance, causing the majority (85–90%) of human cases of campylobacteriosis. However, in the poultry industry, C. jejuni is generally regarded as a normal inhabitant of the intestines of birds. If the infection rate of C. jejuni does not exceed 50%, then the farm is considered free from campylobacteriosis [3].

High antigenic variability of Campylobacter spp. reduces the effectiveness of vaccines and indicates the need to develop alternative methods to combat the pathogen. Alternatives include probiotics and prebiotics.

An alternative approach to the prevention and treatment of campylobacteriosis in poultry is to increase the resistance of the chicken organism associated with the normalization of the intestinal microflora. An increase in the number of beneficial bifidobacteria and lactobacilli, a decrease in stress when changing diets and during vaccinations used in traditional schemes for the use of veterinary drugs is the key to building an effective barrier to the dangerous pathogen, Campylobacter [10–13].

Lactic acid bacteria (LAB) constitute a heterogeneous group of microorganisms; produce lactic acid as the main product in the fermentation process; have antagonistic activity against a wide range of pathogenic and opportunistic microorganisms.

The aim of the study was to assess the potential of the *Lactobacillus plantarum* ATCC 8014 strain when growing broiler chickens.

## 2 Materials and Methods

In the experiment on broiler chickens, the B-148 strain of *Lactobacillus plantarum* ATCC 8014 was used (storage condition - sublimation; source - All-Russian Collection of Industrial Microorganisms (VKPM); products synthesized by the strain - organic acids and antibiotic substances). The scheme of the experimental groups is presented in Table 1.

Experiments on broiler chickens were carried out at the vivarium of the International Laboratory of Molecular Genetics and Poultry Genomics (Federal State Budgetary Educational Institution of Higher Education "Moscow State Academy of Veterinary Medicine and Biotechnology

- MVA named after K.I. Skryabin"). The diet of the chickens of the parent flock was organized according to the recommendations of VNITIP [8].

**Table 1:** Scheme of the experiment on broiler chickens

| Group number | Features of poultry feeding |
|---|---|
| 1 - control | Feeding: basic diet |
| 2 - experience | Feeding: basic diet + probiotic (*Lactobacillus plantarum* ATCC 8014) at a dose of $10^4$ CFU per 1 g of feed |
| 3- experience | Feeding: basic diet + probiotic (*Lactobacillus plantarum* ATCC 8014) at a dose of $10^5$ CFU per 1 g of feed |
| 4 - experience | Chickens - broilers obtained after incubation of intact eggs<br>Feeding: basic diet + probiotic (*Lactobacillus plantarum* ATCC 8014) at a dose of $10^6$ CFU per 1 g of feed |

Chickens were kept in individual cages with the same technological parameters of cultivation (Figure 1).

**Figure 1:** Conditions for keeping and feeding broiler chickens of the Cobb-500 cross

**Table 2:** Feed recipes for broiler chickens, %

| Ingredients | Age, days | | |
|---|---|---|---|
| | 1 – 10 (Prestarter) | 11 – 24 (Starter) | 25 – 35 (Grover) |
| Yellow corn | 50.5 | 49.35 | 46.45 |
| Wheat | 6.00 | - | - |
| Triticale | - | 6.00 | 9.00 |
| Soybean meal | 30.00 | 31.00 | 27.00 |
| Sunflower meal | 3.50 | 4.00 | 5.00 |
| Fish flour | 4.00 | 2.00 | - |
| Meat and bone meal | - | - | 4.00 |
| Rapeseed oil | 1.70 | 3.30 | 4.30 |
| Monocalcium phosphate | 1.30 | 1.20 | 1.25 |
| Chalk | 1.15 | 1.15 | 1.00 |
| Premix | 2.00 | 2.00 | 2.00 |
| 100 g of compound feed contains: | | | |
| Exchange energy, kJ | 1268 | 1295 | 1307 |
| Crude protein, % | 22.21 | 22.21 | 21.12 |
| Crude fiber, % | 3.39 | 3.39 | 3.67 |
| Raw fat, % | 6.20 | 6.20 | 7.98 |
| Calcium, % | 1.08 | 1.08 | 1.04 |
| Phosphorus, % | 0.76 | 0.76 | 0.78 |
| Sodium, % | 0.17 | 0.17 | 0.18 |
| Lysine, % | 1.460 | 1.369 | 1.261 |
| Methionine + cystine, % | 1.072 | 1.030 | 0.988 |
| Tryptophan, % | 0.284 | 0.278 | 0.265 |

Birds were fed in two phases (days 6–21 and from day 22 until the end of rearing). Complete feed was used as the main diet for the experimental birds. Feed recipes are given in Table 2.

For the first 5 days, the chickens of all groups received the same pre-starter feed. A feed additive containing lactobacilli for chickens of the 4th experimental group was introduced starting from the 6th day of cultivation [8].

## 3 Result and Discussion

The results of chick weighing are shown in Table 3.

**Table 3:** Results of control weighings of experimental broiler chickens

| Growing period | 1st (control) group, g/head | 2nd experimental group, g/head | 3rd experimental group, g/head | 4th experimental group, g/head |
|---|---|---|---|---|
| 1 (1-7 days) | 198.6 ±3.53 | 197.8 ±3.57 | 194.2 ±2.69 | 197.4 ±2.91 |
| 2 (15-21 days) | 933.4 ±16.56 | 930.2 ±13.06 | 935.7 ±14.15 | 943.3 ±17.91 |
| 3 (29-35 days) | 2057.5+13.96 | 2083.5+11.46 | 2078.7+11.54 | 2103.2+11.31 |

Note: * P > 0,95; ** P > 0,99; *** P > 0,099.

The safety of broiler chickens in all groups was 100%. Analyzing the indicators of Table 2, it can be seen that during all periods of cultivation, broiler chickens of the 4th group significantly exceeded in terms of live weight not only the analogues of the control group (by 2.2%) but also analogues of the 2nd and 3rd experimental groups. It should be noted a slight (0.3%) decrease in the weight of chickens in the 1st experimental group, which is within the margin of error in relation to the control [14]. The results of feed consumption in the control and experimental groups are presented in Table 4.

**Table 4:** Feed consumption per 1 kg weight gain of broiler chickens

| Indicators | Groups | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| Feed consumption per 1 kg of growth for the entire growing period, kg | 3.29 | 3.29 | 3.23 | 3.25 |
| in % to control | 100 | 100.0 | 98.2 | 98.8 |
| Feed conversion, in % to control | - | 99.4 | 97.5 | 96.3 |

Feed consumption per 1 kilogram of live weight gain of broiler chickens of the Cobb-500 cross in experimental groups 3 and 4 decreased by 1.8 and 1.2%, respectively, compared with the 1st control group. It should be noted the improvement in the feed conversion rate in the 2nd group by 0.6%, and in the 3rd - by 2.5%. The maximum improvement in feed conversion was noted in the 4th experimental group (by 3.7%).

## 4 Conclusion

Thus, the introduction of lactobacilli strain *Lactobacillus plantarum* ATCC 8014 into the diet of poultry has high prospects as an active basis for feed additives for use in industrial poultry farming. The best results were shown by the titer of the *Lactobacillus plantarum* ATCC 8014 strain at a dose of $10^6$ CFU per 1 g of feed. The mechanism of growth-stimulating activity of lactic acid

bacteria is extremely diverse and can be associated with the inhibitory effect of organic acid molecules, the synthesis of exometabolites in the form of toxins, antibiotic-like compounds, lytic enzymes, or bacteriocins (bacteriocin-like inhibitory substance, BLIS).

## 5 Availability of Data and Material

Data can be made available by contacting the corresponding author.

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