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Effectiveness of the use of probiotics in the diet of broiler chickens

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SUMMARY

The aim of the experiment was to research the productivity and carcass characteristics of broiler chickens receiving a probiotic feed supplement. The probiotics added to the diet of broiler chickens were shown to increase live weight by 11,9%, average daily gains by 12,1%, and total weight gain by 12,2%, reducing feed consumption per kg increase by 8,9% compared with the control. Consumption of the probiotic feed supplement increased the pre-slaughter live weight by 12,0% and the gutted carcass weight by 13,3% relative to the control.

KEY WORDS: broiler chickens, probiotic, feed, productivity, meat quality

INTRODUCTION

The search for ways to reduce the total cost of feed in animal husbandry through the use of feed supplements is currently of great interest (Chudak et al., 2020; Pałka et al., 2020; Shevchenko et al., 2017; Sobolev et al., 2019). Increasing broiler meat production is one of the most important challenges, and is also associated with the quality of the products (Pengfei et al., 2017; Poberezhets, 2020).

These problems cannot be solved without the use of biologically active substances. Given the data on the negative impact of artificial additives and biostimulants on animal productivity and the safety of the final product, preference should be given to additives of natural origin, including probiotics (Lopetuso et al., 2017; Podolian, 2017).

Probiotics are feed supplements produced from live microorganisms or growth stimulants of microbial, animal, plant origin which have a beneficial effect on the microbiome (Angelakis, 2017; Ducatelle et al., 2015; Hadieva et al., 2021).

Probiotics do not cause the formation of resistant forms of bacteria and have a wide range of antagonistic activity against pathogenic and opportunistic microorganisms (Caramia, 2004, Vitetta et al., 2014). They also have a multifaceted positive effect on the body, e.g. by reducing the permeability of tissue barriers to toxins and detoxifying compounds produced by pathogens. Antibiotics are known to suppress the immune system, whereas probiotics stimulate the

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production of antibodies. By producing biological substances, they promote the production of mediators by the macroorganism, which has a positive effect on the functions of the digestive tract, liver, cardiovascular system, and metabolic processes. They are also involved in the synthesis and absorption of vitamins (Chralampopoulos and Rastall, 2009; Ashraf and Shah, 2014 Cisek and Binek, 2014; Hadieva et al., 2021).

The aim of the experiment was to research the productivity, carcass characteristics and quality parameters of broiler chickens receiving a probiotic feed additive.

MATERIALS AND METHODS

Ethical considerations

The experiments involving poultry were approved by the Commission on Bioethics of the Vinnytsia National Agrarian University (Ukraine) and conducted in accordance with breeding, housing and feeding standards, as well as the recommendations of the European Convention for the protection of vertebrate animals used for experiments or other scientific purposes.

Birds, housing and experimental diets

The experiment was carried out on two groups of one-day-old Cobb 500 broiler chickens (I - control group, II - experimental group), with 20 birds in each group (Table 1). The experiment lasted for 42 days, including an initial 5-day adaptation period. The control group was fed a basal diet (BD) in the form of complete feed. The experimental group additionally received a probiotic supplement according to the design of the experiment. The microclimate conditions were the same for both groups, in accordance with current veterinary and sanitary standards. The birds had free access to water, and feeding took place according to accepted standards (Ibatullin et al., 2017).

Table 1

Design of the experiment

Group	Duration, days		Number of chickens	Feeding characteristics
	Adaptation period	Main period		
I - control	5	35	20	BD (complete feed)
II - experimental	5	35	20	BD + (ProbiolPlus probiotic supplement; 0,25 kg per t of feed)

BD – basal diet

Feed ration and feed composition

The chickens were fed the completely balanced commercial feed Multigain produced by the joint-stock company Kyiv-Atlantic Ukraine (Myronivka, Kyiv region), A complete compound feed for broilers that provides the birds with all necessary nutrients.

Table 2

Composition of compound feed for broiler chickens aged 4–5 weeks

Ingredient composition, %	
Maize	30
Wheat	27,5
Soybean meal	15,0
Sunflower meal	12,0
Fishmeal	5,0
Soybean oil	3,0
Fodder yeast	3,4
Defluorinated phosphate	1,55
Limestone	1,2
Table salt	0,3
Vitamin and mineral mixture	1,0
Antioxidant	0,0125
Mould inhibitor	0,009
Coccidiostat	0,0097
Chemical composition, %	
Crude protein	21,0
Crude fibre	5,0
Methionine + cystine	0,89
Lysine	1,15
Calcium	0,9
Phosphorus	0,7
Chlorides	0,307
Crude fat	6,2
Tryptophan	0,26
Threonine	0,17
Linoleic acid	3,21
Sodium	0,2
Methionine	0,45
A	3,00
D_3	0,04
B_1	2,0
B_6	2,5
B_{12}	0,01

Performance parameters

Livestock viability and feed consumption were monitored daily, as well as live weight gain and feed conversion. The chickens were weighed weekly up to the 42nd day of growth on Aurora AU 309 electronic scales with accuracy within ± 1 g.

The following carcass properties were determined: pre-slaughter live weight of poultry after 12 hours of fasting; weight of the gutted carcass, i.e. the exsanguinated carcass, without plumage, head, legs, wings (removed at the elbow joint), or gastrointestinal tract; weight of edible and inedible parts (Ibatullin et al., 2017).

Determination of performance parameters

Broiler chickens in group I were fed complete feed in accordance with their age. Broiler chickens in group II received the same feed, but with the addition of the probiotic supplement Probiol Plus. It contains a strain of Saccharomycetes and probiotic cultures (*Streptococcus faecium*, *Lactobacillus plantarum* and *Lactobacillus salivarius*).

Statistical analysis

Analysis of variation and statistical processing of digital data were performed on a PC using MS Excel software and its built-in statistical functions. Statistical evaluation of differences was performed using Student's t-test. The difference was considered significant if the calculated criterion for the reliability of the difference was equal to or exceeded the standard value of Student's t-test. Means were considered statistically significant at $P \leq 0,05$, $P \leq 0,01$ and $P \leq 0,001$. Means and standard deviation of the traits were calculated using R software (R Development Core Team, 2017).

RESULTS AND DISCUSSION

Performance

There was a 17,2% ($P \leq 0,001$) increase in live weight compared to the control analogues (Table 3) from the 14th day of the experiment in group II, receiving the feed supplement. The experimental broiler chickens in Group II outperformed their counterparts in live weight by 9,3% ($P \leq 0,001$) on day 21, 7,7% ($P \leq 0,001$) on day 28, and 11,8% ($P \leq 0,001$) on day 35. At the end of the experiment, the live weight of broiler chickens in group II was 11,9% higher ($P \leq 0,001$) than in the control group of poultry.

Table 3

Live weight of broiler chickens, g

Age, days	Group	
	I – control	II – experimental
1	48,2 ± 1,08	48,0 ± 1,12
7	128,0 ± 2,24	132,6 ± 2,38
14	365,7 ± 4,35	428,8 ± 5,27***
21	755,6 ± 10,56	826,6 ± 11,87***
28	1287,6 ± 11,58	1387,5 ± 12,34***
35	1820,5 ± 14,42	2035,6 ± 13,68***
42	2325,2 ± 17,53	2603,0 ± 15,34***
Survival, %	92,0	98,0

Means were considered statistically significant at ***$P \leq 0,001$

Similar research has been conducted by scientists such as Angelakis (2017), Ducatelle et al. (2015), Pereira et al. (2019), and Hong et al. (2019), who noted an increase in poultry productivity and a reduction in feed consumption when probiotic supplements were included in the diet.

We also determined the average daily gains of broiler chickens receiving feed supplements (Table 4).

Table 4

Effect of feed supplement on the average daily gains of broiler chickens, g

Age, days	Group	
	I – control	II – experimental
1 - 7	11,5 ± 0,34	12,1 ± 0,54
8 - 14	33,9 ± 1,74	42,3 ± 1,82**
15 - 21	55,7 ± 1,93	56,8 ± 2,13
22 - 28	75,9 ± 2,32	80,1 ± 2,76
29 - 35	76,1 ± 2,54	92,6 ± 2,82***
36 - 42	72,0 ± 2,62	81,0 ± 2,51*
Average	54,2 ± 2,75	60,8 ± 2,63

Means were considered statistically significant at *P ≤ 0,05; **P ≤ 0,01; ***P ≤ 0,001

The average daily gains of experimental chickens (group II) were 24,7% higher (P ≤ 0,001) at the age of 8-14 days and 21,6% higher (P ≤ 0,001) at the age of 29-35 days. At the age of 36-42 days, the use of the feed supplement increased the average daily gains of poultry (group II) by 12,5% (P ≤ 0,05) relative to the control counterparts.

Average daily gains were 12,1% higher in group II for the entire period of the experiment. However, no significant difference was found in comparison with the control group.

Similar changes were observed in the total weight gains of broiler chickens additionally fed the feed additive (Table 5).

Table 5

Dynamics of poultry growth, g

Age, days	Group	
	I - control	II - experimental
1-7	80,2 ± 2,35	84,6 ± 2,72
8-14	237,0 ± 5,18	296,0 ± 6,34***
15-21	390,0 ± 6,36	398,0 ± 6,87
22-28	532,0 ± 7,24	561,0 ± 7,92**
29-35	533,0 ± 7,46	648,0 ± 8,15***
36-42	504,0 ± 8,24	567,0 ± 8,56***

Means were considered statistically significant at **P ≤ 0,01; ***P ≤ 0,001

Thus, the increase in weight gain in the experimental chickens (group II) was 4,8% (P ≤ 0,001), 5,4% (P ≤ 0,01), 21,5% (P ≤ 0,001) and 12,5% (P ≤ 0,001) greater than in the control group between days 8 and 14, 22 and 28, 29 and 35, and 36 and 42, respectively.

The results of the research are in agreement with Allahdoa et al. (2018), who reported that the inclusion of a probiotic in the diet during the growing or finishing periods positively affected body weight gain, feed intake, and feed conversion.

In experiments on the use of probiotic supplements in the diet of poultry, Pengfei et al. (2017), Neveling and Dicks (2021), and Jiang Sha et al. (2021) found that the inclusion of a probiotic resulted in a lower feed conversion ratio and induced a higher level of immune response, suggesting greater economic benefits in broiler farming. Özcan et al. (2015) have also reported a positive effect on the productivity and growth of broilers fed probiotic additives.

Carcass characteristics are essential in poultry, so the most important carcass characteristics of broiler chickens receiving the probiotic feed supplement were investigated (Table 6).

Table 6

Carcass properties of broiler chickens, g

Parameter	Group	
	I – control	2 – experimental
Pre-slaughter live weight	2330,0 ± 16,42	2610,0 ± 17,65***
Gutted carcass weight	1580,0 ± 20,62	1790,2 ± 19,46***
Weight of pectoral muscles	498,6 ± 9,45	540,4 ± 10,82*
Weight of thigh muscles	384,2 ± 9,14	452,6 ± 8,85**
Yield of slaughter products, %		
Gutted carcass yield	67,8 ± 2,12	68,6 ± 1,78
Proportion of pectoral muscles	21,3 ± 1,75	20,7 ± 186
Proportion of thigh muscles	16,4 ± 1,28	17,3 ± 1,14

Means were considered statistically significant at *$P \leq 0,05$; **$P \leq 0,01$; ***$P \leq 0,001$

The use of the feed supplement in the diet of broiler chickens (II group) was found to increase the pre-slaughter live weight by 12,0% ($P \leq 0,001$) and the gutted carcass weight by 13,3% ($P \leq 0,001$). The weight of the pectoral muscles increased by 8,4% ($P \leq 0,05$) and the weight of the thigh muscles by 17,8% ($P \leq 0,01$) relative to the control.

The research showed that the use of the probiotic supplement reduced feed costs and increased broiler productivity. The results are consistent with a study by Podolian (2016), in which a probiotic feed additive was shown to improve the live weight, growth and slaughter parameters of Ross 308 broiler chickens.

CONCLUSIONS

To conclude, the use of a probiotic supplement in the diet of broiler chickens has a positive effect on productivity and meat quality while reducing feed consumption.

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