

J. POBEREZHETS

e-mail: podolyan@vsau.vin.ua

I. KUPCHUK

e-mail: kupchuk.igor@i.ua

V. YAROPUD

e-mail: yaropud77@gmail.com

S. BURLAKA

e-mail: ipserhiy@gmail.com

Vinnitsa National Agrarian University

DIGESTIBILITY OF NUTRIENTS AND BROILER CHICKEN PRODUCTIVITY UNDER THE ACTION OF PROBIOTIC ENTERO-ACTIVE

The probiotic "Entero-active", due to the formation of lactic and acetic acids, creates an unfavourable pH environment for pathogenic microflora, stimulates the growth of intestinal normal flora, which has a positive effect on the composition of the microbiocenosis. In addition, probiotic microorganisms produce biologically active substances, enzymes and amino acids. The aim of the research was to investigate the digestion of feed nutrients by broiler chickens fed by the probiotic supplement Entero-active. Optimal doses of probiotic feeding are determined on the basis of obtained results. The influence of probiotic supplement on digestibility of feed nutrients, availability of amino acids and retention of mineral elements of mixed fodder is established. Tendencies of changes in productivity and safety of poultry under the effect of probiotic are revealed.

The broiler chickens fed by additive Entero-active have increased the digestibility of dry matter by 2.4% ($P < 0.01$), protein by 3.4% ($P < 0.001$), fiber by 31.1% ($P < 0.001$) and NFE by 4.0% ($P < 0.001$) comparing with the control group.

According to our research, the application of probiotic supplement Entero-active for the broilers' feeding increases the availability of essential amino acids, i.e. lysine by 4.8%, histidine by 3.8%, arginine by 4.9%, threonine by 7.5%, valine by 4.1%, methionine by 2.6%, isoleucine by 7.6% compared with the control indicator. It was found the absorption of Ca, P, Mg, Mn, and increases respectively, by 23.5%, 6.9%, 12.2%, and by 33.1% under the action of probiotics.

The Entero-active probiotic application in the diet of broiler chickens increases the pre-slaughter live weight by 16.7%, the weight of ungutted carcasses by 15.0% and gutted carcasses by 17.3%, feed costs per 1 kg increase by 12.9%, relative to control.

Our studies have made it possible to identify certain patterns in the digestion of nutrients by poultry, depending on the different doses of probiotic Entero-active used in their diets.

Keywords: broiler chickens, probiotic, digestibility, amino acids, mineral elements, slaughter qualities.

Ю. М. ПОБЕРЕЖЕЦЬ,

І. М. КУПЧУК,

В. М. ЯРОПУД,

С. А. БУРЛАКА

Вінницький національний аграрний університет

ЗАТРАВЛЕННЯ ПОЖИВНИХ РЕЧОВИН ТА ПРОДУКТИВНІСТЬ КУРЧАТ БРОЙЛЕРА ПІД ДІЄЮ ПРОБІОТИКУ ЕНТЕРОАКТИВ

Пробіотик «Ентеро-актив», завдяки утворенню молочної та оцтової кислот, створює несприятливе рН-середовище для патогенної мікрофлори, стимулює ріст нормальної флори кишечника, що позитивно впливає на склад мікробіоценозу. Крім того, пробіотичні мікроорганізми виробляють біологічно активні речовини, ферменти та амінокислоти. Метою дослідження було дослідити перетравлення поживних речовин корму курчат-бройлерів, яких годували пробіотичною добавкою «Ентеро-актив». На основі отриманих результатів визначаються оптимальні дози пробіотичного годування. Встановлено вплив пробіотичної добавки на засвоюваність поживних речовин корму, наявність амінокислот та збереження мінеральних елементів комбікорму. Виявлено тенденції зміни продуктивності та збереженості птиці під дією пробіотика.

Кури-бройлери, яких годували добавкою «Ентеро-актив», підвищили засвоюваність сухої речовини на 2,4% ($P < 0,01$), білка на 3,4% ($P < 0,001$), клітковини на 31,1% ($P < 0,001$) і NFE на 4,0% ($P < 0,001$) у порівнянні з контрольною групою.

Згідно з нашими дослідженнями, застосування пробіотичної добавки «Ентеро-актив» для годування бройлерів підвищує доступність незамінних амінокислот, тобто лізину на 4,8%, гістидину на 3,8%, аргініну на 4,9%, треоніну на 7,5%, валіну на 4,1%. %, метіонін на 2,6%, ізолейцин на 7,6% порівняно з контрольним показником. Встановлено, що всмоктування Ca, P, Mg, Mn збільшується відповідно на 23,5%, 6,9%, 12,2% і на 33,1% під дією пробіотиків.

Застосування Ентероактивного пробіотика в раціоні курчат-бройлерів збільшує передзайну живу масу на 16,7%, масу непотрошених туш на 15,0% та потрошених на 17,3%, витрати корму на 1 кг збільшуються на 12,9% порівняно з контролем.

Наші дослідження дозволили виявити певні закономірності перетравлення поживних речовин домашньою птицею залежно від різних доз пробіотика «Ентеро-актив», які використовуються в їх раціоні.

Ключові слова: курчат-бройлери, пробіотик, засвоюваність, амінокислоти, мінеральні елементи, забійні якості.

Introduction

Nowadays, there is a problem of offering competitive, environmentally friendly and cost-effective products in many world countries. It is known that antibiotics are widely used to increase the growth of farm animals often used as growth stimulator. However, this approach has got a number of disadvantages, as the antibiotics accumulate

in livestock products developing stable microflora, which increases their efficiency, reducing the balance of microorganisms in the gastrointestinal tract leading to antibiotic application control in Europe (Barrow P. A., 1992; Mookiah, S. *et al.*, 2014; Shtainer T. *et al.*, 2010; Podolian Yu. M., 2016; Chudak R.A. *et al.*, 2019).

Analysis of research and publications

Numerous feed additives have been used in animal diets in recent years. However, they do not always have a positive effect on product quality. Nowadays, this issue is important because of advanced technologies introduction for new feeds application, the application of chemical and microbiological synthesis products in animal nutrition (Dunkley C., 2008; Alavi S.A. *et al.*, 2012; Sobolev O. I. *et al.*, 2019).

Probiotics have become widespread among feed additives of natural origin. They create an unfavorable pH environment for pathogenic and opportunistic microflora, stimulate the growth and biological activity of normal intestinal microflora having a positive effect on the composition of the microbiocenosis, probiotic microorganisms also produce biologically active substances and amino acids (Xiaolu Liu, 2012; Park J. H., 2014; Podolian Yu. N., 2017; Salim H.M. *et al.*, 2013; Chudak R. A. *et al.*, 2020).

Digestibility of nutrients depends on the species and the animal age, chemical composition, preparation methods for feeding, feeding level and other factors. It is known that the hydrolysis of feed nutrients to monomers is carried out using enzymes and acids, and symbiotic microorganisms that are in the digestive tract (Chudak R.A. *et al.*, 2020.).

Formulation of goals

The aim of the research was to investigate the digestion of feed nutrients by broiler chickens fed by the probiotic supplement Entero-active. This probiotic supplement contains lactic acid bacteria of the *Lactobacillus* and *Enterococcus* genus. This drug was developed at PE BTU-center (Ladyzhyn, Vinnytsia region).

Material and methods

The experiment was carried out at the research farm of Vinnytsia National Agrarian University. The experiment lasted for 42 days. Four groups of one-day-old broiler chickens of the Ross-308 cross were selected by the method of analogous groups, each group contained 50 heads (Kozyr V. S. *et al.*, 2002).

Broilers were kept in one tier group cages considering all zoohygienic requirements. The control group consumed a basic diet (BD), i.e., complete feeds. The experimental groups were additionally fed by different doses of a probiotic drug (Table 1).

The amount of digestible nutrients, nitrogen balance and retention of mineral elements was determined by the difference between the nutrients, nitrogen or minerals intake with feed and their excretion with manure according to generally accepted methods (Ibatullin I. I. *et al.*, 2017).

Table 1.

Feeding patterns

Group	Duration, days	Feeding characteristics		
		Age, days		
		1 - 10	11 - 28	29 - 42
Control	42	BD (complete feeds)		
Experimental II	42	BD+0.062% Entero-active	BD +0.025% Entero-active	BD +0.0125 % Entero-active
Experimental III	42	BD +0.125% Entero-active	BD +0.05% Entero-active	BD +0.025% Entero-active
Experimental IV	42	BD +0.25% Entero-active	BD +0.1% Entero-active	BD +0.05% Entero-active

Control slaughter of poultry was performed to research hematological parameters at the end of the experiment. Morphological parameters of blood were determined at Vinnytsia Veterinary Hospital. Hematological parameters were researched according to appropriate methods (Levchenko V.I. *et al.*, 2002).

Biometric data processing was performed on a PC according to M.O. Plokhinskyi, 1969. The results of the average values were considered statistically significant at * $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.

Results and Discussion

According to the research results, the highest digestibility of protein and nitrogen-free extractives (NFE) was observed when the average dose of the additive were additionally fed; they were higher by 3.4% and 4.0% ($P < 0.001$) than the control one. The broilers of the II and IV groups had increased the digestibility of protein, although a probable difference with the control was not found (Fig. 1).

It is advisable to pay attention to the dry matter and fiber digestibility by broiler chicken dependence on different doses of Entero-active probiotic supplement comparing them with the control poultry group.

According to the research results, feeding the probiotic maximum dose increased the dry matter digestibility by 2.3% ($P < 0.01$), the average dose increased the dry matter digestibility by 2.4% ($P < 0.01$).

The maximum dose of the additive caused the highest digestibility of fiber by broilers (31.1% ($P < 0.001$)) relative to the control group. However, in groups II and III the digestibility of fiber was higher than in the control by 20.2% ($P < 0.01$) and 16.0 % ($P < 0.001$), respectively.

Group II consumed the minimum dose of probiotic drug; they outperformed by NFE digestibility the control group by 1.5% ($P < 0.05$).

The consumption of probiotics by group IV increased the NFE digestibility by 1.3% ($P < 0.01$). However, it caused decrease of fat digestibility by 1.3% ($P < 0.01$).

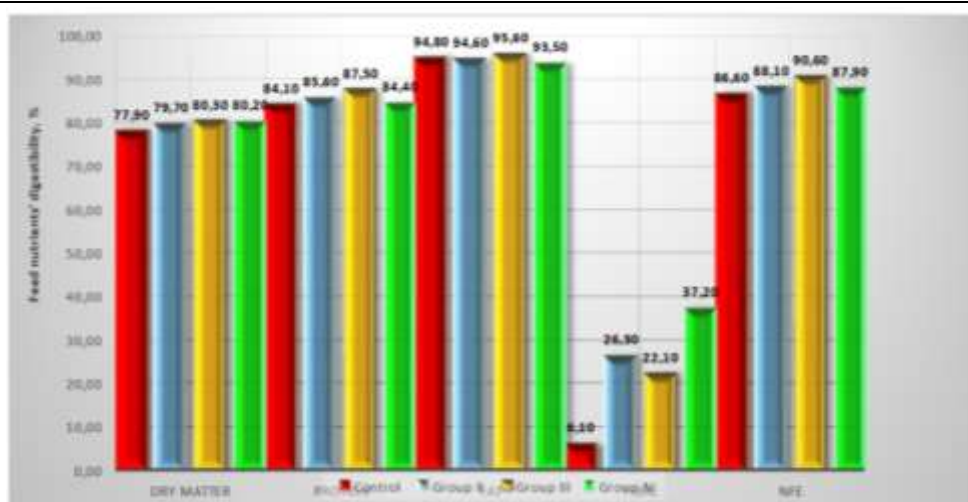


Fig. 1 Coefficients of feed nutrients digestibility

According to research data, the probiotics application for broiler chicken feeding has a positive effect on the amino acids' digestibility (Fig. 2).

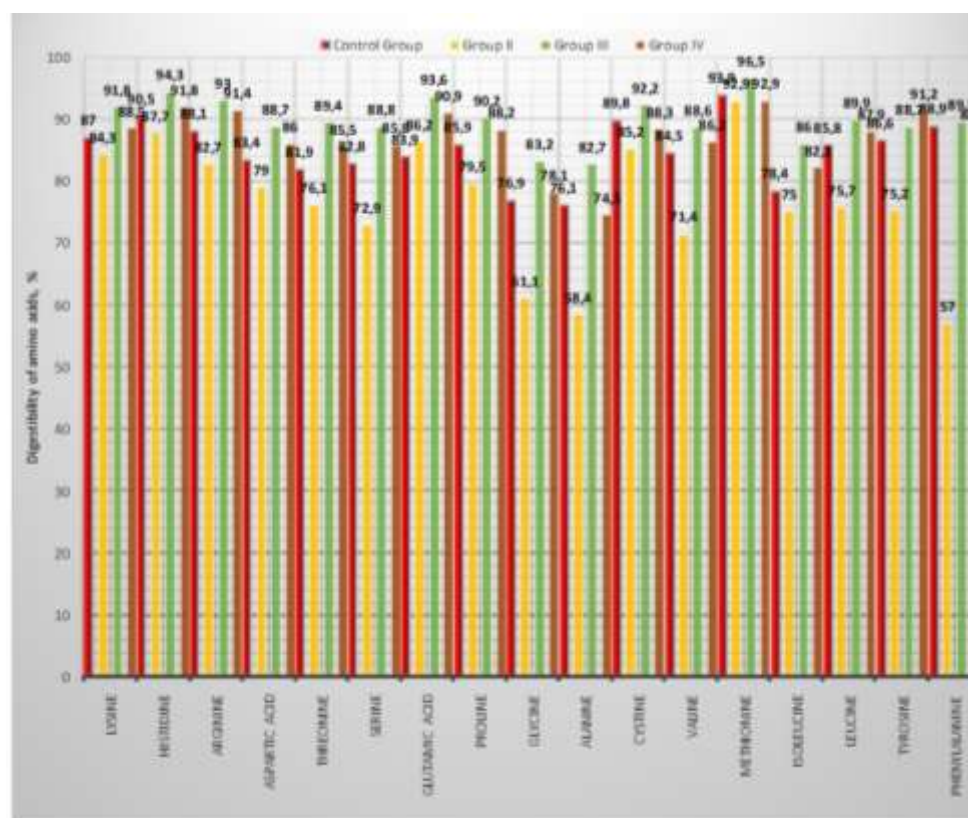


Fig. 2 Digestibility of amino acids by broiler chickens, %

According to the research results, the broiler chickens fed by the average dose of the supplement have the highest digestibility of amino acids. Thus, the digestibility of such essential amino acids as lysine, histidine, arginine, valine, methionine, isoleucine and leucine in group III significantly exceeds the control analogues, respectively, by 4.8%, 3.8%, 4.9%, 4.1%, 2.6%, 7.6% and 4.1% ($P < 0.001$). In group II the absorption of phenylalanine was by 31.9% ($P < 0.001$) less than the control sample.

It should be noted that feeding by the minimum dose of probiotics causes a decrease in the coefficients of digestion of amino acids compared to control values. The highest digestibility of aspartic and glutamic acids was found in the group III, it was higher by 5.3% and 9.7% ($P < 0.001$ and $P < 0.001$), respectively, compared with the control.

It was found that the digestibility of threonine was by 7.5% ($P < 0.001$), serine was by 6.0% ($P < 0.001$), proline was by 4.3% ($P < 0.001$), glycine was by 6.3% ($P < 0.001$), alanine was by 6.6% ($P < 0.001$) and cystine was by 3.1% ($P < 0.001$) more in group III than in the control one. The highest content of tyrosine is observed in group IV, it was higher by 4.6% ($P < 0.01$).

The mineral elements play a vital role in metabolism, because the organic matter of feed is better used by

animals in the presence of sufficient amounts of both macro-and micronutrients. Diets imbalance in terms of mineral content leads to metabolic disorders in animals, as well as a decrease in natural immunity.

Therefore, an important aspect of our research was to study the retention of mineral elements in the feed of broiler chickens (Table 2).

Table 2.

Retention of mineral feed elements, %

Group	Ca	P	Mg	Mn
Control I	17.9 ± 1.53	60.8 ± 1.42	31.8 ± 1.14	7.2 ± 2.45
Experimental II	39.9 ± 2.82***	67.7 ± 1.95*	32.7 ± 3.95	31.8 ± 3.29**
Experimental III	40.1 ± 0.91***	66.8 ± 1.02*	40.8 ± 0.68***	26.0 ± 1.13***
Experimental IV	41.4 ± 1.49***	66.4 ± 2.18	44.0 ± 1.69**	40.3 ± 1.36***

It was found that poultry additionally fed by feed additive had an increased retention of Ca and Mn, respectively, in group II by 22.0% and 24.6% ($P < 0.001$ and $P < 0.01$), in group III by 22.2% and 18.8% ($P < 0.001$ and $P < 0.001$) and in group IV by 23.5 % and 33.1% ($P < 0.001$ and $P < 0.001$) compared with the control group.

The animal growth phosphorus need is the sum of the absorbed phosphorus accumulated in soft tissues and phosphorus deposited in the bones. A significant difference in the phosphorus absorption increase was observed in experimental groups II and III by 6.9% and 6.0% ($P < 0.05$), respectively.

The probiotic has a positive effect on Mg content, it was by 9.0% ($P < 0.001$) and by 12.2% ($P < 0.01$) more in group III and IV than in the control. Lack of this mineral element in the poultry diet leads to increased excitability of the nervous system, ataxia and seizures.

It was found that group II consumed 189.4 kg of feed, it is by 1.5% less than the control group. However, feed consumption per 1 kg of growth decreased by 3.1% in group II, by 7.7% in group III and by 12.9% in group IV (Fig. 3).

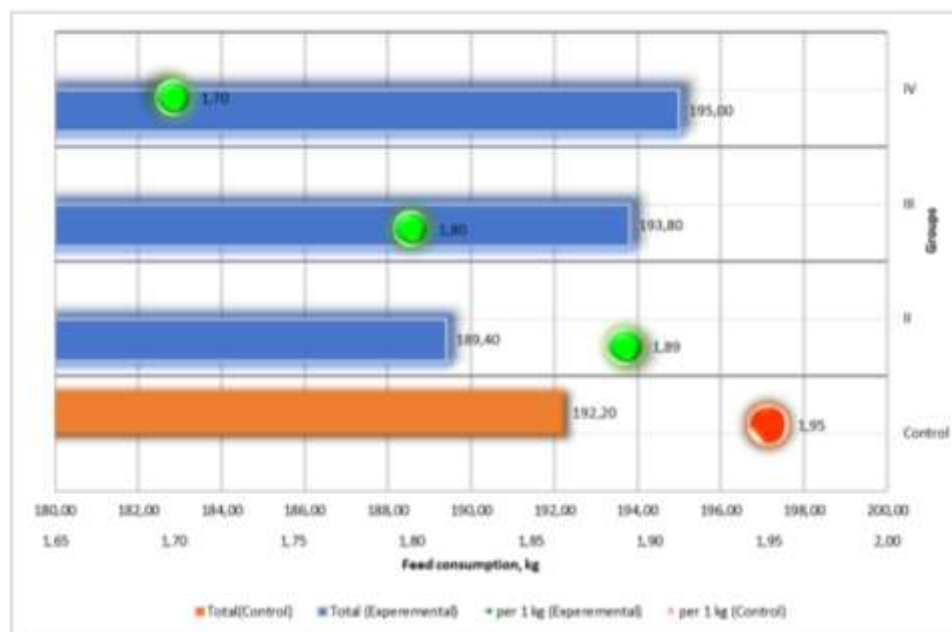


Fig. 3 Feed costs and returns of broilers, kg

It should be noted that poultry additionally fed by Entero-active probiotic drug have increased both feed conversion feed payment. However, feed costs per 1 kg of growth were lower than in the control group.

According to the research results, the probiotic additive had a positive effect on the slaughter indicators of broiler chickens (Table 3).

Poultry from groups III and IV had a significant advantage by 9.3% ($P < 0.001$) and 16.7% ($P < 0.01$) considering the pre-slaughter live weight.

When broilers consumed the probiotic drug, the weight of ungutted and gutted carcasses increased by 8.7% ($P < 0.001$) and 9.5% ($P < 0.01$) in the group III, and by 15.0% ($P < 0.01$) and 17.3% ($P < 0.05$) in group IV respectively, compared with chickens in the control group.

Table 3

Slaughter rates of broiler chickens, g

Indicator	Group			
	Control I	Experimental II	Experimental III	Experimental IV
Pre-slaughter weight	2,064.5 ± 15.3	2,104.0 ± 14.8	2,258.0 ± 26.7***	2,410.7 ± 95.6**
Ungutted carcass weight	1,867.2 ± 8.3	1,923.0 ± 55.9	2,031.0 ± 24.8***	2,148.0 ± 93.1**
Semi gutted carcass weight	1,650.5 ± 53.0	1,652.5 ± 73.0	1,793.2 ± 30.0	1,918.0 ± 101.6
Gutted carcass weight	1,406.0 ± 18.2	1,412.5 ± 89.5	1,540.5 ± 29.5**	1,650.0 ± 82.14*

The weight of semi-gutted carcass was higher by 8.6 % and 16.2 % in groups III and IV, respectively, than in the control group. However, no significant difference was found.

The obtained results on the nutrients digestibility increase under the influence of probiotic additives are consistent with other scholars' researches (Belova et al., 2009; Fedorchenko, 2017; Wondwesen and Moges, 2017). Many scientists confirm the probiotic drugs positive effect on the amino acids absorption and retention of mineral feed elements in poultry (Urdzik, 2010; Balukh, 2016). The positive effect of probiotics on slaughter rates is mentioned in the scientific publications, in particular, that their use increases slaughter qualities and improves the development of internal organs and digestive organs (Patreva and Shevchenko, 2010; Otchenashko, 2012).

Conclusion

1. The broiler chickens fed by additive Entero-active have increased the digestibility of dry matter by 2.4% ($P < 0.01$), protein by 3.4% ($P < 0.001$), fiber by 31.1% ($P < 0.001$) and NFE by 4.0% ($P < 0.001$) comparing with the control group.

2. The application of probiotic supplement Entero-active for the broilers' feeding increases the availability of essential amino acids, i.e. lysine by 4.8% ($P < 0.001$), histidine by 3.8% ($P < 0.001$), arginine by 4.9% ($P < 0.001$), threonine by 7.5% ($P < 0.001$), valine by 4.1% ($P < 0.001$), methionine by 2.6% ($P < 0.001$), isoleucine by 7.6% ($P < 0.001$) compared with the control indicator.

3. It was found the absorption of Ca, P, Mg, Mn, increases respectively, by 23.5% ($P < 0.001$), 6.9% ($P < 0.05$), 12.2% ($P < 0.01$), and by 33.1% ($P < 0.001$) under the action of probiotics.

4. The Entero-active probiotic application in the diet of broiler chickens increases the pre-slaughter live weight by 16.7% ($P < 0.01$), the weight of ungutted carcasses by 15.0% ($P < 0.01$) and gutted carcasses by 17.3% ($P < 0.05$), feed costs per 1 kg increase by 12.9%, relative to control.

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