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Experience of using the feed additive "Enteracid-Dry" in the diets of broiler chickens

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Abstract. The paper analyzes the effect of the feed additive "Enteracid-Dry" based on organic acids (formic and propionic) on the productivity of broiler chickens of the Ross-308 cross. The effect of various dosages of the additive on the dynamics of live weight growth, livestock safety and the microbiological composition of the caecum of the poultry intestine was studied. It was found that the use of "Enteracid-Dry" helps suppress pathogenic microflora in the intestine, including *Escherichia coli*, *Salmonella sp.*, *Proteus sp.* and *Clostridium sp.*, and simultaneously supports the growth of beneficial bacteria, such as *Lactobacillus sp.* and *Bifidobacterium sp.*, which creates the prerequisites for the normal functioning of the gastrointestinal tract and reduces the risk of intestinal infections. It was determined that the use of the additive at a dosage of 2 kg/t of feed leads to the maximum gain in live weight. The effect of the additive on increasing the productivity of poultry is confirmed by reliable differences in live weight gain. The additive improves the survivability of livestock, reducing the number of culled birds due to improved health. It has been established that the use of organic acids improves the digestion and absorption of nutrients, which leads to an increase in the average daily weight gain and, subsequently, to a reduction in growing periods. It has been substantiated that the additive is safe for the environment and complies with the concept of environmentally friendly production. It is proposed to use this additive in industrial poultry farming conditions to improve the economic efficiency of production. The experience of using the feed additive "Enteracid-Dry" demonstrates the prospects of introducing organic acids into the diets of agricultural poultry.

1 Introduction

The use of organic acids in poultry diets is due to their numerous positive effects on health and productivity. Organic acids are active inhibitors of pathogenic microflora growth [1] in feed, drinking water and in the gastrointestinal tract of poultry, but at the same time, they do not inhibit the growth and development of beneficial lactic acid microflora.

These acids, including formic, propionic, lactic and others, act as natural antimicrobial agents that suppress pathogenic microflora such as *Escherichia coli*, *Salmonella sp.* and

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Clostridium sp. They reduce the pH of the gastrointestinal tract, creating unfavorable conditions for the growth of pathogens, while supporting the development of beneficial microflora, including *Lactobacillus sp.* and *Bifidobacterium sp.* [2-3].

In addition, organic acids strengthen the bird's immunity by stabilizing the intestinal microbiome.

Acids have the ability to penetrate the cell membranes of microbes. Inside the cell, acids dissociate, releasing hydrogen ions (H+), which disrupts the homeostasis of the cellular environment, reducing the pH level inside the cell, which leads to its damage and death [4].

Organic acids can also inhibit certain enzymes that are necessary for the metabolism of bacteria and fungi. For example, propionic acid reduces the activity of enzymes involved in the synthesis of the bacterial cell wall, which leads to their destruction.

Reducing the population of pathogenic microflora helps maintain healthy intestinal microflora, helps strengthen the immune system and reduce the bird's susceptibility to infections. Organic acids improve the absorption of nutrients [5] by stimulating the production of digestive enzymes such as pepsin, and improve the development of the villi of the small intestine for more complete digestion and absorption of nutrients.

Inclusion of feed additives with organic acids in the diet helps to increase the safety of livestock, reduce disease incidence and minimize the use of antibiotics, which is important in the context of combating antibiotic resistance.

Organic acids also help to improve the sanitary condition of feed, preventing the growth of mold and fungi, which ensures the safety of feeding and extends the shelf life of feed. Their use corresponds to the concept of environmentally friendly production, which makes them a valuable tool in modern poultry farming systems. Thus, organic acids are an important component of diets, increasing the productivity of poultry and reducing the costs of treatment and disease prevention.

To reveal the genetic potential of meat breeds of poultry, producers use high-energy compound feeds that provide a high amount of energy and nutrients for active growth and development. If they are not sufficiently absorbed in the small intestine, these substances pass into the large intestine, including the caecum, where they become a substrate for the proliferation of pathogenic microorganisms such as *Salmonella*, *Staphylococcus aureus*, *Escherichia coli* and *Proteus.* Also, the high concentration of easily fermentable carbohydrates helps suppress the growth of normal microflora, such as lactobacilli and bifidobacteria, which compete with pathogens for nutrients and attachment sites to the intestinal wall [6].

Salmonellosis is one of the most common intestinal infections in poultry, caused by bacteria of the genus *Salmonella*. The pathogen enters the body through contaminated feed, water or contact with other animals. The infection is accompanied by diarrhea, metabolic disorders and damage to the liver, kidneys and other organs. Deterioration of the general condition of the bird leads to a decrease in weight gain and productivity, and also creates a risk of human infection through products, such as eggs or meat [7]. *Staphylococcus aureus* causes staphylococcosis, which affects the intestines and other organs of the bird. Inflammation of the intestinal wall reduces the digestibility of feed, weakens the immune system, which contributes to secondary infections. Such infections complicate the care of the bird, increase treatment costs and reduce live weight gain.

The causative agent of colibacillosis *E. coli* affects both young and adult animals. Colibacillosis manifests itself as enteritis, diarrhea, inflammation of the internal organs, which often develops into septicemia. The disease is accompanied by a decrease in growth rates and significant mortality. This is due to the deterioration of the absorption of nutrients, an increase in the body's energy costs to fight infection and restore tissue [8-9].

Bacteria of the genus *Proteus* are less common, but also cause serious problems. Their action is associated with diarrhea, impaired intestinal motility and deterioration of food digestion. The result is an increase in the yield of undigested feed and a decrease in feeding efficiency [10].

These problems significantly reduce the efficiency of feeding and productivity of poultry, creating additional economic risks for producers.

Lactobacillus and Bifidobacterium are two of the most well-known and widely studied genera of probiotic bacteria that play an important role in maintaining intestinal health due to their ability to adhere to the intestinal mucosa and their pronounced antagonistic activity against various pathogenic microorganisms [11].

The active ingredients of the studied feed additive "Enteracid-Dry" are organic acids: formic - 29.5-39.5% and propionic 5-10%, silicon dioxide was used as an auxiliary substance. This additive is designed to reduce the level of pathogenic microflora in feed and feed raw materials, as well as in the intestines of poultry and animals in order to maintain health, improve the safety and productivity of livestock. The organic acids included in the additive do not harm the environment and do not accumulate in the body of animals, which corresponds to the concept of producing environmentally friendly poultry products.

2 Materials and methods

To evaluate the effectiveness of the feed additive "Enteracid-Dry", an experiment was conducted under the conditions of JSC "Yaroslavsky Broiler".

For the experiment, three groups of clinically healthy chickens of the Ross-308 cross were formed from day-old broiler chickens, 100 heads each. The birds were kept in three-tiered battery cages, the stocking density was 12 heads/m^2. The duration of the experiment was 42 days.

During the experiment, safety was monitored, and the entire population was weighed weekly to determine the live weight and average daily gains of the birds. At the end of the experimental period, the contents of the caecum of 10 broiler chickens from each group, selected randomly, were examined and a molecular genetic analysis of the microflora was performed to determine the relationship between the zootechnical indices of broiler rearing and changes in the taxonomic composition of the microbiome. A feed additive was introduced into the compound feed of the experimental groups of chickens from the first day of rearing. In addition to the main ration, 0.5 kg/t of "Enteracid-Dry" feed was introduced into the compound feed of the broilers of the 1st experimental group, and 2 kg/t of the 2nd experimental group. The chickens of the control group were fed only the main ration and did not receive the feed additive.

3 Results

During the entire growing period, complete compound feeds were used in feeding chickens of all groups, with nutritional value corresponding to age requirements. The composition of the main diets is presented in Table 1.

During the experiment on broilers, such zootechnical indicators as the survival rate of the livestock, the dynamics of live weight growth and the average daily gain were taken into account.

To study the gain at the end of each week of the experiment, individual weighing of all chickens in the groups was carried out.

Table 1. Composition of poultry diets used in the experiment.

Ingredient	PC-5-1 Prestart	PC-5-2 Start	PC-6 Height	PC -6 Finish 1	PC -6 Finish 2
Wheat	49.69	48.19	49.12	52.72	55.77
Corn	10	10	5	5	5
Lupine			3	4.5	7
Soybean meal	29.5	28	27.3	21.3	15
Sunflower meal		3	5	7	7
Gluten	2	2	1.45		
Fish meal	2.5	1			
Sunflower oil	2.1	4	5.5	6.3	7
Monocalcium phosphate	0.77	0.96	0.97	0.75	0.8
Limestone flour		0.43	0.74	0.5	0.6
Sodium sulfate	0.14	0.12	0.12	0.13	0.13
Coccidiostat	0.05	0.05	0.05	0.05	
Adsorbent	0.15	0.15	0.15	0.15	0.1
Probiotic	0.1	0.1	0.1	0.1	0.1
Premix P 5 prestarter	3				
Premix P 5 start		2			
Premix P 5 growth			1.5		
Premix P 6 Finish -1				1.5	
Premix P 6 Finish -2					1.5

The growth dynamics of broiler chickens of the Ross-308 cross are presented in Figure 1.

* P≤0.05

Fig. 1. Growth dynamics of experimental birds, g.

At the age of one day, the chickens of the control group had a live weight of 36.4 g, in the 1 experimental group - 38.2 g, in the 2 experimental group - 34.1 g. By the age of 7 days, the average live weight in the control was 178.5 ± 2.2 g, in the 1 experimental group - 5.0 g, and in the 2 experimental group - 6.9 g more. By the 14th day of growing, the superiority in live weight of the chickens of the 2 experimental group, which received the highest dosage of the additive "Enteracid-Dry" with feed, over the control was 35.3 g or 8%.

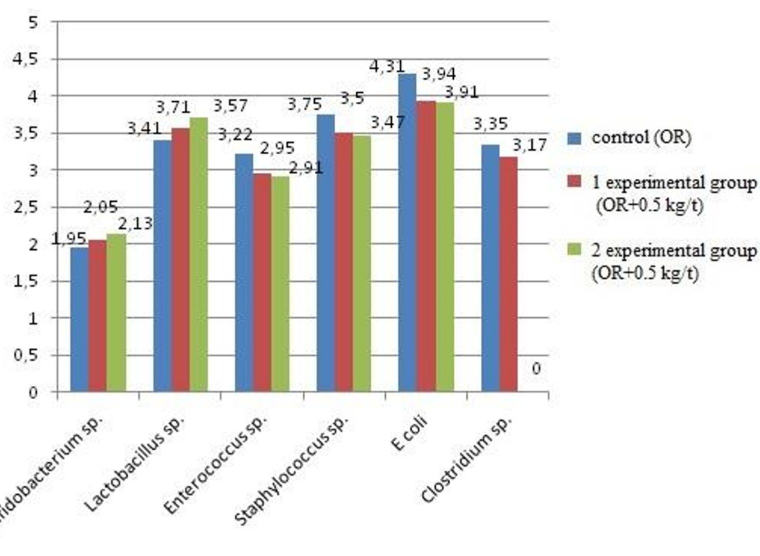
The tendency for the growth rate of chickens in the experimental groups to be superior to the control was confirmed in further studies. On the 28th day of growing, the best second experimental group exceeded the control by 134.1 g. By the end of rearing, the difference between these groups increased to 186.7 g, and in the second experimental group the average live weight was 2475.2 ± 52.4 g, in the control - 2288.5 ± 43.2 g. The result of the 1st experimental group had an intermediate value, but also exceeded the control indicator by 129.1 g.

The difference in live weight was reliable ($P \leq 0.05$), starting from the 14th day of rearing.

The absolute increase in live weight of broilers during the experiment in the control group was 2252.1 ± 43.3 g, in the first experimental - 2377.4 ± 40.4 g or 125.3 g more, in the second experimental 189.0 g more than the control. The average daily gain of birds in the control group was 53.6 g, in the second experimental group – 58.1 g, which is 8.4% higher.

Throughout the experiment, the survival rate of the livestock was taken into account. In the control group, 13 heads died and were culled, in the first experimental group - 8, in the second - 6. Thus, the survival rate of the livestock was higher in the group where the highest dosage of 2 kg/t of Enteracid-Dry compound feed was used. At the end of the experimental period, all experimental birds were slaughtered. From each group, 10 chickens were randomly selected for molecular genetic analysis and study of the microflora of the cecum. To process reads and determine the taxonomic affiliation of DNA sequences to the genus, the CLC Bio GW 7.0 bioinformatics platform (Qiagen, the Netherlands) was used.

Figure 2 shows the results of the taxonomic analysis of the microbiome of the cecum of the chickens in the experimental groups.



* $P \leq 0.05$

Fig. 2. Composition of the microbiota of the cecum of broiler chickens, (lg CFU/g), n = 10.

The study of the microbiota composition of the cecum of broiler chickens in the control, first experimental and second experimental groups demonstrates a significant effect of organic acids (propionic and formic) on the bacterial population. In the contents of the cecum of chickens in the experimental groups, suppression of pathogenic microflora and improvement of conditions for the development of beneficial bacteria were noted.

When using the feed additive "Enteracid-Dry" at a concentration of 0.5 kg / t of feed in broiler chickens, the content of bacteria of the genus *Bifidobacterium sp.* increases in the small intestine by 5.1% and bacteria of the genus *Lactobacillus sp.* by 4.7%. At the same time, the number of opportunistic and pathogenic microorganisms decreases: *Enterococcus sp.* - by 8.4%, *Staphylococcus sp.* - by 6.7% and *Clostridium sp*. - by 5.4%. The content of E. coli decreased by 8.6%. The feed additive in the experimental groups inhibited the growth of bacteria of the genus *Proteus sp.*, while in the control group they contained 1.27 ±0.12 lg CFU/g.

The use of the additive concentration in the amount of 2.0 kg/t of feed contributed to a relative increase in the number of bacteria of the genus *Bifidobacterium sp.* by 9.2%, *Lactoba-cillus sp.* by 8.8%, with a simultaneous decrease in the number of Enterococcus sp., Staphylococcus sp., and E coli by 9.6%, 7.5% and 9.3%, respectively.

Also, pathogenic microorganisms of the genus *Clostridium sp.* and *Proteus sp.*, and fungi of the genus *Candida* were not detected in the intestinal contents of the chickens of the second experimental group.

4 Discussion

The results of the analysis of the dynamics of live weight growth of broiler chickens show a pronounced positive effect of various dosages of the feed additive "Enteracid-Dry" on the productive indicators of poultry. Experimental data confirm that the use of the additive in the compound feed contributes to an increase in the live weight of poultry at all stages of growth, especially with an increase in the dosage to 2 kg / t of feed.

In the control group, the starting weight of chickens was 36.4 g, and by the 7th day the gain was 142.1 g. In the first experimental group, the weight of broilers at the start was slightly higher (38.2 g), which ensured a more significant gain by the 7th day (145.3 g). In the second experimental group, the starting weight was lower than the control (34.1 g), but due to the use of a higher dosage of the additive, the gain was 151.3 g, which is the best result. This indicates that the supplement, despite the initial differences, helps to compensate for the initial mass deficit and ensures better growth already in the early stages.

During the growing period from 7 to 28 days, the differences between the groups become more pronounced. In the control group, the weight increases from 178.5 g to 1351.1 g, which reflects a gain of 1172.6 g in 21 days. In the first experimental group, the weight increases from 183.5 g to 1431.6 g, the gain was 1248.1 g, which is 75.5 g more than in the control. In the second experimental group, the gain was even higher - 1299.8 g. This indicates that the additive, especially in a dosage of 2 kg / t of compound feed, helps optimize metabolism, improve the absorption of nutrients and stimulate bird growth in the most intensive period of weight gain.

In the final stage (28-42 days), the experimental groups maintain dynamics that exceed the control indicators. In the control group, the weight increases by 937.4 g (from 1351.1 g to 2288.5 g). In the first experimental group, the gain during this period was 986 g, and in the second - 990 g. Thus, the additive continues to have a positive effect on weight gain also at the final stages, ensuring stable growth and higher final weight.

The absolute increase in live weight of broilers in the 1st and 2nd experimental groups (by 125.3 g and 189.0 g more than the control, respectively) proves that the use of the additive increases the overall weight gain, and the effect is more pronounced at a dosage of 2 kg / t.

Average daily weight gain in experimental groups 1 and 2 was 3.1 and 4.5 g higher than in the control, indicating a stable increase in feed efficiency due to the additive.

Increased weight gain in the experimental groups, especially in the second (additive introduction 2 kg / t of feed), indicates improved digestion and absorption of nutrients. The additive stimulates metabolic processes that support active growth and development of poultry.

Use of the additive can reduce the negative impact of stress factors, which is reflected in the stability of weight gain at all stages of the experiment.

A study of the microbiota composition of the cecum of broiler chickens in the control, first experimental and second experimental groups demonstrates a significant effect of organic acids on the bacterial population. In the experimental groups, suppression of pathogenic microflora and improved conditions for the development of beneficial bacteria were noted.

Pathogenic microorganisms such as *Escherichia coli*, salmonella, staphylococci and *Proteus* bacteria pose a serious threat to poultry health, causing severe intestinal infections. These diseases significantly reduce poultry productivity and cause economic losses to poultry farms.

Due to the introduction of a feed additive based on organic acids into the diet, *Lactobacillus sp.* and *Bifidobacterium sp.* levels in the experimental groups were maintained or increased. These microorganisms are key to intestinal health, as they participate in the suppression of pathogenic bacteria, the synthesis of lactic acid and the maintenance of an acidic pH, which creates unfavorable conditions for the growth of pathogens. In particular, the level of Lactobacillus sp. increased in the second experimental group, which indicates a favorable effect of the applied factors.

Pathogenic bacteria such as *Clostridium sp., E. coli* and *Proteus sp.* showed a significant decrease in numbers or complete suppression in the experimental groups. This is important, since *Clostridium sp.* is associated with the development of necrotic enteritis in birds, and *E. coli* and *Proteus sp.* are associated with inflammatory diseases and deterioration of the intestinal condition.

Staphylococcus sp. and *Enterococcus sp.* also showed a decrease in numbers in the experimental groups. Although these bacteria may be opportunistic, their decrease may indicate a balancing effect of the supplements on the intestinal microflora.

The complete absence of Candida in all groups indicates that the experimental conditions did not promote the development of fungal infections, which has a positive effect on intestinal health.

Thus, the feed additive "Enteracid-Dry", which includes formic and propionic acids, has a pronounced positive effect on the microbiota of the cecum. It suppresses the growth of pathogenic microflora, helps maintain or increase the number of beneficial bacteria, such as *Lactobacillus* and *Bifidobacterium*, and creates conditions for the normal functioning of the gastrointestinal tract. This improves the health of birds, increases their resistance to infections and optimizes the use of nutrients.

5 Conclusion

The results of the experiment show that the feed additive "Enteracid-Dry" works at all stages of rearing, starting from the first days and until the end of the experiment, ensuring a stable improvement in productive indicators.

The use of the additive "Enteracid-Dry", especially at a dosage of 2 kg / t of feed, allows achieving maximum weight gain, which can reduce the time of rearing poultry and improve the overall output. This makes the use of the additive economically feasible, especially in conditions of intensive production.

References

1. M.W. Mirza, Z. Rehman, N. Mukhtar, Use of Organic Acids as Potential Feed Additives in Poultry Production, Journal of World's Poultry Research, **6**(**3**), 105-116 (2016)
2. P. Chukwudi, P. Umeugokwe, N. Ikeh, The effects of organic acids on broiler chicken nutrition: A review : Anim Res One Health, **3**, 43–53 (2025) https://doi.org/10.1002/aro2.85
3. W. K. Jong, H.K. Jong, Y.K. Dong, Dietary organic acids for broiler chickens: a review: Revista Colombiana de Ciencias Pecuarias, **28**, **2**, 109-123 (2015) doi: 10.17533/udea.rccp.v28n2a01.
4. W. El-Ghany, Applications of Organic Acids in Poultry Production: An Updated and Comprehensive Review Agriculture, **14**(**10**), 1756 (2024) https://doi.org/10.3390/agriculture14101756
5. Z. Haq, A. Rastogi, R.K. Sharma, Advances in role of organic acids in poultry nutrition: A review: Journal of Applied and Natural Science, **9**(**4**), 2152-2157 http://dx.doi.org/10.31018/jans.v9i4.1502
6. S. Ricke, Perspectives on the Use of Organic Acids and Short Chain Fatty Acids as Antimicrobials. Poultry Science, **82**, 632-639) (2003) https://doi.org/10.1093/ps/82.4.632
7. R.K. Gast, R.E. Porter, Salmonella Infections. Diseases of Poultry, 717–753 (2019)
8. L.K. Nolan, H.J. Barnes, J.-P. Vaillancourt, T. Abdul-Aziz, C.M. Logue, Colibacillosis, Diseases of Poultry, 751–805 (2017)
9. A.E. Stella, M.C. Oliveira, V.L. Fontana, Characterization and antimicrobial resistance patterns of Escherichia coli isolated from feces of healthy broiler chickens, Arq. Inst. Biol., **83**, **1-5**, e0392014 (2016)
10. D.A. Vasiliev, N.A. Feoktistova, S.N. Zolotukhin, Isolation and study of biological properties of bacteria of the genus Proteus, Bulletin of the Ulyanovsk State Agricultural Academy, **2** (**38**) (2017)
11. T.A. Egorova, T.N. Lenkova, L.A. Ilyina, Effect of probiotics based on Saccharomyces sp. and Bacillus subtilis on the bacterial community of the caecum and productivity of broiler chickens, Agricultural biology, **51**(**6**), 891-902 (2016)