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ENZYME PREPARATION APPLICATION IN COMPOUND FEEDS FOR BROILER CHICKENS

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Abstract
The most developed Western European countries such as the United Kingdom widely use enzyme preparations to improve feed quality (70-90% of feed is produced with the inclusion of enzymes).

The experimental results proved the positive effect of feeding enzyme drug Ronozym WX- 2000 on productivity, slaughter and hematological parameters of broiler chickens.

The enzyme drug Ronozym WX- 2000 as a part of the compound feed causes better feed consumption by 269 g (6.0%) per head than their counterparts in the control group. It has also reduced feed costs per 1 kg increasing gain by 0.16 kg, or 8.33%.

The absolute increase was 2703.3 g in the experimental group during the rearing to slaughter period, it is by 365.1 g (15.6%) more than the control group chickens.

The enzyme drug Ronozym WX- 2000 positive effect on the slaughter indicators of broiler chickens was also proved, i.e. the weight of the gutted carcass increased by 288.8 g (16.26%), the difference is significant at $P<0.01$.

Considering the meat ratio, broiler chickens treated with the enzyme preparation outperformed the analogues of the control group by 260.3 g or 16.9%mdue to an increase in muscle mass (including fillets) by 58 g or 13.5%.

The use of the enzyme preparation did not affect the main internal organs weight. The largest difference was found in the muscular stomach weight by 5 g or 10.7% ($P <0.01$). The blood parameters were within the physiological norm.

We recommend the enzyme preparation WX-2000 application in the amount of 7 g per 10 kg of compound feed at all ages in order to stimulate the growth and increase the productivity of broiler chickens.

Keywords: broilers, feed, enzyme preparation, productivity, slaughter rates, hematological parameters.

Statement of the problem. World poultry production is mainly based on raising broiler chickens. The poultry production has always been the leading one in terms of price and quality of food products considering the population purchasing power. The quality of poultry meat is directly related to the selection, feeding and keeping conditions, as well as the technology of meat processing and storage. There is a need to constantly find ways to improve technological processes, issues of feeding, keeping, slaughter and processing of poultry carcasses in order to increase the production of high-quality wholesome food [3].

The concept of feeding farm animals involves the organization of scientifically sound feeding not only in the full provision of animals with the necessary food, but also in order to help them absorb from the diet the maximum possible amount of nutrients. That's why it is necessary to eliminate the factors restraining splitting, digestibility and assimilation of proteins, lipids and carbohydrates, the factors leading to emergence of diseases, leaving of the animals reducing reproductive function, etc. [1, 2, 4, 7].

It is crucial to enrich the animal's diets and feed with special additives including physiologically active substances in order to achieve a high level of complete feeding of farm animals. The composition of premixes and feeds is developed considering modern scientific research on the animals needs in energy, protein, amino acids, vitamins, macro-and micronutrients, enzymes and other nutrients taking into account the level of productivity, sex, age, and species.

Taking into account the Ukrainian and foreign researches it is possible to increase the efficiency of poultry feeding and partially solve the problems of digestion in animal husbandry by using enzyme preparations and their compositions [1-11].

The most developed Western European countries such as the United Kingdom widely use enzyme preparations to improve feed quality (70-90% of feed is produced with the inclusion of enzymes) [5, 6].

The current challenge for the poultry industry is to maintain the productivity and efficiency of poultry farming overcoming the antibiotic dependence. In the UK, long-term research has been conducted to study the threat to human health from the use of antibiotics in agriculture. The campaigns began to reduce the antibiotics application in poultry farming.

Effective feed splitting for further optimal absorption of nutrients is the most important factor in both parent and broiler livestock keeping. Intestinal health impairs digestion and absorption of nutrients leading to a deterioration in feed conversion, reducing the economic profitability of production and creating an increased susceptibility to disease [7, 8].

Review of recent research and publications. According to [1 - 11], balanced feeding of animals, the additives need and diets including biologically active substances is both sufficiently justified and isn't in doubt.

This research is a part of the scientific project on improvement of livestock production technology in the cultivation and fattening of farm animals in terms of high quality and environmentally friendly products at farms of in Podillia developed at the Department of

Livestock Production Technology of Vinnytsia National Agrarian University.

For the first time, we have experimentally established the effectiveness of using the enzyme preparation Ronozym WX-2000 in the feeding of broiler chickens in the amount of 7g per 10 kg of compound feed.

The aim of the research was to investigate the enzyme drug Ronozym WX- 2000 effect on productivity, slaughter and meat quality of broiler chickens.

Materials and methods of research. Research methods are zootechnical (conducting experiments on broiler chickens), analytical (literature review and generalization of research), statistical (biometric digital data processing).

Ronozym WX is an enzyme preparation, feed additive to improve feed absorption, it is included in the diets for pigs and poultry grain products such as wheat, triticale and rye containing arabinoxylan.

Ronozyme WX acts on both soluble and insoluble arabinoxylan contained in feed materials; it improves the overall absorption of energy and other nutrients in the feed. As a rule, this enzyme preparation is used to improve feed when included in the diet of broilers, laying hens and pigs, i.e. wheat (20-70%), barley (up to 30%), and rye (up to 25%).

Ronozym WX is a heat-resistant endoxylanase from the Thermomyces lanuginosus family obtained by deep fermentation of genetically modified microorganisms Aspergillus oryzae. It does not contain salmonella bacteria.

Product: 20 kg in multilayer paper bags or 40 kg in cardboard boxes.

Shelf life is 24 months from the date of manufacture, 1 month after opening the package. Manufacturer is DSM Nutritional Products Ltd, Switzerland

We have conducted experiment to research the impact of enzyme drug Ronozym WX- 2000 application on the productivity and slaughter of broiler chickens.

The scheme of the conducted researches is given in table 1.

Table 1

Scheme of Experiment

Group	Duration of the period, days		Poultry, heads	Feeding conditions
	comparative	basic		
1 - control	7	35	50	BD (complete feeds)
2 – experimental	7	35	50	BD + Ronozym WX- 2000 , 7 g per 10 kg of complete feed

* BD – basic diet.

We have formed two groups of broiler chickens of the Cobb-500 cross, each group includes 50 heads selected according to the principle of analogue groups.

Thus, according to the Table 1, broiler chickens of the control group were fed by complete feed. The experimental chickens were additionally fed by enzyme drug Ronozym WX- 2000 in the amount of 7 g per 10 kg of feed for 42 days.

During the research, the consumption of feed was recorded. The intensity of growth of chickens was determined by weighting them weekly. They were weighted at the age of 7, 14, 21, 28, 35 and 42 days. The growth of broilers was controlled by determining the absolute, relative and average daily gains at these age periods.

The chickens were kept on the floor in deep bedding in a warm, dry, and well-ventilated room. The floor in the room is hard-coated, which makes it easier to clean the litter and disinfect. Sawdust (humidity no more than 25%) was used for bedding. All parameters of the microclimate were in accordance with the norms.

Stocking density was 18 heads per m^2 to 4 weeks of age, it was 12 heads per m^2 from 4 weeks of age to slaughter. The feeding area was 2.5 cm, the drinking area was 1.5 cm. The microclimate parameters of the room were identical for the birds of both groups and corresponded to the established hygienic standards.

At the end of the experiment, the slaughter performance of animals was studied. Eight heads of broiler chickens were selected from each group and control slaughter was carried out. The samples of tissues and internal organs were taken.

The weight of carcasses and internal organs was determined by weighing on a VLKT-500 balance.

Blood for hematological examinations was taken in the morning before feeding from the axillary (shoulder) vein in an amount of at least 0.5 ml. Disposable syringes with a volume of 1.0 cm^3, irrigated with heparin, were used for blood collection. Blood smears were stained with the Papenheim method and the Diff Quik express method (Leukodif-200 reagent kit). The hemoglobin content was determined by hemoglobin cyanide method using a biochemical analyzer Labline – 010. The total number of cells (erythrocytes, leukocytes and platelets) was counted according to the generally accepted method in a counting chamber (hemocytometer) with a Goryaev grid.

Blood tests were performed at the veterinary clinic in Vinnytsia.

To determine hematological indicators, the blood samples of experimental chickens were taken at the end of slaughter. Hematological studies were performed according to the following methods:

– total protein – refractometrically, using the device RLU - 1 (A. Popov and others, 1973);

– glucose – by color reaction with orthotoluidine (B. Antonova, 1991);

– calcium – trilonometric method (N. Korotchenko, 1987);

– inorganic phosphorus – by Ivanivskyi's method (V. Antonova, P. Blinova, 1971);

– cholesterol – according to Stankevych (V. Kolb and others, 1976);

– leukocytes – by counting in Gorev's chamber (E. Tomik, 1980);

– erythrocytes with the help of FEC (B. Antonova, 1991);

– hemoglobin – by colorimetric method according to H. Derviz, A. Vorobiov (H. Derviz, 1959).

Biometric data processing was carried out on a PC using the MSExsel software with the help of a special statistical program. The results of the mean values were considered statistically significant at * P <0.05; ** P <0.01; *** P <0.001.

Research results and their discussion. Broiler chickens of the experimental groups were fed factory-produced feed for four age periods, i.e. the first one was 0-10 days, the second one was 10-20 days, the third one was 20-30 days and the fourth one was 30-42 days.

The nutritional value of these feed recipes generally met the needs of broiler chickens at different ages. Thus, the energy-protein ratio was 122 kcal per g in the first period, 129 kcal per g in the second period, 133 kcal per g in the third period and 142 kcal per g in the fourth period.

The ratio between calcium and phosphorus over the four age periods was 1.4:1; 1.1:1; 1.3:1; 1:1 respectively.

Table 2

Compound feed recipes for broiler chickens

Component	Poultry age, days			
	0-10	10-20	20-30	30-42
Corn, %	37.00	30.00	40.00	40.00
Wheat, %	24.95	29.95	11.95	22.45
Grover, %	10.00	5.00	5.00	5.00
Adsorbent of toxins (Токs-O), %	0.05	0.05	0.05	0.05
Soybean oil, %	1.00	2.00	3.50	2.50
Soybean meal, %	27.00	31.00	33.50	19.00
Sunflower meal, %	-	2.00	3.00	6.00
Meat and bone meal, %	-	-	3.00	5.00
Total, %	100	100	100	100
Nutrition of recipes:				
Metabolic energy, kcal	275.2	279.2	280.0	283.2
Crude protein, g	22.6	21.7	21.0	19.9
Dry matter, g	87.9	87.9	88.5	88.2
Crude fat, g	5.6	6.8	8.2	7.1
Crude fiber, g	3.5	4.1	4.2	4.2
Crude ash, g	5.0	4.9	6.0	4.9
Lysine, g	13.6	12.6	12.8	9.9
Methionine + cystine, g	9.5	9.0	8.3	6.8
Threonine, g	8.6	8.0	7.7	7.1
Tryptophan, g	2.4	2.5	2.3	2.1
Calcium, g	6.4	4.7	8.3	7.2
Phosphorus, g	4.7	4.2	6.3	7.4
Sodium, g	1.4	1.3	1.2	0.7
Potassium, g	9.0	9.6	9.2	8.4

Broiler chicken weekly feed consumption is shown in Table 3.

Table 3

Feed consumption by experimental broiler chickens, g

Group	Age of broiler chickens, days						Total per 1 head, g
	1 - 7	8 - 14	15 - 21	22 - 28	29 - 35	36 - 42	
1-control	120	320	730	875	998	1441	4484
2-experimental	121	356	760	907	1076	1533	4753

According to the Table 3 data, broiler chickens fed by compound feed with the enzyme preparation Ronozym WX-2000 consumed it better than chickens of the control group.

Thus, for the second week the difference in feed consumption in favor of the experimental group was 36 g, for the third week it was 30 g, for the fourth week it was 32 g, for the fifth week it was 78 g, or 7.81%, for the sixth week it was 92 g or 6.4%. In general, the chickens of the experimental group consumed 4,753 g of compound feed per 1 head, it is by 269 g or 6.0% more than their counterparts from the control group.

Thus, the additional feeding by the enzyme preparation Ronozym WX-2000 promoted better absorption of the feed nutrients and increased the feed intake by broiler chickens.

The absolute increase in the experimental group was 2703.3 g, and in the control group it was 2338.2 g. The difference in absolute growth was plus 365.1 g, or 15.6% in favor of the experimental group.

Due to the greater absolute growth of broiler chickens fed by compound feed with the addition of Ronozym WX-2000 feed costs per 1 kg of gain were 1.76 kg, which is 0.16 kg or 8.33% less than in the control group.

The main indicator of the effectiveness of the particular drug application is the growth rate of broiler chickens.

The live weight of chickens in dynamics by age is shown in Table 4.

Table 4

Dynamics of live weight of broiler chickens (M± m, n = 50)

Age, days	Group	
	Control	Experimental
1	42.4±1.02	42.3±1.07
7	172.5±2.32	194.1±2.61
14	441.5±7.12	509.8±6.78
21	844.6±10.1	922.3±16.02*
28	1302.7±19.02	1414.7±19.28**
35	1836.5±24.16	2059.1±33.4*
42	2380.6±48.16	2745.6±48.3***

*P <0.05, **P <0.01, *** P < 0.001.

The Table 4 data indicate the positive effect of the enzyme preparation Ronozym WX-2000 on the live weight of broilers at all age periods of their growth.

In the first weeks of rearing, the difference in live weight of chickens was insignificant. It was significantly higher by 77.7 g, or 9.2% (P <0.05) in the experimental on the day 21st day; it was higher by 112 g (P <0.01) at 28th day; it was higher by 222.6 g at 35th days (P <0.05). And at the end of the rearing period, broiler chickens fed by the enzyme preparation Ronozym WX-2000 had an average live weight of 2,745.6 g, it exceeds the control group by 365 g or 15.33% with a probable difference (P <0.001).

Thus, there was a better utilization of feed nutrients, in particular, grain feed, which led to a more intensive consumption of compound feed.

The live weight of the chickens in the experimental group also showed high average daily gains (Table 5).

Table 5

Average daily gains of broiler chickens' live weight (M ± m, n = 50)

Age, days	Group	
	Control	Experimental
1 - 7	18.6±0.7	21.7±1.03
8 - 14	38.4±2.01	45.1 ±2.08
15 - 21	57.6±2.31	57.6±3.16
22 - 28	62.7±2.61	70.34±3.01**
29 - 35	76.4±10.97	92.1±10.88**
36 - 42	77.7±11.01	98.1±13.6**
Average for 1-42 days	55.7±2.23	64.4±3.32*
Safety, %	96.0	96.0

The difference in average daily gains is reliable in the last weeks of growth. So, the average daily experimental chicken increase was 92.1 g for the period of 29-35 days, it is by 15.7 g or 20.5% (P <0.01) more; it is 98.1 g for the period 36-42 days, it is by 20.4 g or 26.3% (P <0.01) more than in control group.

The average daily gain of experimental chickens was 64.4 g, it is by 8.7 g or 13.5% higher than the control group chickens.

Two chickens died both in the control and in the experimental groups, the percentage of safety was 96.0.

The Table 6 data indicate a positive effect of the Ronozyme WX-2000 enzyme on the slaughter performance of broilers.

Table 6

Slaughter characteristics of broiler chickens (M ± m, n = 8)

Indicator	Group	
	1-control	2-experimental
Pre-slaughter live weight, g	2380.6±48.16	2745.6±48.3***
Weight of semi-gutted carcass, g	1961.1±13.7	2273.4±19.1***
Output of semi-gutted carcass, %	82.4±0.31	82.8±0.42
Weight of gutted carcass, g	1775.9±13.03	2064.7±14.02
Output of gutted carcass, %	74.6±0.11	75.2±0.13
Weight of edible parts, g	1462.8±11.4	1733.1±13.9
Weight of inedible parts, g	313.1±1.4	331.6±1.7
Meat ratio	4.67	5.22
Weight of the fillet, g	431±1.29	489±1.53

So, broiler chickens of the experimental group surpassed their counterparts by 365 g or by 15.33% with a significant difference (P <0.001) considering the pre-slaughter weight. Their gutted carcass weight was by 288.8 g (16.26%) more, the difference is significant at P<0.01.

The gutted carcass weight of the experimental was higher by 0.6%.

The broiler chickens fed by the enzyme preparation prevailed control group chickens by 260.3 g or 16.9% by the number of edible parts of the carcass.

The ratio of edible parts to inedible parts (meat content coefficient) in the chickens of the experimental group was by 0.55 more than in the control one.

An increase of edible parts weight is mainly caused by muscle mass increase (including fillets) by 58 g or 13.5%.

Table 7 shows the weight of the internal organs of the experimental poultry.

Table 7

Weight of internal organs of the experimental poultry, g (M ± m, n = 8)

Indicator	Group	
	1-control	2-experimental
Weight: skin, g	203.4±2.55	236.5±2.5
internal fat, g	52.2±1.31	53.5±2.7
liver	58.0±0.46	58.8±0.98
muscular stomach, g	46.8±0.27	51.8±0.34**
heart, g	16.5±0.31	17.0±0.33

According to Table 8 data, it can be seen that the enzyme preparation application did not affect the main internal organs weight. The live weight increase of broiler chickens increased the internal organs weight. In particular, the greatest difference was found with the weight of the skin by 23.1 g or 11.4% and the weight of the muscular stomach by 5 g or 10.7% (P <0.01).

Hematological researches help to track the certain factor influence on the mechanisms of regulation of metabolic homeostasis of the body and the poultry productivity.

Blood plays an important role in the biochemical processes. It is the main indicator characterizing metabolism; it performs trophic, excretory, respiratory, protective, thermoregulatory, and correlative functions. Biochemical and morphological indicators change with the season, growth phases, productivity, fatness, they react to changes in conditions of detention, air pollution or microbial loads, lack of oxygen, starvation or blood collection in fed poultry, the influence of stress factors etc.

Haematological parameters of broiler chickens are shown in table 8.

Table 8

Hematological parameters of broiler chickens

Indicator	Group	
	1-control	2-experimental
Hemoglobin, g / l	111.3±1.41	112.9±1.5
Erythrocytes, g / l	3.29±0.03	3.31±0.03
Leukocytes, g / l	30.9±0.9	31.2±0.81
Platelets, g / l	38.6±0.83	38.4±0.71

Thus, the table 8 data show that the enzyme preparation Ronozym-WX-2000 application does not affect the blood parameters of broilers in the experimental group, since minor changes have no reliability. All researched blood parameters were within the physiological norm.

The blood biochemical composition of broiler chickens is shown in table 9.

Table 9

Biochemical composition of broiler chickens' blood

Indicator	Group	
	1-control	2-experimental
Total protein, g / l	43,6±0,61	43,9±0,71
Immunoglobulins, g / l	6,5±0,21	6,5±0,23
Total ALP, units / l	1212,4±21,11	1214,3±23,3
Calcium, mmol / l	3,23±0,11	3,33±0,07
Phosphorus, mmol / l	1,82±0,02	1,85±0,03*

The protein total amount and the calcium amount in the blood has a slight tendency to increase in comparison with the indicators of the 1st control group, but the data obtained are within the physiological norm.

No significant changes in blood parameters of broiler chickens have been established due to the action of the enzyme preparation Ronozym WX-2000.

Conclusions.

1. It was established that the enzyme preparation Ronozym WX-2000 had a positive effect on the live weight of broiler chickens, i.e. the average poultry live weight was 2745.6 g in the experimental group at the end of the growing period exceeding the control group by 365 g or 15.33 % with a significant difference (P <0.001).

2. In the experimental group the absolute increase was 2703.3 g, which is by 365.1 g or 15.6% more than in the control group. The live weight of the experimental chickens showed high average daily gains. In general, the average daily gain of chickens in the experimental group was 64.4 g, which is 8.7 g or 15.6% higher than this indicator in the control group.

3. The enzyme preparation application improves feed consumption per 1 head by 269 g or 6.0% compared to the control group, while reducing feed costs per 1 kg of gain by 0.16 kg or 8.33%.

4. It has been proven that the Ronozym WX-2000 enzyme increases the pre-slaughter live weight by 365 g (15.33%) compared to the control. The weight of the gutted carcass was by 288.8 g (16.26%) higher, the difference is significant at P<0.01. The gutted carcass output of the experimental group chickens was by 0.6% higher. Broiler chickens receiving the enzyme preparation prevailed the control group chickens by 260.3 g or 16.9% by the number of edible parts of the carcass due to an increase in muscle mass (including fillets) by 58 g or 13.5 %.

5. The use of the enzyme preparation did not affect the weight of the main internal organs. The greatest difference was found in the weight of the gizzard (by 5 g or 10.7%) (P <0.01).

6. No significant changes in blood parameters of broiler chickens due to the action of the enzyme preparation Ronozym WX-2000 have been established. The studied parameters were within the physiological norm.

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