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PRODUCTIVITY AND METABOLISM IN BROILERS UNDER THE ACTION OF COMPOUND FEEDS OF DIFFERENT COMPOSITION

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Abstract

It is established that the use of the compound feed produced on the basis of protein-vitamin-mineral supplement and the compound feed «Multigain» in feeding broiler chickens contributes to the increase of their live weight at 42 days of age by 8.5% in favor of the compound feed «Multigain». The yield of gutted carcass increased due to the greater weight of pectoral and thigh muscles. No significant changes in the weight of internal organs and their chemical composition have been established. The chickens of the 2nd group were found the increasing in protein metabolism due to a higher content of aspartate aminotransferase (by 45.3%), as well as in carbohydrate metabolism due to a higher content of glucose in plasma (by 16.8%).

Keywords: broiler chickens, feeding, compound feeds, productivity, metabolism.

Setting the problem. In the conditions of increasing the cost of forages, the reduction in price of compound feeds components will contribute to an increase in profitability of livestock products. Therefore, they can be used to produce complete compound feeds and modern protein-vitamin-mineral supplements at livestock enterprises, having the feeds of their own production. In order to do this, the market of feed additives offers protein-vitamin-mineral feed supplements, pre-mixes, etc. [1, 2]. According to many scientists, a reasonable combination of feed components and a high quality of protein-vitamin-mineral supplements added to the bulk of compound feed has the necessary energy and biological value, which will contribute to the realization of the genetic potential of modern breeds and crosses [2, 3].

The aim of research was to study the effect of the compound feed produced on the basis of protein-vita-

min-mineral supplement and the compound feed «Multigain» on meat productivity and slaughter indicators of broiler chickens of «Ross-308» cross.

The object of research is broiler chickens of «Ross-308» cross, which have a high genetic potential and are able to reach a live weight of 2.500 g and more in the conditions of satisfactory microclimate and feeding at the age of 42 days.

The subject of research: the impact of compound feed developed by the Institute of Feed and Agriculture of Podillia NAAS, as well as the compound feed «Multigain» on productivity, slaughter and hematological indicators of broilers.

The methods of research: biometric, zootechnical, biochemical, hematological, organoleptic.

Material and methods of research. The experiment was conducted on the research farm of Vinnitsia National Agrarian University on two groups of broiler chickens according to the scheme (Table 1).

Table 1

Scheme of experiment

Groups	Duration of the period, days		Broiler chickens, heads	Feeding characteristics
	comparing	basic		
I-control	7	42	20	Compound feed produced on the basis of protein-vitamin-mineral supplement
II-experimental	7	42	20	Compound feed «Multigain»

40 chickens of «Ross-308» cross were selected for the experiment, they were divided into two groups of 20 heads each according to the principle of analogues. Chickens were kept in group cages.

The chickens of the 1st experimental group were given the complete compound feed of their own production with the addition of protein-vitamin-mineral supplement.

The chickens of the 2nd control group received the complete compound feed «Multigain», meeting the need for basic nutrients according to detailed standards.

The duration of the experiment was 42 days; the comparing period was 7 days. At the end of the basic period of research, 4 heads of broiler chickens were selected from each group for the control slaughter.

The research of forages was carried out using the traditional methods (E.Petukhova and others, 1989).

During the slaughter, the weight of the carcass individual parts and internal organs was determined; the carcass and slaughter yields were calculated.

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 Ivanivskiy'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);

The data obtained in the experiments were processed biometrically by conventional methods of N. Plokhinskiy's variation statistics (1969), using computer programs. The difference between groups was established by the following criteria: $P < 0.05^*$; $P < 0.01^{**}$; $P < 0.001^{***}$.

Research results and their discussion. Throughout the entire period of growing broiler chickens were fed with the complete compound feed «Multigain» and the compound feed developed by the NAAS Feed Institute, in accordance with the norms taking into account age periods. The recipes for these feeds are developed in accordance with State standards.

The composition of the compound feed «Multigain» is shown in Table 2.

Table 2

Composition of the compound feed «Multigain»

Composition of recipe	Introduced supplements per 1 ton, g	Quality indicators	Content in the recipe
Wheat	Vitamins:	Humidity, %	11.0
Corn gluten	A – 10,000,000 IU	Crude protein, %	21.0
Soybean meal	D ₃ – 1,500,000 IU	Crude fiber, %	3.9
Sunflower meal	B ₁ – 2.0	Feed units	
Fishmeal	B ₂ – 4.0	Metabolic energy, kcal / 100 g	324
Fodder yeast	B ₆ – 2.5	Methionine + cystine, %	0.88
Soybean oil	B ₁₂ – 0.01	Lysine, %	1.22
Dicalcium phosphate	PP – 20.0	Calcium, %	1.0
First class limestone	E – 20.0	Phosphorus, %	0.7
Sodium chloride	Pantothenic acid – 10.0	Chlorides and sodium chloride, %	0.287
Fodder methionine	Folic acid – 0.5	Crude fat, %	6.7
Choline chloride	Biotin – 0.05	Na, %	0.1
	K ₃ – 2.0	Tryptophan, %	0.27
Mineral complex for poultry	Salts of:	Threonine, %	0.95
Vitamin mixture for broilers	Copper – 8.0	Linoleic acid, %	2.22
Coccidiostatic	Iron – 80.0	Methionine, %	0.45
Enzyme	Cobalt – 0.4	-	-
Antioxidant	Manganese – 60.0	-	-
Mold inhibitor	Zinc – 40.0	-	-
-	Iodine – 0.8	-	-
-	Selenium – 0.02	-	-
-	Antibiotics	-	-
-	Amino acids	-	-
-	Antioxidants	-	-
-	Enzymes	-	-

«Multigain» is a 100% environmentally friendly natural product that does not contain hormones and artificial growth stimulants. By using «Multigain» feed products, one can be sure that the animals and poultry

will be provided with a balanced, easily digestible, nutritious and highly efficient feed, which, when properly dosed, gives maximum results in the production of high quality meat, milk and eggs.

The broiler chickens of the 1st experimental group were fed with the complete compound feed containing protein-vitamin-mineral supplement, which was prepared according to recipes.

The recipes for mixing protein-vitamin-mineral supplement with compound feed are shown in Table 3.

Table 3

Recipes for mixing protein-vitamin-mineral supplement with compound feed, %

Indicator	Type of compound feed		
	Starter	Grower	Finisher
Corn	34	39	42
Wheat	30	30	30
Soybean oil	1	1	1
Protein-vitamin-mineral supplement Starter 35%	35	–	–
Protein-vitamin-mineral supplement Grower 30%	–	30	–
Protein-vitamin-mineral supplement Finisher 27%	–	–	27
Total	100	100	100

The percentage of introducing the protein-vitamin-mineral supplement is reduced from 35% in Starter compound feed to 27% in Finisher (Table 4).

Table 4

Nutritional value of compound feed with protein-vitamin-mineral supplement

Indicator	Type of protein-vitamin-mineral supplement		
	Protein-vitamin-mineral supplement Starter 35%	Protein-vitamin-mineral supplement Grower 30%	Protein-vitamin-mineral supplement Finisher 27%
Metabolic energy, kcal	326	324	325
Crude protein, %	23	21	19
Crude fat, %	6.7	6.8	6.9
Crude fiber, %	3	4	4
Lysine, %	1.20	1.15	1.10
Methionine, %	0.47	0.45	0.40
Methionine + cystine, %	0.81	0.78	0.75
Calcium, %	1.0	0.9	0.9
Phosphorus, %	0.8	0.7	0.7

The nutritional value of compound feed with protein-vitamin-mineral supplement fully complies with the established norms. The rates of nutritional value vary depending on the type of compound feed (Starter, Grower or Finisher). The content of metabolic energy decreases from 326 kcal in Starter compound feed to

325 kcal in Finisher. Most of other components are also reduced, except for the percentage of crude fat and crude fiber.

The development and rearing of birds were controlled by weekly weighing. The weighing of broiler chickens was carried out in the morning before feeding.

Table 5

Live weight of broiler chickens, g, M±m, n=20

Age of poultry, days	Group	
	I-control	II-experimental
1-7	167.2±5.43	166.8±5.31
7-14	340.5±10.43	342.2±8.60
15-21	635.9±14.76	653.0±13.09
22-28	1068.7±25.30	1194.4±23.45**
29-35	1578.6±49.83	1736.0±49.77*
36-42	2357.7±51.09	2558.4±72.21**
Survival, %	92	98

Live weight at the beginning of the experiment in both groups did not differ much, but during the rearing period there were changes; and live weight of the 2nd experimental group had higher indicators. At the age of 42 days, the live weight of broiler chickens in the control group was 2357.7 ± 51.09 g, while the weight of broiler chickens in the experimental group was 2558.4

± 72.21, i.e. it was greater by 200.7 g.

The survival of broiler chickens also differs. The indicator of survival is higher in the broiler chickens of the experimental group; it is 98% vs. 92% in the broiler chickens of the first group.

The live weight absolute gains of broiler chickens of two groups are shown in Table 6, according to age.

Table 6

Age of poultry, days	Group	
	I-control	II-experimental
1-7	122±4.26	121±4.44
8-14	173±5.82	175±6.29
15-21	295±6.28	311±8.82
22-28	433±13.05	541±14.46***
29-35	510±14.25	542±15.72
36-42	779±18.98	822±16.29*
For the entire period of the experiment	2313	2512.9

The absolute gains change according to the live weight of broiler chickens. The broiler chickens of the experimental group dominated their analogues of the control group during all periods of rearing.

At the end of the rearing period the absolute gain

in the chickens of the control group consuming the compound feed «Multigain» was 2313 g, while it was 2512.9 g in the chickens of the experimental group.

According to the age, the average daily gains of broiler chickens are shown in Table 7.

Table 7

Age of poultry, days	Group	
	I-control	II-experimental
1-7	17.5±0.25	17.3±0.36
8-14	24.8±0.56	25±0.59
15-21	42.2±1.48	44.4±2.31
22-28	61.9±2.17	77.3±2.42***
29-35	72.8±4.25	77.4±6.21
36-42	111±7.69	117±8.52
Average	55.0	59.8

According to the average daily gain of broiler chickens, it can be concluded that the chickens of the experimental group, which consumed the compound feed, having been produced industrially, had better gains compared to the chickens of the control group.

During the day, broiler chickens of the first group gained an average of 55.0 g, while those of the second group gained 59.8 g. The growth rate of broiler chickens during the experiment was not the same (Table 8).

Table 8

Age of poultry, days	Group	
	I-control	II-experimental
1-7	115±3.76	114±3.28
8-14	68.3±2.44	68.9±2.59
15-21	60.5±2.21	62.5±2.30
22-28	50.8±2.17	58.8±2.12*
29-35	38.5±1.15	37±1.61
36-42	39.6±1.89	38.3±1.75

The relative gains of broiler chickens in the experimental group were higher than the indicators in the control group during the rearing period. They were lower only at the end of the period.

Also, one of the important indicators of broiler chickens' productivity is the cost of feed per 1 kg of live weight gain (Table 9).

For 42 days of rearing, the total feed consumption of the control group was 85 kg, while it was 88 kg in the experimental group.

The calculations showed that broiler chickens in the experimental group consumed by 0.15 kg of feed more than in the control group, but their feed costs per 1 kg of gain were lower by 0.05 kg.

Table 9

Group	Feed costs per 1 kg of broilers' live weight gain, kg					
	Feed costs, kg				per 1 kg of gain	
	for the experimental period		per one head			
total	± before control	total	± before control	total	± before control	
I-control	85	–	4.25	–	1.8	–
II-experimental	88	+3	4.4	+0.15	1.75	-0.05

A control slaughter at the age of 42 days was carried out at the end of the experiment. Four heads from each group were selected for the control slaughter (Table 10).

Table 10

Indicator	Group	
	1-control	2-experimental
Pre-slaughter live weight	2306.8±51.12	2488.0±38.45*
Weight of ungutted carcass	2266.2±36.31	2378.5±32.64
Weight of semi-gutted carcass	1845.1±33.54	1938.4±36.22
Weight of gutted carcass	1522.0±28.30	1653.0±32.21*
Weight of pectoral muscles	484.0±12.37	550.8±14.25**
Weight of thigh muscles	295.0±15.28	368.0±17.47*
Yield of gutted carcass	65.9±5.64	66.4±4/53

Comparing slaughter indicators, it has been found that broiler chickens in the experimental group have better results. Pre-slaughter live weight of chickens of the experimental group is higher by 181.2 g, the weight of ungutted carcass – by 112.3 g, the weight of semi-gutted carcass – by 93.3 g, the weight of gutted carcass – by 131.0 g, the weight of pectoral muscles – by 66.8 g and the weight of thigh muscles – by 73 g, compared

with the control group.

Studies have shown that the weight of digestive organs, such as glandular and muscular stomachs and liver, was greater in the broiler chickens of the experimental group, while the weight of kidneys, spleen and heart was greater in the broiler chickens of the control group (Table 11).

Table 11

Indicator	Group	
	I-control	II-experimental
Weight of glandular stomach	10.8±0.32	11.2±0.57*
Weight of muscular stomach	54.2±7.24	56.8±7.69
Liver	48.2±8.74	49.6±2.58
Kidneys	15.4±3.12	13.7±1.28
Spleen	3.8±0.84	3.6±0.76*
Heart	18.6±2.82	17.8±2.25

The linear measurements of digestive organs, which are shown in Table 12, have been also determined in the process of studying the slaughter indicators of broiler chickens of «Ross-308» cross.

Table 12

Digestive organ	Group		
	1-control	2-experimental	
Length of esophagus	17.4±0.87	17.6±0.68	
Measurements of glandular stomach	length	4.8±0.72	5.1±0.85
	width	2.4±0.10	2.5±0.11
	the third measurement	1.2±0.12	1.1±0.18
Measurements of muscular stomach	length	5.6±0.32	5.7±0.43
	width	4.4±0.26	4.6±0.24
	the third measurement	2.2±0.25	2.3±0.27
Small intestine	duodenum	27.6±2.51	28.4±2.46
	jejunum	69.7±11.18	75.2±10.24
	ileum	77.4±8.52	81.4±6.72
Large intestine	right cecum	17.6±1.48	18.4±0.83
	left cecum	16.4±1.82	16.6±1.57
	rectum	7.8±0.65	8.2±0.88

It has been found that the right cecum is longer on average by 0.8 cm, the left cecum – by 0.2 cm and the rectum – by 0.4 cm in the chickens of the experimental group.

The nutritional value of meat is determined by its chemical composition, energy value, taste and level of

digestibility.

During the study, the internal organs of broiler chickens of «Ross-308» cross were sent for chemical analysis to the laboratory of the Institute of Feed and Agriculture of Podillia NAAS (Table 13).

Table 13

Indicator	Dry matter	Гідроволога	Nitrogen	Protein	Fat	Ash
I-control						
Stomach	36.5	4.8	6.7	44.9	46.6	2.4
Heart	25.2	4.8	8.4	53.4	32.6	3.8
Liver	25.7	8.4	8.3	55.7	27.2	5.8
Kidneys	21.8	8.6	9.5	59.8	13.7	6.7
II-control						
Stomach	36.3	4.9	8.5	51.9	35.4	2.8
Heart	25.8	4.9	8.2	48.1	34.0	3.4
Liver	26.6	8.7	9.2	61.5	23.4	5.5
Kidneys	20.9	8.5	9.5	60.3	12.6	6.8

The chemical composition of internal organs, such as stomach, heart, liver and kidneys in two groups had small differences in most indicators. The largest fluctuations were observed in the fat content of the stomach. According to the research results, the average fat content in the stomach of broiler chickens of the control group was by 11.2% higher than in the broiler chickens

of the experimental group.

The quality of the pectoral muscles is an important indicator in the poultry farming, because the nutritional value of this part of the carcass is the highest. Data from the chemical analysis of the quality of broiler chickens' pectoral muscles are shown in Table 14.

Table 14

Indicator	Group	
	1-control	2-experimental
Hygro moisture, %	7.1±0.01	7.2±0.02*
Total moisture, %:	76.2±0.83	76.8±1.17
- free moisture, %	20.4±0.94	19.5±1.28
- bound moisture, %	55.8±1.16	57.2±0.88
Dry matter, %	23.8±0.53	23.2±0.08
Fat, % (in natural matter)	2.4±0.07	2.2±0.09
Nitrogen, % (in natural matter)	3.5±0.12	3.6±0.13
Softness, cm ² /g	169.4±15.26	181.3±5.22
pH	5.4±0.12	5.5±0.11
Color intensity, E ⁻¹⁰⁰	0.64±0.084	0.65±0.073
Caloric content, kJ/100g	498.4±22.37	492.2±28.42

Analyzing the data, it can be noted that the average moisture content in the pectoral muscles is higher in the broiler chickens of the experimental group, while the average dry matter content is higher in the broiler chickens of the control group. The results of the study of the softness of the pectoral muscles showed that they

are softer in the broiler chickens of the experimental group.

During the experiment, the quality of broiler chickens' thigh muscles was also determined (Table 15).

Table 15

Indicator	Group	
	1-control	2-experimental
Hygro moisture, %	7.3±0.03	7.4±0.04
Total moisture, %:	75.8±0.52	76.5±0.92
- free moisture, %	16.3±1.32	15.3±1.84
- bound moisture, %	59.5±2.16	61.2±1.24
Dry matter, %	24.2±0.84	23.5±0.61
Fat, % (in natural matter)	8.4±0.18	8.8±0.25
Nitrogen, % (in natural matter)	2.9±0.07	3.2±0.09
Softness, cm ² /g	220.2±11.25	244.7±22.69
pH	6.1±0.026	6.2±0.055
Color intensity, E ⁻¹⁰⁰	0.76±0.084	0.78±0.046
Caloric content, kJ/100g	657.2±15.11	665.8±17.82

It was found that the average caloric content of thigh muscles of broiler chickens in the experimental group was 665.8 kJ/100 g, i.e. by 8.6 kJ/100 g higher than in the control group.

After the end of the basic period of rearing, the blood samples of broiler chickens of «Ross-308» cross were taken for further analysis (Table 16).

Table 16

Indicator	Group	
	I-control	II-experimental
Total protein, g/l	36.0±1.83	35.2±1.62
Albumins, g/l	16.8±1.05	17.0±1.54
Aspartate aminotransferase, unit/l	216.3±15.69	314.3±33.60
Alanine amylotransferase, unit/l	12.3±5.62	11.3±5.81
Glucose, mmol/l	8.9±0.15	10.4±0.72
Cholesterol, mmol/l	3.4±0.44	3.6±0.32
Ca, mmol/l	2.6±0.15	2.7±0.24
P, mmol/l	2.8±0.17	2.5±0.22

Comparing the biochemical indicators, it was found that the level of glucose in the blood of broiler chickens in the experimental group was 10.4 mmol/l. It was by 1.5 mmol/l more than in the control group (8.9 mmol/l).

Many scientists claim that high levels of aspartate

aminotransferase and alanine amylotransferase are usually observed in the highly productive animals. In our studies, such an increase was observed in broilers of the experimental group.

The results of morphological indicators of broiler chickens' blood are shown in Table 17.

Table 17

Group	Hemoglobin (g/l)	Erythrocytes (t/l)	Leukocytes (g/l)	ESR (mm/hour)
I-control	118.2±4.58	3.1±0.15	17.6±0.76	1.6±0.55
II-experimental	121.0±4.67	3.2±0.14	19.4±0.84	1.5±0.46

It was found that the hemoglobin content in the blood of broiler chickens in the experimental group was by 2.8 g/l higher than in the control group.

Analyzing the data in Table 18, it can be noted that the content of basophils, eosinophils and neutrophils is

higher in broiler chickens of the experimental group. And the content of lymphocytes and monocytes is higher in broiler chickens of the control group by 3.7 and 0.5%, respectively.

Table 18

Indicator	Group	
	1-control	2-experimental
Basophils	2.0±0.32	2.1±0.30
Eosinophils	3.2±0.14	4.0±0.52
Neutrophils:		
segment nuclear	24.2±1.22	25.2±1.47
stick nuclear	8.5±0.41	9.6±1.32
Lymphocytes	54.1±1.53	50.4±1.43
Monocytes	8.0±0.84	7.5±0.71

Conclusions: It is established that the use of the compound feed produced by the recipe on the basis of protein-vitamin-mineral supplement and the compound feed «Multigain» causes:

1. An increase by 8.5% in the live weight of broiler chickens at the age of 42 days, while their feed consumption decreased by 2.7%.

2. The yield of gutted carcass increased by 0.5% due to the increase in the weight of pectoral and thigh muscles with the use of the compound feed "Multigain".

3. No significant differences were found in the experimental chickens by the weight of internal organs, their chemical composition and the linear measurements of digestive organs.

4. Biochemical blood indicators show an increase in the protein and carbohydrate metabolism due to a higher content of aspartate aminotransferase (by 45.3%) and glucose (by 16.8%). No significant differences were found in the rest of studied indicators.

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