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Influence of Sorbent Additives on Quality Indicators of Meat as Raw Materials for Food Production in Broiler Diet.

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ABSTRACT

The results of the conducted study confirmed that the sorbent additives "Koretron" and "Biokoretron-forte" in the ration of broilers had a positive influence on the slaughter and meat indicators, as well as on feed conversion, chemical composition, environmental safety and profitability of meat production.

Keywords: broiler, slaughter yield, protein, fat, productivity index, amino acids, heavy metals, koretron, biokoretron forte.

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INTRODUCTION

In the structure of the global meat production of all kinds of farm animals poultry occupies the second place after pigs, and by 2022, according to the experts' calculations poultry in the overall share of meat production is going to take the first place among all types of farm animals.

The results of innovative research at the current stage of development of domestic poultry farming contribute to the production of a variety of poultry meat –derived products for human consumption, including the ones for medical and functional purpose. In general, about 300 different poultry products have been created and introduced in production only in recent years. Thus obtaining high-quality food raw materials in broiler poultry breeding is an important aspect in obtaining finished food products.

However, adequate nutrition of people depends not only on the variety and quantity of the food consumed, but also largely on the quality of food raw materials. Quality control and safety is the basis of raw meat in the food production industry. The requirements of normative documents of state control and supervision agencies specified the need of raw materials' quality control throughout the entire cycle of food production. Changing the quality indicators of food raw materials is first of all, the result of the impact of such factor as feeding. In recent years, hundreds of new domestic and foreign preparations appeared on the feed market with which it is possible to influence the level of realization of genetic potential, quantitative and qualitative indicators of meat productivity of animals and poultry.

In this regard, feed additives of new generation “Koretron” and “Biokoretron-forte” are distinguished, which by adsorbing heavy metals and optimizing microbiocenosis in feeds and in the digestive tract of animals reduce the toxicological burden on their bodies thus providing an increase of productivity and improving its quality [1,3,4,5,6,7,8].

The purpose of research work is to find out the slaughter and meat indicators of broilers, as well as feed conversion, chemical composition, ecological cleanliness and profitability of meat production after inclusion in their diet organic -siliceous sorbent feed additives “Koretron” and “Biokoretron-forte” that have prebiotic and probiotic properties (produced by “Diamix” production company).

OBJECTIVES AND METHODS OF RESEARCH

Feed additives “Koretron” and “Biokoretron forte” are diatomite-based containing up to 40 minerals, including silicon in an available form (up to 75-88%), aluminum, iron, potassium, sodium, calcium, magnesium, barium, titanium and others. The Ulyanovsk region has huge deposits of minerals that can be used in diets of broilers in order to increase their efficiency and ecological safety of meat. The biological effect of additives is caused not only by their mineral composition but also by adsorption properties due to the large nanoporosity of the agent. “Biokoretron forte”, in its turn, includes biologically active substances in its composition (vitamins B1, B2, B5, B6, B12, K3, calcium pantothenate, chelated trace elements Zn, Cu, Mn and bacteria of probiotic character (Bacillus subtilis and Bacillus licheniformis in the ratio 1: 1 and a concentration of $1,6 \times 10^{12}$ spores / g).

Experimental studies were conducted at the poultry farm “Tagaiskaya” on seven groups of day old broilers with 66 heads each. Their feeding was carried out with the same complete feed, balanced content of nutrients and energy in accordance with the “Recommendations on poultry feeding” [2]. Thus 10, 20 and 30 kg of additive “Koretron” per 1 ton of mixed feed was introduced by stepwise mixing for broilers of II, III, IV experimental groups; and for broilers of the V, VI, VII groups - the above-mentioned amount of “Biokoretron forte”.

Indicators of broiler live weight, meat productivity and chemical composition of meat, feed conversion rates were determined by conventional methods in zootechnics. The content of toxic metals in meat - by atomic absorption spectrometry with electrothermal atomization of chemical elements in the “Quantum-Z-ETA” device.

RESULTS OF RESEARCH

At almost the same body weight of chickens of compared groups (43.44 ... 44.23 g) at the beginning of the experiment, the intensity of their growth was different (Table 1). If after a 40-day feeding broilers gave a weight gain of 1539.44 g, then the broilers of the experimental -II, III, IV, V, VI and VII groups were superior to the control group, respectively by 7.66%; 13.32; 10.53; 13.71; 17,4 and 20,54%. Over the entire period of fattening a relative rate of growth in chickens of the control group amounted to 189.13% and in chickens of the experimental groups was more and respectively equal to 190.0% in group II, in III - 190,5 and IV - 190,27; in V - 190,54; VI - 190,79 and VII - 190,97%. Because of this, by the end of the 40 day fattening period control broilers reached 1583,67g of live weight and live weight of broilers of experimental groups was greater (P <0.01-0.001) in group II by 117.28 g; in III - by 204.33; in IV by 161.33; in V by 210.33; in VI by 267.25 and in VII by 315.87 g. Consequently, the use of sorbent additives in broiler diets makes it possible to reduce the time they reach a live weight of control broilers in "koretron" groups by 2,8..4,7 days, and in the "biokoretron" groups by 4.8 ... 6.8 days (Table 1).

Table 1: Broiler productivity and feed conversion by them

Group	Live weight, gr			Weight gain			Productivity index, units	Feed conversion kg/kg of weight gain
	At the beginning of the experiment	On day 40	weight I-K reached for days	absolute, gr	daily, gr	relative,%		
I	44,23±0,32	1583,67±28,67	-	1539,44	38,49	189,13	162,5	2,215
II	43,62±0,29	1700,95±22,93*	37,2	1657,33	41,43	190,00	190,40	2,077
III	43,51±0,27	1788,0±18,52x	35,3	1744,49	43,61	190,50	218,25	1,997
IV	43,53±0,28	1745,0±25,96x	36,2	1701,47	42,54	190,27	209,10	2,021
V	43,44±0,31	1794,0±23,11x	35,2	1750,56	43,76	190,54	222,06	1,970
VI	43,61±0,28	1850,92±20,83x	34,1	1807,31	45,18	190,79	233,81	1,911
VII	43,86±0,33	1899,54±25,89x	33,2	1855,64	46,39	190,97	247,59	1,862

*P<0,01; x P<0,001

Feed conversion in broilers consuming mixed feed enriched with various doses of "Koretron" and "Biokoretron-forte" was by 6.23 ... 9.84 ... 8.76 and 11.06 ... 13.72 ... 15.94% better than in broilers consuming non-enriched mixed feed (2,215 kg). Their productivity index was significantly higher than that of the control group of broilers. These data convince us that the use of "Biokoretron forte" at a dose of 1; 2 and 3% is more effective than similar doses of "Koretron".

In broiler poultry farming the slaughter yield is of considerable importance, as well as the output of the edible parts of the carcass, an increase in the protein content in it and decrease in fat. In this regard, the slaughter yield of eviscerated broiler carcasses of experimental groups was significantly greater than in the control group (Table 2). At the same time, if in broilers consuming the mixed feed enriched with various doses of "Koretron" the slaughter yield was almost the same, then with the introduction of the additive "Biokoretron forte" in the composition of feed of broilers it increased from 67.6% to 68.5 ... 68.7%. In slaughter it has been found that the yield of carcass weight of the first category from the broiler "koretron" groups was in 1.18; 1.21 and 1.18 times higher, but in non standard carcasses - 1.38; 2.10 and 1.51 times lower than that of the control group (4.77% and 54.52). In broilers consuming the mixed feed enriched with "Biokoretron-forte", the output of non-standard carcasses was 1.58; 1.89 and 2.33 times less. But what is more important is the output of the first category carcasses increased at the expense of lowering in 1.58; 1.74 and 1.86 times of the carcasses weight of the second category than when "Koretron" was used (in 1.31; 1.36 and 1.39 times). This was the result of stimulating influence of the fodder fed previously enriched with additives tested primarily on digestion and synthesis of the muscle tissue. The distinguished changes in quality indicators of meat productivity are more expressed in broilers consuming the mixed feed containing "Biokoretron forte".

Table 2: Broiler meat productivity values

Group	The results of slaughtering all the flock				
	mean body weight, g.	slaughter yield of a eviscerated carcass, %	broiler carcass categories, %		
			I	II	i / c
I	1583,67±28,67	65,60	54,52	40,71	4,77
II	1700,95±22,93	67,05	64,23	32,31	3,46
III	1788,00±18,52	67,50	65,92	31,81	2,27
IV	1745,00±25,96	67,10	64,34	32,51	3,15
V	1794,00±23,11	67,60	71,27	25,72	3,01
VI	1850,92±20,83	68,50	74,10	23,38	2,52
VII	1899,54±25,90	68,70	76,08	21,87	2,05

+P<0,05; xP<0,01; *P<0,001; **

Table 3: Chemical composition of meat, %

Group	Moisture	Dry matter	Protein	Fat	Ash	Meat index	
						qualities	physiol. maturity
Meat of pectoral muscles							
I	74,11±0,63	25,89±0,63	22,52±0,29	2,30±0,03	1,07±0,02	9,79	0,349
II	75,07±0,31	24,93±0,31	21,79±0,14*	2,06±0,02+	1,08±0,01	10,58	0,332
III	74,90±0,53	25,10±0,53	22,05±0,24	2,06±0,03+	0,99±0,0x	10,70	0,335
IV	74,87±0,17	25,13±0,17	22,09±0,08	2,01±0,02+	1,03±0,0*	10,99	0,336
V	75,47±0,16	24,53±0,16	21,63±0,08*	1,89±0,01+	1,01±0,0x	11,44	0,325
VI	75,24±0,66	24,76±0,66	21,82±0,30	1,88±0,01+	1,06±0,06	11,61	0,329
VII	75,06±0,31	24,94±0,31	22,05±0,15	1,87±0,02+	1,02±0,02	11,79	0,332
Meat of femoral muscles							
I	71,12±0,49	28,88±0,48	24,15±0,16	3,44±0,06	1,29±0,02	7,02	0,406
II	71,15±0,71	28,85±0,71	24,14±0,32	3,32±0,06	1,39±0,02	7,26	0,405
III	71,11±1,14	28,89±1,40	23,67±0,43	3,41±0,09	1,42±0,04	6,94	0,406
IV	71,24±0,24	28,76±0,24	23,98±0,13	3,37±0,04	1,43±0,0*	7,12	0,404
V	71,10±0,99	28,90±0,99	24,14±0,42	3,11±0,09*	1,46±0,0*	7,76	0,406
VI	71,58±0,71	28,42±0,71	23,74±0,29	3,25±0,08	1,40±0,04	7,30	0,397
VII	72,77±0,59	27,23±0,59	22,96±0,29*	2,99±0,06x	1,28±0,04	7,68	0,374

*P<0,05; xP<0,01; +P<0,001

Biological value of poultry meat is expressed mainly in the high protein content, digestibility of which is 80%, whereas of beef is 75% [9]. Protein of poultry meat is presented by various amino acids, the most important of them are lysine, valine, isoleucine. The content of these amino acids in it is greater than in any other farm animal meat. So in protein of the broiler meat the amount of essential amino acids is 82%, and for example in beef protein - 72, in lamb - 73%.

In view of the meat of broilers of the experimental groups a trend is observed, with its more marked manifestations in broilers consuming "Biokoretron-forte", the reduction of the dry matter by reducing the accumulation of fat in its composition (Table 3). In other words, the increase of weight of young chickens is conditioned by a continuation of their "metabolic youth", whereby the fat content is reduced in meat. Broilers of these groups unlike the control group continued to grow rapidly, and do not run to fat, which provided a better feed conversion. However, the gross yield of protein and fat from the total muscle tissue of broiler carcasses in experimental groups was large.

Thus the yield of protein from breast muscles of meat of carcasses, using different doses of "Koretron" additive was 12.69 ... 25.44% and fat by 4.32 ... 11.76% more, while using "Biokoretron forte" this advantage has increased in protein to 20.02 ... 40.20%, and in fat to 2.69 ... 17.01%. In this case, the carcasses of broilers are characterized by a much greater quality index (the ratio of protein to fat) of meat of pectoral

and femoral muscles. In this respect, a dose of 20-30 kg / t of feed mixture was optimal in both “Koretron” and “Biokoretron – forte”. Due to the excellent quality of meat in broiler carcasses one can get a wide range of high-grade food products for the population. An improvement of qualitative indicators of food raw materials, in this case broiler meat, by introducing sorbent additives in the ration raises the competitiveness of finished products in public catering institutions.

Toxicological safety of raw meat is a mandatory condition in food production. According to the decision of the FAO-WHO Codex Alimentarius (Codex Alimentarius) the content of toxic metals is controlled in food products.

The conducted analysis of white (pectoral muscles) and red meat (thigh muscle) did not give any presence of arsenic in its composition, and the concentration of lead, cadmium and mercury in compared groups of broilers (Table 4) does not exceed the maximum permissible concentration (0.5, 0.05 and 0.03 mg / kg).

Table 4: Toxic metals content in broiler meat, mg/kg

Group	Lead	Cadmium	Mercury
Meat of pectoral muscles			
I	0,0463684 ± 0,00362452	0,019254370 ± 0,00124911	0,00024306 ± 0,00002325
II	0,02981484 ± 0,00429765*	0,01770225 ± 0,00274772	0,00017383 ± 0,00002235*
III	0,02260048 ± 0,00328109x	0,01550788 ± 0,00207519	0,0001497 ± 0,0000158*
IV	0,2294070 ± 0,003025100x	0,017580430 ± 0,00323209	0,00015777 ± 0,00001145*
V	0,01892649 ± 0,00135965+	0,01250575 ± 0,00078905x	0,00015116 ± 0,00003644*
VI	0,01593191 ± 0,00289708+	0,01148517 ± 0,00308493x	0,00012102 ± 0,000019630x
VII	0,01634245 ± 0,00146513+	0,01009276 ± 0,001777x	0,000114350 ± 0,00003571*
Meat of femoral muscles			
I	0,125901 ± 0,001720	0,04417778 ± 0,00338538	0,00082724 ± 0,00004681
II	0,125548 ± 0,001663	0,03759866 ± 0,00490104	0,00047313 ± 0,00003309+
III	0,105884 ± 0,002844+	0,03287011 ± 0,00277897*	0,00039891 ± 0,00004316+
IV	0,112586 ± 0,001375+	0,03404607 ± 0,00332584-	0,00039537 ± 0,00004843+
V	0,097740 ± 0,002098+	0,03075732 ± 0,00327403*	0,00033306 ± 0,00002411+
VI	0,092361 ± 0,002024+	0,03074091 ± 0,00338214*	0,00032152 ± 0,00003008+
VII	0,087487 ± 0,002141+	0,02847383 ± 0,0042663*	0,00030118 ± 0,00001750

*P<0,05; xP<0,01; +P<0,001; -P<0,1

Thus in the thigh muscles of broilers with respect to the breast ones the content of toxic metals was significantly more. At the same time, feeding broilers with feed enriched with “Koretron” resulted in a significant (P <0.05-0.001) decline in the accumulation of lead, cadmium and mercury in the pectoral muscle in group II by 35.7; 8.1 and 28.5%, and in femoral – by 0.3; 14.9; and 42.8%, respectively in III by 51.3; 19.5; 38.4 and 15.9%; 25.6 and 51.8%; in group IV – by 50.5; 8.7; 35.1 and 10.6%; 22.9; 52.3%. When broilers were fed with mixed feed, containing “Biokoretron-forte”, there was a much greater decrease in the accumulation of lead, cadmium and mercury in pectoral muscles of broilers in group V by 59.2; 35.1; 37.8%, and respectively in femoral by 15.9 30.4; 59.7%; in the VI group – by 55.6; 40.4; 50.2 and 10.6%; 30.4; 61.1%; in VII – by 64.8; 47.6; 53 and by 30.5%; 35.6; 63.6%.

CONCLUSION

A specific feature of the meat industry of Agro-Industrial Complex is a direct dependence of the finished product quality on qualities of meat raw materials. Based on the results, it can be stated that feeding broilers with the use of sorbent pre-probiotic additives “Koretron” and “Biokoretron forte” in the broiler diet makes it possible to realize the biological resources of meat production (slaughter and meat indicators, chemical composition, feed conversion) and obtain meat raw materials with a high biological value and

criteria of ecological safety, which increases its competitiveness for food industry, and directly satisfies the strategy of the RF Government up to 2030 in the area of enhancing food quality requirements.

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