

Effect of mold inhibitor and adsorbent on digestive processes and consumer quality of broiler meat

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Abstract

The research aims to study broilers meat productivity and enzymatic activity of enzymes in the gastrointestinal tract when preparations mold inhibitor Myco Curb at a dose of 1 kg/t feed + adsorbent ALNI-SORB at a dose of 2 kg /t feed are introduced into diets with a tolerant level of aflatoxin B₁. The object of research was broilers of cross «Smena-8», which at day old by the analogue scale were divided into 4 groups of 100 birds each. The period of growing chickens lasted 42 days. As established in the course of the experiment, due to the combined feeding of preparations of a mold inhibitor and an adsorbent in broilers of the Test 3 group relative to poultry of the control group, a statistically significant increase in the activity of enzymes of proteinases, cellulases and amylases in the muscular stomach and duodenum was observed. These data indicate an improvement in digestion processes under the influence of these drugs due to better detoxification of aflatoxins. The best influence on the slaughter performance and consumer properties of poultry meat from Test group 3 was provided by joint additives of tested preparations, which manifested itself against the control in a significant (P> 0.95).) an increase in the carcass weight of a half-carcass by 14.7% and gutted - by 13.7%, a slaughter yield by 1.6%, as well as an increase in the mass fraction of dry matter, proteins and an indicator of the biological value of meat in the samples of the pectoral and femoral muscles.

Keywords: meat broiler; aflatoxins; mold inhibitor; adsorbent; activity of digestive enzymes; slaughter and meat quality food.

Introduction

The increase in the production of dietary poultry meat depends not only on the genetic potential of meat poultry cross, full value feeding, but also the feed quality, which is often infected with mold fungi. The harmful effect of feed, affected by fungal microflora, on the poultry body is associated with the presence of toxic substances arising when feed is affected during storage by microscopic fungi *Aspergillus*, *Penicillium*, etc. Among mycotoxins, aflatoxins produced by microscopic fungi *Aspergillus flavus* and *Aspergillus parasitikus* are provided by their toxic, carcinogenic and mutative properties (Temiraev *et al.*, 2017; Kairov *et al.*, 2020; Temiraev *et al.*, 2011; Tsalieva *et al.*, 2017).

It is known that to detoxify various toxicants, including mycotoxins, feed adsorbents are successfully used, which bind these compounds in the digestive tract and remove them from the bird's body allowing to reduce the risk of intoxication and increase consumer properties of poultry meat (Gadzaonov *et al.*, 2009; Tedtova *et al.*, 2017; Temiraev *et al.*, 2017; Yuldashbaev *et al.*, 2020).

Adsorbents are characterized by synergetic effect with a wide range of different biologically active additives, including mold inhibitors that are successfully used to reduce the accumulation of mycotoxins in feed, which positively affects broilers metabolism and biological value of poultry meat (Kizinov *et al.*, 2007; Kokaeva *et al.*, 2017; Temiraev *et al.*, 2017).

The research aims to study broilers meat productivity and enzymatic activity of enzymes in the gastrointestinal tract when preparations mold inhibitor Myco Curb at a dose of 1 kg/t feed and adsorbent ALNI-SORB at a dose of 2 kg /t feed are introduced into diets with a tolerant level of aflatoxin B₁.

Material and methods

The aim was achieved by conducting the experiment on the poultry farm of the agricultural production cooperative «Vesna» in Digorsky district, RNO – Alania (Longitude: 44° 40'04 " East, Latitude: 43° 02'12 "North. Altitude: 671 m). The object of research was broilers of cross «Smena-8», which at day old by the analogue scale were divided into 4 groups of 100 birds each. The period of growing chickens lasted 42 days. Experimental bird feeding was carried out in accordance with the existing standards of poultry feeding by the scheme given in Table 1.

To determine the fermentation intensity of nutrients in diets of 5 selected birds from each group, the activity of proteinases, cellulases, lipases and amylases in accordance with the standard practice was studied in the content of the gizzard stomach and duodenum after the control slaughter. The control slaughter of broilers was carried out according to the standard practice. Mold inhibitor Myco Curb – at Manufacturer: Alltech (Alltech), USA/ Contains modified glucomannans isolated from the inner surface of the cell walls of the yeast *Saccharomyces cerevisiae* and forming a unique structure with a huge adsorbing surface area. Adsorbent ALNI-SORB – Production of "Alnikorproduct Vertelishki" (Republic of Belarus). Alni-Sorb contains a modified natural zeolite with a high clinoptilolite content (90-95%), a clay mineral montmorillonite (calcium bentonite), as well as a specific carbonaceous mineral – shungite.

Aflatoxin B₁ quantitation in feed was carried out according to the standard practice. When growing meat chickens, special compound feeds were used for meat poultry (Table 2). Thanks to the use of standard feed dispensers, the level of tolerance to aflatoxin B₁ (0.25 mg / kg) in the compound feed used was achieved by stepwise mixing with environmentally friendly ingredients.

The experimental material was statistically processed by Student's t-test using software package SNEDECOR.

Results and discussion

To reduce the cost of mixed feeds, this enterprise buys cereal and soybean grain mainly from the farms of RNO – Alania. On this basis, the content of some mycotoxins was studied: T-2-toxin, ochratoxin A and aflatoxin B₁ in grain ingredients of mixed feeds for experimental broilers (Table 3).

During the research it was found that the content of aflatoxin B₁ exceeded the maximum permissible concentration (MPC) in soybean of «Rannyaya-10» variety by 1.60 times. in corn chop – 1.60 and wheat chop – 1.40 times. According to the chemical analysis, it was found that the MPC excess in T-2-toxin was only in wheat chop by 1.10 times, and in the content of ochratoxin A – only in corn chop – 1.40 times. Thanks to the technological method of mixing corn, wheat and soybean grain, unfavourable for mycotoxins, and other favourable ingredients, T-2-toxin and ochratoxin A level in the experimental birds feed was reduced below the MPC. The content of aflatoxin B₁ was 20% higher than MPC in the formulation of mixed feed PK-5 and PK-6, but did not exceed the tolerant amount -0.25 mg/kg.

The digestive processes of hydrolysis of feed organic polymers in the poultry body are directly affected by the structural features of the digestive system, i.e. the presence of goiter and two-chamber stomach, where, mainly,

Table 1 – Scheme of the scientific and economic experiment

Group	Feeding habits
Control	Basic diet (BD)
Test 1	BD + mold inhibitor Myco Curb at a dose of 1 kg/t feed
Test 2	BD + adsorbent ALNI-SORB at a dose of 2 kg /t feed
Test 3	BD + mold inhibitor Myco Curb at a dose of 1 kg/t feed + adsorbent ALNI-SORB at a dose of 2 kg /t feed

Table 2 – Composition and nutrition of feed for broiler chickens

Components, %	Recipe
	feed PK-6
Wheat	42.5
Sorghum	25.0
Sunflower meal	15.0
Wheat bran	5.0
Herbal flour	2.0
Hydrolysis yeast	3.4
Fish flour	2.0
Feed fat	1.0
Chalk feed	1.0
Reverse dry	0.2
Common salt	1.0
Tricalcium phosphate	0.9
Premix P6-1-89	1.0
100 g of feed contained:	
exchange energy, MJ	1339
crude protein, g	21.01
crude fat, g	6.48
crude fiber, g	4.03
calcium, g	1.21
phosphorus, g	0.71
sodium, g	0.20
lysine, g	0.84
methionine + cystine, g	0.64

Table 3 – Mycotoxin content in cereal and soybean grain, mg/kg

Feed	Mycotoxins					
	aflatoxin B ₁		T-2 toxin		ochratoxin A	
	MPC	actual	MPC	actual	MPC	actual
Corn chop	0.05	0.08	0.1	0.08	0.05	0.07
Wheat chop	0.05	0.07	0.1	0.11	0.05	0.05
Soybean “Rannyaya-10”	0.05	0.08	0.1	0.09	0.05	0.04

Table 4 – Fermentative activity of the experimental chickens’ gizzard stomach and duodenum chyme, u/g

Digestive tract division	Group			
	Control	Test 1	Test 2	Test 3
Proteinases activity				
Gizzard stomach	0.534±0.002	0.577±0.002	0.599±0.002	0.611±0.001
Duodenum	1.611±0.001	1.751±0.001	1.814±0.001	1.848±0.002
Cellulases activity				
Gizzard stomach	2.15±0.02	2.47±0.02	2.42±0.02	2.32±0.02
Duodenum	12.17±0.02	13.99±0.02	13.72±0.02	13.19±0.02
Amylases activity				
Gizzard stomach	0.61±0.003	0.66±0.001	0.69±0.002	0.70±0.001
Duodenum	1.74±0.002	1.89±0.001	1.96±0.002	2.06±0.003

*P>0.95

along with the small intestine, the protein is cleaved. On this basis, the fermentative activity of content in boilers' gizzard stomach and duodenum was studied (Table 4).

The obtained during the experiment results showed that the mixture of preparations mold inhibitor Myco Curb and adsorbent ALNI-SORB had the most promoting effect on the activity of proteolytic enzymes in the digestive tract of boilers from the third test group, which allowed them to surpass in the proteinases activity of the gizzard stomach content – by 14.4% and duodenum – 14.7% respectively.

It is known that cellulases are not produced in the gastrointestinal tract of poultry. However, a part of the feed cellulose undergoes hydrolysis due to cellulolytic enzymes extracted with the gut microflora. In the course of studies it was found that the mixture of preparations mold inhibitor Myco Curb and adsorbent ALNI-SORB had the greatest promoting effect on the cellulases activity in the digestive tract of boilers from the third test group, which allowed them to surpass in cellulases activity of the gizzard stomach content by 7.9% and duodenum – by 8.3%, respectively.

The mixture of preparations mold inhibitor Myco Curb and adsorbent ALNI-SORB had the greatest promoting effect on the activity of amylolytic enzymes in the digestive tract of boilers from the third test group, which allowed them to surpass in amylases activity of the gizzard stomach content by 14.7% as well as duodenum – by 18.4%, respectively. Our data are consistent with the results of researchers who experimentally found that when the natural adsorbent zeolite is included in broiler diets, the enzymes of proteinases, amylases and cellulases are activated in the chyme of the small intestine (Kairov *et al.*, 2020).

Meat productivity of boilers depends on the activity of hydrolysis in the gastrointestinal tract and nutrients fixation. On this basis, the control slaughter using five selected birds from each group was carried out (Table 5). It is found that the highest promoting effect on slaughter indicators of the experimental birds had joint supplement of preparations mold inhibitor Myco Curb and adsorbent ALNI-SORB to the mixed feed, which provided for broilers in the third test group relative to the control significant ($P>0.95$) increase in the weight of semi-eviscerated carcass by 14.7% and eviscerated – by 13.7% as well as slaughter yield – 1.6%, respectively. The inclusion of chelaton enterosorbent in broiler diets increased the yield of conditioned carcasses and the slaughter yield (Gadzaonov *et al.*, 2009; Tedtova *et al.*, 2017).

Feeding conditions have an impact on the nutritional value of poultry meat. In view of the high growth rate of modern meat poultry crosses, the chemical composition of meat should be also considered (Table 6). The most favourable effect on consumer properties of boilers meat had joint supplement of preparations mold inhibitor and adsorbent. Due to this, broilers in the third test group relative to the control contained significantly 1.04-1.16% and 1.24-1.59% ($P>0.95$) more dry matter and protein in pectoral and femoris and fat, on the contrary, 0.20 and 0.74% ($P>0.95$) less.

Table 5 – Results of the experimental birds' slaughter

Indicator	Group			
	Control	Test 1	Test 2	Test 3
Pre-slaughter weight of 1 bird, g	2054.9 ± 7.1	2232.9 ± 6.5	2225.8 ± 6.6	2280.8 ± 6.1
Wt. of semi-eviscerated carcass, g	1676.7 ± 5.9	1842.1 ± 5.7	1843 ± 5.9	1922.7 ± 5.5
In % to live weight	81.6	82.5	82.8	84.3
Weight of eviscerated carcass, g	1321.2 ± 4.5	1458 ± 3.7	1460.2 ± 4.3	1502.9 ± 3.6
Slaughter yield, %	64.3	65.3	65.6	65.9

Table 6 – Chemical composition of pectoral and femoris, %

Indicator	Group			
	Control	Test 1	Test 2	Test 3
Pectoral				
Dry matter, %	25.17±0.18	25.79±0.22	26.00±0.14	26.21±0.12
Protein, %	21.76±0.14	22.65±0.17	22.88±0.13	23.00±0.13
Fat, %	2.22±0.03	2.14±0.05	2.19±0.03	2.02±0.03
Femoris				
Dry matter, %	23.69±0.20	24.39±0.17	24.52±0.11	24.85±0.14
Protein, %	18.84±0.12	19.72±0.14	20.00±0.15	20.43±0.19
Fat, %	3.30±0.04	3.14±0.03	2.80±0.03	2.54±0.05

Table 7 – Biological full value of chickens meat (pectoral)

Indicator	Group			
	Control	Test 1	Test 2	Test 3
Tryptophan, %	1.63 ± 0.14	1.73 ± 0.14	1.76 ± 0.14	1.79 ± 0.14
Oxyproline, %	0.43 ± 0.01	0.415 ± 0.01	0.4 ± 0.02	0.39 ± 0.012
PQI	3.773 ± 0.22	4.149 ± 0.23	4.434 ± 0.44	4.612 ± 0.47

Biological full value of the experimental birds meat (Table 7) was determined by meat protein quality index (PQI) (estimated in ratio of tryptophan to oxyproline in pectoral). The results obtained during the experiment showed that joint supplement of preparations mold inhibitor Myco Curb and adsorbent ALNI-SORB provided for chickens in the third test group the most significant ($P>0.95$) superiority over the control in the biological meat value by 22.2%. Our data are consistent with those of a number of authors (Kizinov *et al.*, 2007; Temiraev *et al.*, 2017) who have optimized the biological and nutritional value of broiler meat using bentonite to reduce the risk of aflatoxicosis.

Conclusion. On the basis of the data obtained the mixture of preparations mold inhibitor Myco Curb at a dose of 1 kg/t feed and adsorbent ALNI-SORB at a dose of 2 kg /t feed is recommended to introduce into broilers diets with increased content of aflatoxin B₁ to activate enzymes in the gastrointestinal tract and improve consumer qualities of poultry meat.

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