The influence of antioxidant on the productivity and activity of digestive broiler enzymes in reducing the risk of T-2 toxin

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Abstract

Recently, positive results have been achieved to reduce the risk of mycotoxicosis in meat poultry by rational use of various feed antioxidants, which inhibit processes of lipid peroxidation in the body and increase its immunity. The research aims to study the effect of different dosages of feed antioxidant Epofen on the basic economic and useful performance and digestive enzyme activity of broiler chickens grown on wheat-sorghum-sunflower-based diets with tolerance level of T-2 toxin. To achieve this aim, the experiment using day-old "COBB-500" broiler chickens, which by the analogue scale were divided into 4 groups, was carried out on the poultry farm, agricultural production cooperative "Batraz", RNO – Alania. The resulting digital material was processed biometrically using the information program Excel. The research found that the best dose of feeding Epofen by reducing the risk of T-2 toxicosis in broilers is 200 g/t feed, which improves the basic economic and useful qualities and intensification of feed enzymolysis. At the same time versus counterparts from the control group, broilers in the second experimental group had increase in poultry stock safety by 4.0%, gross and daily average gain – by 9.29% ($P<0.05$). Due to a better level of T-2 toxin detoxification by introducing preparation Epofen in mixed feed at a dose of 200 g/t feed, in the muscular stomach content of meat chickens of the second experimental group was significant ($P<0.05$) increase in protease activity by 11.61%, cellulase – by 19.93% and amylase – by 14.43%. Also, the broilers of the second experimental group showed a significant ($P<0.05$) increase in the activity of proteinases in the chyme of the small intestine by 15.50%. cellulase – by 14.19% and amylase – by 15.12%.

Keywords: broiler; antioxidant; T-2 toxin; detoxification; live weight gain; activity of digestive enzymes.

Introduction

In recent years, scientific research to reduce the risk of mycotoxicosis in meat poultry due to the use of biologically active additives in mixed feed that can remove or neutralize mold fungi toxins in the body is enriched. They are especially dangerous for broiler chickens because in the first days of life, due to the malformation of useful composition of microbiocenosis and the enzymatic link of the digestive system their immunity is still weak (Kisinov et al., 2005; Tsalieva et al., 2017; Lopatov, 1999).

Mold fungi especially heavily pollute grain components of poultry mixed feed in conditions of high humidity and violations of temperature-humidity storage conditions. Moreover, they begin to actively give off mold toxins – mycotoxins, which are very often resistant to high temperature, enzymatic treatment even when the fungus-producer is lost. Their danger is caused by the carcinogenic and mutagenic action of all known mold toxins, as well as the inhibitory action on the digestive enzymes and the growth rate of young birds (Temiraev et al., 2017; Temiraev et al., 2020; Tedtova et al., 2017).

One of the most resistant to various external factors of the mold are fungi Fusarium, which can actively contaminate grain ingredients of bird mixed feed with trichotecenes mycotoxin T-2 toxin (or "Yellow Rain"). When entering the bird's body, appear multiple symptoms of severe damage to its organs and tissues, primarily the lungs and stomach (Kokaeva, 2008; Temiraev et al., 2012; Baeva et al., 2013).

Recently, positive results have been achieved to reduce the risk of mycotoxicosis in meat poultry by rational use of various feed antioxidants, which inhibit processes of lipid peroxidation in the body and increase its immunity (Baeva et al., 2014; Kokaeva et al., 2017; Vityuk et al., 2017).

The research aims to study the effect of different dosages of feed antioxidant Epofen on the basic economic and useful performance and digestive enzyme activity of broiler chickens grown on wheat-sorghum-sunflower-based diets with tolerance level of T-2 toxin.

Material and methods

To achieve the above stated aim in the conditions of the poultry farm, agricultural production cooperative "Batraz", (RNO – Alania, Longitude: 44° 40′04 ″ East, Latitude: 43° 02′12 ″ North. Altitude: 671 m) was carried out the experiment according to the scheme presented in table 1. The research objects were day-old "COBB-500" broiler chickens, which by the analogue scale were divided into four groups of 100 heads each.

When growing meat chickens, special poultry mixed feed PK-5 and PK-6 (Table 2) were used, the grain basis of which was represented by wheat grain, sorghum grain and sunflower meal. They were purchased from local manufacturers. Due to the use of standard feed dispensers the tolerance level of T-2 toxin (0.1 mg/kg in accordance with GOST R 51899-2002) in used mixed feeds have been achieved by step mixing with environmentally friendly ingredients (Yesuf et al., 2017).

Poultry in compared groups was grown during 42 days, at this its weekly weighing was performed to determine body weight gain. At the same time the poultry stock safety was observed.

The tested feed supplement antioxidant Epophen in the organization of analogs of the experimental groups in the feed were injected by multi-stage mixing with the help of standard dispensers. Feed additive epophen is a natural analog of polyphenolic compounds of bioflavonoids in its structural structure. This additive is a new generation of domestic production (an effective antioxidant and antihypoxant), which has a structural similarity with a number of vitamins (E, K, PP). Epophen increases the intensity of tissue respiration, significantly optimizes energy and vitamin metabolism, inhibits the reaction of free radicals and toxins, removing some types of toxicants from the body. On the basis of experimental data, Z. T. Baeva (2009) recommends using the antioxidant Epophen in the diets of lactating cows with a subtoxic dose of nitrates in the amount of 3.0 g / head. (Sethy et al., 2017)

After the control slaughter, the activity of digestive enzymes in different sections of the gastrointestinal tract was studied in five birds from each group according to conventional methods (Fyodorov & Kuzmin, 2013).

The resulting digital material was processed biometrically using the information program Excel.

Table 1 - Scheme of scientific and economic experiment on broilers (n=100)

Cows group	Features of birds' feeding
Control	Basic diet with tolerance dose of T-2 toxin (BD)
Experimental 1	BD + Epofen at a dose of 100 g/t feed
Experimental 2	BD + Epofen at a dose of 200 g/t feed
Experimental 3	BD + Epofen at a dose of 300 g/t feed

Table 2 – Composition and nutrition of feed for broiler chickens

Components, %	Recipe	
	feed PK-5	feed PK-6
Wheat	40.0	42.5
Sorghum	20.5	25.0
Sunflower meal	15.5	15.0
Wheat bran	3.0	5.0
Herbal flour	2.0	2.0
Hydrolysis yeast	6.0	3.4
Fish flour	5.2	2.0
Feed fat	1.0	1.0
Chalk feed	2.0	1.0
Reverse dry	2.5	0.2
Common salt	0.3	1.0
Tricalcium phosphate	2.0	0.9
Premix P6-1-89	1.0	1.0
100 g of feed contained:		
exchange energy, MJ	1297	1339
crude protein, g	23.0	21.01
crude fat, g	6.87	6.48
crude fiber, g	4.02	4.03
calcium, g	1.05	1.21
phosphorus, g	0.41	0.71
sodium, g	0.21	0.20
lysine, g	1.27	0.84
methionine + cystine, g	0.93	0.64
linoleic acid, g	1.11	1.2
T-2 toxin,		
For 1 t of feed is added: methionine, r	600	700

Results and discussion

In the course of the experiment during mycotoxins detoxification through feeding different doses of antioxidant Epofen, the stock safety, growth rate and feed efficiency in experimental meat chickens was studied (Table. 3).

It is found that the best higher productive effect was achieved when feed supplementing with Epofen at a dose of 200 g/t feed. At this versus counterparts from the control group, broilers in the second experimental group had an increase of stock safety by 4.0%, gross and daily average gain – by 9.29% ($P<0.05$).

In the course of the experiment, it was found that versus control, due to the highest growth rate, the meat chickens in the second experimental group consumed mixed feed 9.00% less per unit of received gross formation. It shows that the best dose of Epofen feeding by reducing the risk of T-2 toxicosis in broiler-chickens is 200 g/t feed, which improves the basic economic and useful qualities (Dzhaboeva et al., 2019; Kennedy et al., 2019)

To ensure high growth rate for broiler chickens, especially at the risk of mycotoxicosis, the problem of increasing the activity of digestive enzymes is of paramount importance, so we studied the effect of different antioxidant doses on the enzymes activity in the content of the muscular stomach (Table 4) and duodenum (Table 5).

Due to the best level of T-2 toxin detoxification due to the inclusion of the epofen preparation in feed at a dose of 200 g / t of feed in the contents of the muscle stomach of meat chickens of the 2nd experimental group. a significant ($P <0.05$) excess of proteinase activity by 11.61%. cellulase by 19.93% and amylase by 14.43%.

The main part of the organic nutrients in feed is hydrolyzed and absorbed in the small intestine, so more attention was paid to the activity of endogenous enzymes in the duodenum chyme of experimental meat chickens. It is found that in the analyzed section of the intestine when feeding antioxidant Epofen at a dose of 200 g/t feed by reducing risk of T-2 toxicosis in broiler chickens of the second experimental group there was significant ($P<0.05$) increase in the activity of proteases by 15.50%, cellulase – by 14.19% and amylases – by 15.12% in the chyme of the small intestine.

Conclusion. At a tolerance level of T-2 toxin it is advisable to introduce antioxidant Epofen in wheat-sorghum-sunflower-based mixed feed of broiler chickens at a dose of 200 g/t feed to increase the stock safety, the

live weight gain, feed conversion into production due to enzymatic hydrolysis of nutrients in different sections of the gastrointestinal tract.

Table 3 – Stock safety, growth rate and food conversion ratio in chickens

n=100

Indicator	Group			
	Control	Experimental 1	Experimental 2	Experimental 3
Safety, %	91	93	95	94
Live weight per 1 head, g:				
at the beginning of the experiment	40.88±0.28	40.79±0.31	40.90±0.26	40.87±0.30
at the end of the experiment	2381.42±5.9	2529.71±5.5	2599.31±6.2	2543.65±4.9
Body weight gain, g				
gross	2340.54±6.0	2488.92±6.2	2558.41±5.9	2502.78±5.3
daily average	55.73±0.30	59.26±0.19	60.91±0.33	59.59±0.29
In % to control	100.00	106.33	109.29	106.93
Feed consumption per 1kg gain, kg	2.00	1.88	1.82	1.86

Table 4 – Enzymatic activity in the muscular stomach contents

n=5

Group	Enzymes activity, unit/g			
	proteinase	lipase	cellulase	amylase
Control	0.534±0.002	0.564±0.014	0.296±0.002	0.627±0.002
Experimental 1	0.578±0.003	0.569±0.019	0.322±0.002	0.700±0.003
Experimental 2	0.596±0.003	0.560±0.013	0.355±0.003	0.717±0.003
Experimental 3	0.581±0.002	0.057±0.012	0.233±0.004	0.707±0.002

Table 5 - Enzymatic activity of the chyme of the duodenum

n=5

Group	Enzymes activity, unit/g			
	proteinase	lipase	cellulase	amylase
Control	1.585±0.003	1.638 ± 0.006	1.219±0.004	1.720±0.004
Experimental 1	1.795±0.003	1.645± 0.015	1.381±0.003	1.947±0.005
Experimental 2	1.826±0.004	1.633±0.014	1.392±0.005	1.980±0.004
Experimental 3	1.802±0.003	1.651±0.011	1.387±0.005	1.957±0.006

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