Effect of probiotics and anti-oxidants in reducing the risk of aflatoxicosis in poultry

F.N. Tsogoeva[1], R.B. Temiraev[2*], A.A. Baeva[3], L.A. Vityuk[4], V.V. Tedtova[2], I.I. Ktsoeva[1]. E.F. Tsagaraeva[5]

[1]Faculty of Biological Sciences, Gorsky State Agrarian University, 362040, Vladikavkaz, 37 Kirov Street; [2]Faculty of Agricultural Sciences, North-Caucasian Mining and Metallurgical Institute (State Technological University), Vladikavkaz 362021, & Faculty of Agricultural Sciences, Professor, Gorsky State Agrarian University, 362040, Vladikavkaz, 37 Kirov Street; [3]Chair of Technology of Food Products, North-Caucasian Mining and Metallurgical Institute (State Technological University), Vladikavkaz 362021; [4]Faculty of Technical Sciences, North-Caucasian Mining and Metallurgical Institute (State Technological University), Vladikavkaz, 362021; [5]Faculty of Biological Sciences, Chechen State Pedagogical University, City Grozniy, 364068, Russian Federation
[*] Corresponding author e-mail: temiraev@mail.ru

Journal of Livestock Science (ISSN online 2277-6214) 11: 90-94
Received on 29/1/20; Accepted on 3/4/2020
doi. 10.33259/JLivestSci.2020.90-94

Abstract

In the conditions of RNO – Alania the most effective way to protect grain from contamination with mycotoxins is to prevent their formation all the way from the field to the consumer. For this purpose it is necessary to apply the improved technologies of cultivation, treatment, storage, as well as partially to disinfect grain products during grain processing. In the course of the research the MPC excess in T-2-toxin and ochratoxin A concentration in the selected samples of corn, barley and soybeans was not found. At the same time, the content of aflatoxin B_1 in the composition of cereal and legume-based feed ingredients exceeded the MPC. By mixing corn, barley and soybeans, unfavourable in aflatoxin B_1 concentration with other favourable in this toxin ingredients managed to reduce its content in the composition of complete mixed feed PK-5 and PK-6 – to 0.23 mg/kg. Moreover, aflatoxin B_1 concentration in the formulation of these mixed feeds in both phases of feeding does not exceed the tolerance amount – 0.25 mg/kg. According to two metabolism trials using rearing flocks and laying hens, the joint introduction of probiotic Bifidumbacterin at the rate of 5 doses per 200 heads and preparation Santochinum at a dose of 125 g/t feed in the diet with tolerance level of aflatoxin B_1 increased significantly the digestibility coefficients of organic matter, crude protein, crude fiber and nitrogen-free extractives, as well as the best protein conversion into products.

Keywords: broiler; aflatoxin B_1; antioxidant; probiotic; digestibility and accessibility of feed nutrients.

Introduction

The use of the genetic potential of modern poultry crosses, aimed at obtaining maximum production, leads to a decrease in the adaptive capacity of the poultry body to alimentary factors typical for modern industrial poultry farming (Kokaeva, 2008; Temirayev et all., 2015; et al., 2017).

On this basis, the improvement of the protective functions in the birds body often brings up the question about the additional application of antioxidants in animal mixed feed, which are essential for growth and reproduction, they regulate digestive metabolism, take part in protective reactions of the body, etc. the Main source of these compounds for poultry are feeds of plant origin (Temiraev et al., 2017; Vityuk et al., 2017; Kennedy et al., 2019).

In biochemical processes of the poultry body antioxidants increase its immunobiological reactivity. Their application serves to improve the health and productivity of poultry. There is a positive experience of the joint application of antioxidants and probiotics in the diets of farm animals (Temiraev et al., 2012; Baeva et al., 2014; Tedtova et al., 2017; Sethy et al., 2017).

Probiotics have become more widely used in poultry farming. They are necessary to form eubiosis and improve the overall resistance of the bird's body to unfavourable factors. Usually, the number of bifidobacteria which perform some important functions in the body: protect the intestinal mucosa from penetration of pathogenic and opportunistic microorganisms into the blood decreases in the intestine (Kokaeva et al., 2017; Temiraev et al., 2017; Temiraev et al., 2020). The aim of this research was to study the effect of probiotic Bifidum-SHG and antioxidant Santochinum on nutrients digestibility and absorption with aflatoxin B_1 tolerance level in the diets of rearing flocks and laying hens.

Materials and methods

Bifidum-SHG is lyophilized microbial mass of live antagonistically active bacteria of bifidumbacterium bifidum no.1 strain on a lactulose basis. One dose of this probiotic drug contains 10 million cells of bifidobacteria and is a loose mass (powder) of beige or whitish-gray color with a specific smell and sweet taste. When dissolved in water, it forms a weakly phosphorescent colorless suspension.

The experimental part of the work was performed in the conditions of LLC "Iraf-agro" (Republic of North Ossetia – Alania, Longitude: 44° 40′04 ″ East, Latitude: 43° 02′12 ″ North. Altitude: 671 m). The research objects were rearing flocks and laying hens of meat cross "Smena-7".

The scientific and industrial experiment consisted of two stages. During the first stage of scientific and economic experiment on the rearing day old conditioned chickens of a single hatch were divided by the analogue scale into 4 groups of 200 birds each. Rearing flocks raising lasted 23 weeks, after which the experimental bird was transferred to the laying hens room. During the second stage of the scientific and economic experiment, the same stock as during the first stage of the experiment was used, but due to the safety of the rearing flocks, the number of laying hens was reduced to 170 birds.

Feeding the experimental birds during the experiment was carried out according to "Recommendations for poultry feeding" (2003) by the scheme given in table 1. To determine the digestibility and use of nutrients in diets two physiological experiments on 90 days old rearing flocks and 350 days old hens were conducted by the method (Fomin and Avrutina,1967) using an inert indicator of chromium oxide in an amount of 0.5% by feed weight. When calculating the nitrogen balance, the separation of nitrogenous substances of feces and urine in the litter was carried out.

Table 1 – Scheme of scientific and economic experiment

Group	Feeding peculiarities
The first stage of the scientific and economic experiment on rearing flocks	
Control	Basic diet (BD) – standard mixed feed
Test 1	BD + Bifidum-SHG at the rate of 5 doses per 200 birds
Test 2	BD + Santochinum at a dose of 125 g/t feed
Test 3	BD + probiotic Bifidum-SHG at the rate of 5 doses per 200 birds + Santochinum at a dose of 125 g/t feed
The second stage of the scientific and economic experiment on laying hens	
Control	Basic diet (BD) – standard mixed feed
Test 1	BD + Bifidum-SHG at the rate of 5 doses per 200 birds
Test 2	BD + Santochinum at a dose of 125 g/t feed
Test 3	BD + probiotic Bifidum-SHG at the rate of 5 doses per 200 birds + Santochinum at a dose of 125 g/t feed

Results and Discussion

In the formulation of mixed feed grain ingredients of cereal and legume crops were represented by: corn, barley (cultivated on the farm "40 Let Oktyabrya" in Mozdoksky district) and soybean of domestic variety "Rannyaya-10" (cultivated in JSC "Nogir" the Prigorodny district of North Ossetia – Alania).

Results from the chemical analysis found that the selected samples of corn, barley and soybeans did not show the MPC (Maximum Permissible Concentration) excess in T-2-toxin and ochratoxin A concentration. At the same time, in the composition of cereal and legume-based ingredients of mixed feed according to aflatoxin B_1 content, there was the MPC excess: in corn grain by 60%, barley – by 40% and soybeans – by 60%.

In the compound feed (Table 2) of repair young stocks according to the PK-6 recipe, corn grain accounted for 31.5%, barley - 25.7% and soybean meal - 20.0%; and in the composition of compound feeds of laying hens according to the PK-2 recipe, the share of corn grain was 28.7%, barley - 25.0% and soybean meal - 18.3%. This suggests that the experimental feed was corn barley soybean type. Bifidum SChZh and santokhin were introduced into the composition of dry full-feed compound feeds of the experimental bird in a three-stage way using standard dispensers, due to which they were more evenly mixed with other ingredients. By mixing corn, barley and soybeans, unfavourable in aflatoxin B_1 concentration with other favourable in this toxin ingredients managed to reduce its content in the composition of complete mixed feed to 0.23 mg/kg. Moreover, the concentration of aflatoxin B_1 in the formulation of these mixed feeds in both feeding phases does not exceed the tolerance amount – 0.25 mg/kg (Baeva et al., 2013; Gharehsheikhlou et al., 2017).

In the course of physiological experiments, the digestibility coefficients of nutrients in the diets of rearing flocks and laying hens were calculated (table 3).

The results from the physiological experiments found that the introduction of biologically active additives into the mixed feed had a positive effect on the nutrients digestibility in feeds of the experimental poultry, but the joint supplements of probiotic and antioxidant had a higher stimulating effect.

By mixing corn, barley and soybeans, unfavourable in aflatoxin B_1 concentration with other favourable in this toxin ingredients managed to reduce its content in the composition of complete mixed feed to 0.23 mg/kg. Moreover, the concentration of aflatoxin B_1 in the formulation of these mixed feeds in both feeding phases does not exceed the tolerance amount – 0.25 mg/kg (Baeva et al., 2013; Gharehsheikhlou et al., 2017).

In the course of physiological experiments, the digestibility coefficients of nutrients in the diets of rearing flocks and laying hens were calculated (table 3). The results from the physiological experiments found that the introduction of biologically active additives into the mixed feed had a positive effect on the nutrients digestibility in feeds of the experimental poultry, but the joint supplements of probiotic and antioxidant had a higher stimulating effect.

Table 2 - Composition and nutritional value of full feed poultry (Composition of the basic diet)

Indicators	Repair young	Laying hens
	Age, weeks	Age, weeks
	1-23	23-52
Composition, %:	-	-
Corn	31.5	28.7
Barley	25.7	25.0
Soybean meal	20.0	18.3
Dry corn gluten	4.2	3.9
Hydrolysis yeast	4.5	4.3
Fish flour	5.3	4.4
Herbal flour	4.1	5.1
Feather flour	2.5	2.0
Chalk feed	1.0	6.8
Common salt	0.4	0.5
Premix P - I - I - 89	1.0	1.0
100 g of feed contained:		
exchange energy, MJ	1.093	1.115
crude protein, g	15.29	14.12
crude fat, g	2.58	2.88
crude fiber, g	5.07	4.46
calcium, g	1.15	2.70
phosphorus, g	0.75	0.76
sodium, g	0.24	0.30
lysine, g	0.65	0.75
methionine + cystine, g	0.47	0.45
linoleic acid, g	1.14	1.23
aflatoxin B1, mg / kg	0.24	0.24
For 1 t of feed is added: lysine, г methionine г	680 440	430 310

Table 3 – Digestibility coefficients of nutrient in diets, %

Indicator	Group			
	control	test 1	test 2	test 3
First physiological experiment				
Organic matter	82.44±0.39	84.97±0.44*	85.14±0.48*	85.77±0.42*
Protein	75.86±0.24	77.72±0.35*	78.22±0.33*	79.10±0.38*
Fibre	12.65±0.31	14.24±0.41*	14.47±0.44*	14.98±0.38*
Fat	83.33±0.32	84.12±0.48	83.77±0.41	84.01±0.52
Nitrogen-free extractives	86.22±0.36	88.87±0.32*	89.06±0.47*	89.65±0.40*
Second physiological experiment				
Organic matter	84.07±0.49	86.83±0.36*	86.97±0.44*	87.46±0.38*
Protein	77.91±0.34	79.42±0.24*	80.17±0.41*	81.10±0.44*
Fibre	13.31±0.26	15.95±0.31*	16.08±0.35*	16.40±0.37*
Fat	85.02±0.36	86.05±0.43	85.89±0.40*	86.06±0.41*
Nitrogen-free extractives	86.44±0.41	89.24±0.43*	89.33±0.51*	89.95±0.35*

*P>0.95

Table 4 – Use of dietary nitrogen by experimental birds, g

Indicator	Group			
	Control	Test 1	Test 2	Test 3
The first physiological experimental				
Taken with feed	2.03±0.012	2.02±0.011	2.02±0.014	2.01±0.010
Excretion: in feces	0.49±0.002	0.45±0.003*	0.44±0.002*	0.42±0.003*
in urine	0.78±0.001	0.78±0.002	0.78±0.003	0.76±0.002*
Deposited	0.76±0.002	0.79±0.001*	0.80±0.001*	0.83±0.003*
Used from taken, %	37.43±0.29	39.11±0.37*	39.60±0.32*	41.29±0.33*
The second physiological experimental				
Taken with feed	3.44±0.012	3.45±0.027	3.43±0.020	3.44±0.023
Excreted: in feces	0.76±0.002	0.71±0.002*	0.68±0.001*	0.65±0.003*
in urine	1.33±0.001	1.35±0.002	1.35±0.002	1.37±0.004
in eggs	0.81±0.002	0.88±0.001*	0.90±0.002*	0.95±0.003*
Deposited	0.54±0.001	0.51±0.001*	0.50±0.001*	0.47±0.003*
Used from taken, %	39.24±0.25	40.29±0.30*	40.82±0.37*	41.28±0.41*
Including excreted in eggs	23.55±0.40	25.51±0.32*	26.24±0.38*	27.62±0.36*

*P>0.95

During the first balance experiment feeding the mixture of these preparations the young of the third test group provided vs the control counterparts significantly (P>0.95) best digestion of organic matter by 3.33%, crude protein – by 3.24%, crude fiber – by 2.33% and nitrogen-free extractives – by 3.43%.

During the second balance experiment the joint introduction of these feed additives in mixed feeds allowed hens in the third test group vs the control significantly (P>0.95) to increase the digestibility of organic matter by 3.39%, crude protein – by 3.19%, crude fiber – by 3.09% and nitrogen-free extractives – by 3.51%.

The results of the metabolism trials determined the effect of the preparations on using nitrogen in diets of experimental birds (table 4).

During the first balance experiment it was found that joint supplements of probiotic and antioxidant provided for the rearing flocks in the third test group significantly (P>0.95) greater nitrogen deposition per day by 9.21% and the best its use of the taken with feed amount by 3.86%, which is consistent with the average daily gain of rearing flocks in the compared groups.

Laying hens, unlike young, most of the digested nitrogen excrete as part of the egg mass. Feeding the antioxidant in combination with the probiotic had a stimulating effect on the conversion of feed nitrogen into egg mass one. Moreover, the most stimulating effect of these preparations on the process of egg formation had hens in the third test group, which contained 17.28% (P>0.95) more nitrogen in the egg than in the control.

By the deposited in the body the amount of nitrogen laying hens of all test groups were significantly (P>0.95) inferior to their control counterparts, which is consistent with the changes in live weight of the experimental birds, that is after transferring to the main room to increase the body weight the hens of the test groups were inferior to their control counterparts.

Conclusion- To improve the digestibility and accessibility of cereal-soybeans nutrients, probiotic Bifidumbacterin at the rate of 5 doses per 200 birds and preparation Santochinum at a dose of 125 g/t feed should be jointly introduced into diets with tolerance level of aflatoxin B_1.

References

1) Baeva A.A., Ktsoeva I.I., Abaev A.V., Vityuk L.A., Kovaleva Yu.I., Payuchek V.G. 2014. Using Sorbents in Feeding for Increasing Environmental and Food Value of Broiler Meat. Scientific Journal of KubSAU (Polythematic online scientific journal of Kuban State Agrarian University) 101, no. 07: 2510–20.
2) Baeva A.A., Vityuk L.A., Abaeva S.K., Buzoeva L.B., Abaev A.V. 2013. Evaluation of Chicken Broiler's Meat when Disturbing the Nutritive Ecology. Izvestia of Gorky State Agrarian University 50, no. 2: 105–10.
3) FominA.I. Avrutina A.Ya. Metodika opredeleniya perevarimosti kormov i skorosti prokhozhdeniya pishchi po pishchevaritel'nomu traktu spomoshch'yu okisi khroma. Metodiki nauchnykh issledovaniy po kormleniyu sel'skokhozyaystvennoy ptitsy. M. – 1967. – S. 21 - 25.
4) Gharehsheikhlou H.R., Chamani M., Seidavi A.R., Sadeghi A.A., Mohiti-Asli M. 2017- Effect of fennel and savory essential oils on performance, carcass characteristics and blood parameters of broilers. Journal of Livestock Science (ISSN online 2277-6214) 9: 23-31
5) Kennedy O.O.O., Mbaba E.N., Iso I.E., Halilu A., Robert A.N., Micheal A. N. & B. 2019. Effects of turmeric rhizome powder on growth, carcass and meat quality of Japanese quails fed sorghum-soybean-based diets. Journal of Livestock Science (ISSN online 2277-6214) 11: 1-7. doi.10.33259/JLivestSci.2020.1-7
6) Kokaeva M.G. 2008. Improving the Nutritional Value of Broiler Meat. Paper presented at the 12th All-Russia scientific-practical conference "Agribusiness Industry and Topical Problems of Regions' Economy", in Maikop, Russia.
7) Sethy K., Swain P., Behera K., Sahoo N., Agrawalla J., Khadanga S., Mahapatra M.R. and Parhi S.S. 2017. Effect of turmeric (Curcuma longa) supplementation on antioxidants and immunity of broiler birds. Journal of Livestock Science (ISSN online 2277-6214) 8: 103-106
8) Tedtova V.V., Kozhokov M.K., Shugusheva L.H., Kanukova V.N., Baeva A.A., Vityuk L.A. 2017. Preventive and detoxicative action of probiotics on metabolism and consumer quality of broilers meat**.** Journal of Pharmaceutical Sciences and Research. 9 (6)**:** 997-1001.
9) Temiraev, V.K., Kairov, V.R., Temiraev, R.B., Kubatieva, Z.A. and Gukezhev, V.M. 2017. Method to improve productive performance and digestion exchange of broiler chickens with reduced risk of aflatoxicosis. Ecology, Environment and Conservation. 23 (1) : 554-561.
10) Temiraev V.H., Baeva A.A., Vityuk L.A., Mamukaev M.N., Yurina N.A., Ktsoeva I.I., Bobyleva L.A., Zagaraeva E.F., Kokov T.N., Vologirova F.A. 2020. Effect of probiotics on digestive metabolism in growing and laying poultry birds. Journal of Livestock Science (ISSN online 2277-6214) 11: 33-39. doi. 10.33259/JLivestSci.2020.33-39
11) Temiraev R.B., Kozhokov M.K., Cherchesova S.K., Kokaeva F.F., Tletseruk I.R. 2017. Method for diminishing the adverse effect of anthropogenic heavy metal pollution on poultry meat products. Journal of Environmental Management and Tourism. 8. 3 (19): 567-573.
12) Temiraev, R.B., Kokaeva, F.F., Tedtova, V.V., Baeva, A.A., Khadikova, M.A. and Abaev, A.V. 2012. Method for increasing the dietary meat quality and improvement of broilers metabolism in conditions of the industrial zone of North Ossetia – Alania. Proceedings of Gorsky State Agrarian University. – Vladikavkaz. 49 (44): 130-133.
13) Temiraev, R.B. Vityuk L.A., Ktsoyeva I.I., Karsanov M.D. 2015. Indices of natural resistance and peroxidation of lipids in poultry fed biologically active supplements withrations. Livestock of the South of Russia. - Krasnodar. 3-5: 25-30.
14) Tsalieva, L.V., Temiraev, R.B., Kononenko, S.I., Dzagurov, B.A., Gazzaeva, M.S. and S.A. Grevtsova, S.A. 2017. Ecological and consumer properties of pig meat from different breeds produced in technogenic zone. Journal of Pharmaceutical Sciences and Research. 9 (12): 2397-2400.
15) Vityuk, L.A., Baeva, A.A., Kochieva, I.V., Stolbovskaya, A.A., Kononenko, S.I., Yarmoc, A.V., Tletseruk, I.R., Bobyleva, L.A., Tsugkiev, B.G., Sattsaeva, I.K. 2017. Assessment of the productivity of broiler chicken sunder and the heavy metal detoxication in the context of industrial pollution. Pollution Research. 36 (4): 748-754.