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EFFICIENCY OF VARIOUS FEED ADDITIVES ON THE PERFORMANCE OF BROILERS TREATED WITH T-2 TOXIN

K. Nešić[1], R. Resanović[2], D. Jakić-Dimić[1], V. Nešić[2]

[1]Institute of Veterinary Medicine of Serbia, Belgrade, Republic of Serbia
[2]Faculty of Veterinary Medicine of Serbia, Belgrade University, Republic of Serbia
Corresponding author: ksenija_n@yahoo.com
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Abstract: Experiment was conducted on 160 one-day-old broiler chicks "Ross" provenientionduring 21 day. This research was done with the aim to investigate performances of broilers exposed to the relatively small amount of T-2 toxin (2 mg/kg) and the possibility of prevention and/or alleviating its adverse effects by using various feed additives. Results showed negative consequences of T-2 toxin on body weight, weight gain, feed:gain ratio. All used feed additives in the concentration of 0.2% in feed: inorganic (Minazel-plus, Mz) and organic (Mycosorb, Ms) adsorbents, as well as mixed adsorbent (Mycofix-plus, Mf) mostly alleviated negative effects of T-2 toxin.

Key words*:* T-2 toxin, broiler, performances, adsorbents

Introduction

Trichothecenes inhibit protein synthesis and from the pathological and immune point of view they are of extreme importance for poultry. When animals ingest relatively small amounts of T-2 toxin, clinical symptoms can miss and performances can remain unalterable during longer period. In this way toxin might be undiscovered although it causes subclinical changes that could be found at the pathomorphological examination.

A new approach to mycotoxin control is to alleviate and/or prevent harmful effects of mycotoxins in feed. Different feed additives are in use today which either adsorb mycotoxins on their surface or they provide enzyme degradation of mycotoxins. Efficacy of alleviating harmful effects depends mostly of chemical structure of adsorbent, as well as of the type of mycotoxin.

Adsorbents are substances nonresorbable from the gut which can physically bind some chemicals and thus block their resorption. Mineral adsorbents are commonly in use (active charcoal, hydrated sodium calcium aluminosilicate,

sodium bentonit, dietary clay and zeolites) *(Tomašević-Čanović et al., 2003)*. The feasibility of utilizing organic adsorbents is also examined, particularly esterified glucomanane which is isolated from the inner layer of yeast cell wall and which possesses significant capability of mycotoxin adsorption *(Devegowda et al., 2004)*. Recently a new type of additive is developed which contains microorganisms with the ability to inactivate mycotoxins by enzyme modification of its structure *(Fuchs et al., 2002)*.

The primary objective of this study was to overhaul the feasibility of alleviating and/or preventing decrease of performances in broilers exposed to T-2 toxin by utilizing different feed additives.

Materials and Methods

Pure T-2 toxin isolate, obtained in laboratory conditions by cultivation of *Fusarium sporotrichoides*, from 4 isolates: ITM-496, KF-38/1, M-1-1 i R-2301 (Bočarov-Stančić and Radošević, 1991) was used for feed contamination. It was used as ethil-acetate extract which was sprayed at certain amount of feed that was afterwards mixed into the rest of the feed necessary for whole experiment up to the level of 2 mg/kg T-2 toxin in feed. After the proper preparation of the feed samples the determination of the present amount of T-2 toxin was done using ELISA method (Barna-Vetro i sar., 1994). *Minazel-plus* (Modified clinoptilolite, ITNMS Beograd), *Mycosorb* (Esterified glucomanane, Altech, USA) and *Mycofix-plus* (Biomin, Austria) were added to the feed in the amount of 0,2%.

In vivo trial 21 day long was performed on 160 one-day old broiler chicks "Ross" provenientionof both sexes. Chickens were kept in floor system holding, on deep litter, in the thermoregulated and ventilated two separate rooms. Feed and water were provided ad libitum. Animals were divided into 8 experimental groups, each containing 20 broilers: O-I group: positive control, 2 mg/kg T-2 toxin without binders; O-II group: 2 mg/kg T-2 toxin + 0,2% Minazel-plus; O-III group: 2 mg/kg T-2 toxin + 0,2% Mycosorb; O-IV group: 2 mg/kg T-2 toxin + 0,2% Mycofix-plus; K-V group: negative control, free from T-2 toxin and additives; K-VI group: 0,2% Minazel-plus without T-2 toxin; K-VII group: 0,2% Mycosorb without T-2 toxin; K-VIII group: 0,2% Mycofix-plus without T-2 toxin. The chemical composition of feed mixture is shown in Table 1.

Table 1. Chemical composition of feed mixture

Protein [%]	Fat [%]	Moisture [%]	Ash [%]	Cellulose [%]	NEM [%]	Ca [%]	P [%]	ME [MJ/kg]
21.87	6.62	10.90	6.42	2.99	51.20	0.98	0.81	13.09

During the experiment, the production parameters (body weight, total and daily gain and feed consumption) were observed. Control measurements of experimental animals were carried out at the first and 21st day of experiment using an electronic balance with accuracy 10-2 g. Based on the obtained results average weight of chickens was calculated, as well as total gain and daily gain. Amount of feed for each group was measured throughout the trial. From the obtained data for the consumption of feed and the weight gain, feed conversion (feed:gain ratio) was also calculated.

Results and Discussion

From Table 2 it could be seen that the broilers had appropriate body weight for provenance at the beginning of the experiment and the differences in body weight (BW) among all experimental groups on the first day were not statistically significant ($p \geq 0.05$). The differences in average BW of broilers on 21st day of the experiment were clearly visible. Regarding weight gain of broilers of the control groups (K, K_{Mz}-VI, K_{Ms}-VII, K_{Mf}-VIII) no statistically significant differences ($p \geq 0.05$) between them were found. Statistically highly significant difference ($p \leq 0.01$) was observed between BW and weight gain of broilers of all control groups (K-V, K_{Mz}-VI, K_{Ms}-VII, K_{Mf}-VIII) and experimental groups that were given feed contaminated with T-2 toxin, as well with the addition of inorganic (Mz) and organic (Ms) adsorbent (O-I, O-II, O-III). Only in broilers of experimental group fed with the addition of mixed adsorbent (O-IV) this difference in respect to the control groups were smaller and at the significance level of $p \leq 0.05$. Statistically highly significant difference ($p \leq 0.01$) was observed among all control groups (K-V, K_{Mz}-VI, K_{Ms}-VII, K_{Mf}-VIII) and experimental group (O-IV) in which mixed adsorbent (Mf) was applied.

Table 2. Performances of broilers [g]

Groups	Body weight 1st day (X±SD)	Body weight 21st day (X±SD)	Weight gain 21st day (X±SD)	Feed consumption 21st day	Feed:gain ratio [g:g]
O-I	43.0±3.40	600.4±62.58	557.4±59.38	973.4	1.75
O-II	43.0±3.81	628.3±72.98	585.3±69.79	1039.5	1.78
O-III	43.0±3.28	627.3±62.07	584.3±59.51	1034.3	1.77
O-IV	43.0±4.28	662.5±54.68	619.5±50.55	1060.5	1.71
K-V	43.1±3.75	689.5±11.24	646.4±7.94	1085.7	1.68
O-I	43.0±3.40	600.4±62.58	557.4±59.38	973.4	1.75
O-II	43.0±3.81	628.3±72.98	585.3±69.79	1039.5	1.78
O-III	43.0±3.28	627.3±62.07	584.3±59.51	1034.3	1.77

Feed consumption during the experiment is also shown in Table 2. Control groups (K-V, K_{Mz}-VI, K_{Ms}-VII, K_{Mf}-VIII) consumed the usual amount of feed. Broilers that were given T-2 toxin (O-I, O-II, O-III, O-IV) consumed less feed, except that the broilers from O-I group, who did not receive absorbents and who had expressed necrotic changes in the oral cavity, consumed significantly lower amounts of feed compared to the corresponding control group of broilers (K-V) and to the other experimental groups received contaminated feed with absorbents (O-II, O-III, O-IV). In broilers of control groups K-V, K_{Mz}-VI and K_{Ms}-VII feed conversion was significantly lower ($p \leq 0.05$) than in broilers of experimental groups that received T-2 toxin without adsorbent (O-I) or with present inorganic (O-II) and organic adsorbent (O-III). Broilers of O-IV group, who got mixed adsorbent in addition to T-2 toxin in feed achieved a better feed conversion, which was slightly higher than feed conversion of broilers of appropriate control group (K_{Mf}-VIII).

Decrease of body weight in poultry was noted by many authors when the T-2 toxin was involved in the feed at a concentration of 2 to 6 mg/kg, while the same parameters were not reduced in broilers that received in feed 1 mg/kg T-2 toxin *(Chi et al., 1977; Doerr et al. 1981; Raju and Devegowda, 2000; Diaz et al., 2005; Girish and Devegowda, 2006)*. Lesions in the mouth, which were noted in chickens who received 2 mg/kg T-2 toxin without adsorbents obviously effected body weight and other production parameters. Feed refusal is very specific symptom of poisoning with T-2 toxin, and it is caused by changes in the oral cavity and mucosa of the small intestine, which leads to loss of body weight *(Ueno,1977)*.

Application of inorganic adsorbent Minazel (Mz) gave the results which were partially in accordance to studies of *Fazekas et al. (2000)* and *Casarin et al. (2006)* who also, in conditions of low concentrations of T-2 toxin (1.25 and 1 mg/kg feed), found some protective effects of HSCAS as inorganic adsorbent. On the other hand, there are studies which demonstrated that the efficiency of aluminosilicates in adsorption of trichothecenes was practically zero *(Kubena et al., 1998)*. Application of zeolites and other aluminosilicates is very effective in preventing aflatoxicoses and other polar mycotoxins, but their effectiveness on zearalenone, trichothecenes and ochratoxin is very limited. Moreover, aluminosilicates exhibit some negative effects that are reflected in a high degree of adsorption of vitamins and minerals *(Huwig et al., 2001)*.

The results obtained by the organic adsorbent Mycosorb (Ms) are not fully in line with studies of *Raju and Devegowda (2000, 2002)*, *Denli and Okano (2002)*, *Aravind et al. (2003)*, *Girish and Devegowda (2006)* where the esterified glucomannan shown to be very effective in preventing the harmful effects of T-2 toxin in broiler chickens. The achieved production results indicate that the addition of Mycosorb did not completely prevent harmful effects of T-2 toxin because body weight, daily gain and feed consumption were significantly lower and feed:gain ratio was significantly higher than the corresponding control group (K_{Ms}-VII), what is in accordance to studies of other authors *(Dvorska and Surai, 2001; Diaz et al., 2005)*.

Conducted trial confirmed the results obtained by other researchers who have performed tests with Mycofix in which the adverse effects of trichothecenes were almost completely neutralized *(Garcia et al., 2003; Diaz et al., 2005; Cortyl and Heidler, 2006)* . It is obvious that during its metabolism, BBSH 797 as part of MP produces enzymes, de-epoxydases, which degrade trichothecenes by selective destruction of their toxic-epoxy group 12:13. As it is well known that the epoxy-trichothecene 12:13 ring is responsible for its toxicity, the addition of specific enzymes (de-epoxydase) consequently leads to a significant reduction in toxicity. In this way, T-2 toxin inactive transforms to de-epoxy-HT-2 toxin by deacetylation, through intermediate HT-2 toxin *(Fuchs et al., 2002)*.

Conclusion

According to the obtained results of examination of efficacy of various feed additives on the performance of broilers treated with T-2 toxin it could be concluded:

A significant decline in the value of broiler performance, which were given T-2 toxin at a concentration of 2 mg/kg feed, were typical of T-2 toxicosis.

The best results in alleviating the harmful effects of T-2 toxin were obtained using a mixed adsorbent (Mf). Partial protective effects were noted in broilers of experimental groups in which inorganic (Mz) or organic (Ms) adsorbent was added to feed.

Performance of broilers in control groups, which were given tested additives (K_{Mz}-VI, K_{Ms}-VII and K_{Mf}-VIII), did not differ from the control group of broilers where these additives were not present (K-V).

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Ispitivanje efikasnosti različitih dodataka hrani za životinje na proizvodne rezultate brojlera tretiranih T-2 toksinom

K. Nešić, R. Resanović, D. Jakić-Dimić, V. Nešić

Rezime

Rezultati istraživanja, koje je urađeno sa ciljem da se ispitaju proizvodni rezultati brojlera izloženih relativno malim količinama T-2 toksina (2 mg/kg), kao i i mogućnost sprečavanja i/ili ublažavanje njegovih štetnih posledica posledice

upotrebom različitih dodataka hrani za životinje, pokazali su negativne posledice T-2 toksina na telesnu masu, prirast i konverziju hrane. Svi primenjeni dodaci u koncentraciji od 0,2% u hrani: neorganski (Minazel plus, MZ), organski (Mycosorb, MS), kao i mešoviti adsorbens (Mycofix plus, MF) najvećim delom su ublažili negativne efekte T-2 toksina. Pa ipak, kao najefikasniji pokazao se mešoviti adsorbent. Naime, očigledno je da tokom svog metabolizma BBSH 797, kao sastavni deo Mycofix-a, proizvodi enzime de-epoksidaze koji degradiraju trihotecene selektivnim uništavanjem njihove toksične 12,13-epoksi grupe. Kako je poznato da je 12,13-epoksi prsten trihotecena odgovoran za njegovu toksičnost, dodavanje specifičnih enzima (de-epoksidaza) posledično dovodi i do značajnog smanjenja toksičnosti. Na ovaj način je mešoviti adsorbent najviše ublažio štetno dejstvo T-2 toksina na proizvodne rezultate brojlera.

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