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INFLUENCE OF FEED SUPPLEMENTATION WITH PLANT-MINERAL PREPARATION DETOXIN-V® ON THE BROILER PERFORMANCES

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Abstract

The aim of this trial was to get more detailed insight into health status and performance and investigate the possibilities of prevention of detrimental effects of mycotoxins in feed by the use of plant-mineral preparation for detoxification of animals Detoxin-V®. The study was performed on 100 one day old Cobb provenience broilers of both sexes with average body mass of 40 g. The study lasted 42 days and was divided into 3 phases that lasted 14, 21 and 7 days, respectfully. The broilers were randomly assigned to one of two treatment groups. First group of broilers was given complete feed mixture which was composed of mouldy corn grain with no Detoxin-V® supplemented; second group of broilers was given same complete feed mixture with Detoxin-V® supplemented. Body mass, daily gain, amount of consumed feed and feed efficiency of broilers were monitored. At the end of the study control group of broilers have achieved lower average daily gain (49.95 g), ($p>0.05$) than the gain achieved in the experimental group of broilers (56.02 g). The group of broilers which feed was supplemented with 0.5% of Detoxin-V® had consumed higher amount of feed (100.65g) compared to the control group (94.92g). Also feed efficiency of experimental groups of broilers was better than the feed efficiency of control group of broilers during all phases of the study. The use of Detoxin-V® preparation has doubtlessly lead to the increase in immune defence and resistance of the animals exposed to the permanent negative effect of feed mycotoxins, which lead to increased

production results of experimental group of broilers. Based on these results we can conclude that the use of Detoxin-V® preparation in broiler nutrition has its nutritive, medical and economic rationale.

Key words: *Detoxin-V®, Broilers, Mycotoxins, Prevention, Production.*

Introduction

Mycotoxins are secondary metabolites produced by filamentous fungi that cause a toxic response (mycotoxicosis) when ingested by higher animals. *Fusarium*, *Aspergillus*, and *Penicillium* are the most abundant moulds that produce these toxins and contaminate human foods and animal feeds through fungal growth prior to and during harvest, or during (improper) storage (Bhatnagar *et al.*, 2004). For practical consideration in the feed manufacturing process aflatoxins, trichothecenes, zearalenone, ochratoxins, and fumonisins are of particular interest, though the extent of harm each toxin (group) can cause is highly species-dependant (Binder, 2007). In the mid 1980s the topic of conjugated or masked mycotoxins received attention, because in some cases of mycotoxicoses, clinical observations in animals did not correlate with the low mycotoxin content determined in the corresponding feed. The unexpected high toxicity was attributed to undetected, conjugated forms of mycotoxins that hydrolyse to the precursor toxins in the digestive tract of animals. As part of their metabolism, plants are capable of transforming mycotoxins into conjugated forms (Berthiller *et al.*, 2005a,b). So far, natural occurrence of a zearalenone glucoside (Schneweis *et al.*, 2002) and deoxynivalenol glucoside (Berthiller *et al.*, 2005a,b) have been reported. Gareis *et al.* (1990) demonstrated that zearalenone-4-beta-d-glucopyranoside was decomposed during digestion, releasing zearalenone into the animal gut. As zearalenone-glycoside is not detected during routine analysis, but is hydrolysed during digestion, it seems likely that masked mycotoxins may contribute to cases of mycotoxicoses (Binder, 2007). Various mycotoxins may occur simultaneously, depending on the environmental and substrate conditions. Considering this coincident production, it is very likely, that humans and animals are exposed to mixtures rather than to individual compounds (Binder, 2007).

The losses occur due to impaired health as well as to decreased production performances. The economic costs of mycotoxins are impossible to be determined accurately, but the US Food and Drug Administration (FDA) provided estimations based on a computer model. In the US alone the mean economic annual costs of crop losses from the mycotoxins aflatoxins, fumonisins, and deoxynivalenol, were estimated to be USD 932 million (Cast Report, 2003).

Management practices to maximize plant performance and decrease plant stress can decrease mycotoxin contamination substantially. This includes planting

adapted varieties, proper fertilization, weed control, necessary irrigation, and proper crop rotation (Ewards, 2004). But even the best management strategies cannot eliminate mycotoxin contamination in years favourable for disease development.

For post-harvest mycotoxin control prevention of conditions that favour fungal growth and subsequent toxin production needs to be considered, *i.e.* factors such as water activity of stored products, temperature, grain condition, gas composition of the intergranular air, microbial interactions, and presence of chemical or biological preservatives (Shapira and Paster, 2004). Although certain treatments have been found to reduce the levels of specific mycotoxins, no single method has been developed that is equally effective against the wide variety of mycotoxins which may occur together in various commodities (Shapira and Paster, 2004). The most commonly used strategy of reducing exposure to mycotoxins is the decrease in their bioavailability by the inclusion of various mycotoxin binding agents or adsorbents, which leads to a reduction of mycotoxin uptake and distribution to the blood and target organs. Various substance groups have been tested and used for this purpose, with aluminum silicates, in particular clay and zeolitic minerals, as the most commonly applied groups. Fröschl *et al.* (2000) investigated the aflatoxin-binding capacities of a large number of different aluminum silicates in relation to their physic-chemical properties. The tested materials were classified as bentonites (calcium bentonites, sodium bentonites, organophilic (modified) bentonites, acid-treated bentonites, as well as some special forms), zeolithes, diatomites, and vermiculites. Most minerals tended to show higher adsorption of aflatoxins at higher pH levels, with sorption by vermiculites and zeolites being the most sensitive to pH alteration. No correlation could be found between the cation exchange capacity and sorption of aflatoxins, while high specific surface and micro-pore volumina seemed to be related to better binding properties. Criteria considered important in the evaluation of potential mycotoxin binders are the stability of the sorbent-toxin bond, in order to prevent desorption of the toxin, as well as their effectiveness within a broad pH level since a product must work throughout the gastro-intestinal tract. Galvano *et al.* (2001) reviewed dietary strategies to counteract the effects of mycotoxins, covering additional aspects such as antioxidants or plant ingredients as possible protectants. Among all aluminosilicates tested with regard to mycotoxin adsorption, hydrated aluminosilicate (HSCAS) have been the most extensively studied and described, in particular because of their promising aflatoxin binding capacity (Phillips *et al.*, 1988; Harvey *et al.*, 1989). Recently, a novel product Detoxin-V® (Grand Eko Agrar, Belgrade, Serbia) was introduced with a purpose of mycotoxin decontamination. In that light study was designed to test the efficacy of this product. The main aim of this study was to get more detailed insight into health status and performance and to investigate the possibilities of prevention of

detrimental effects of mycotoxins in feed by the use of plant-mineral preparation for detoxification of animals Detoxin-V®.

Material and methods

The study was performed on a registered broiler farm of Mijatović Aleksandar in Stara Pazova. For the trial 100 one day old broilers of both sexes with average body mass of 40 g, Cobb provenience was used. The study lasted 42 days and was divided into 3 phases that lasted 14, 21 and 7 days, respectfully. Broilers were fed complete mixtures (produced on the farm) with different chemical composition according to the age of animals. Three mixtures of standard raw material composition which have completely satisfied the needs of broilers in different age: from 1st to 14th (starter), from 14th to 35th (grower) and from 35th till 42nd (finishing feed). All animals were fed *ad libitum* and have had unlimited access to clear drinking water.

The broilers were randomly assigned to one of two treatment groups (by 50 animals each group). First group of broilers (the control group) was given complete feed mixture which was composed of mouldy corn grain with no Detoxin-V® supplementation. Second group of broilers (the experimental group) was given complete feed mixture (containing mouldy corn grain) with Detoxin-V® added in the amount of 5 kg/T of complete feed mixture.

Body mass of broilers was measured on a technical scale on the begging and then in predicted intervals until the end of the study. On a basis of measurement results average body mass of broilers on the end of each phase as well as on the beginning and the end of the study was calculated. From the difference in body mass on the beginning and on the end of the study, complete gain was calculated, and on the basis of different phase and study duration daily gain was obtained. During the study, in predicted intervals, amount of consumed feed in each group was measured. On a basis of the data's of consumed feed and gain feed efficiency (feed conversion ratio) for each phase and all study was calculated. Health status of all animals as well as mortality rate were monitored throughout the study (all 42 days).

Feed basic chemical composition was determined by the modified Weende procedure, while for the detection of mycotoxins in feed thin layer column chromatography was used.

All results were grouped in appropriate statistical series and processed by mathematical-statistical methods (descriptive statistics and T-test) in Stat View and MS Excel 07.

Results

Microbiological analyses of feed mixtures for experimental group of broilers contained saprophytic microorganisms in following amount:

	Bacteria (per gram of feed)	Fungi (yeast and moulds) (per gram of feed)
PT-1-starter feed	800000.00	60000.00
PT-2-grower feed	900000.00	70000.00
PT-3-finishing feed	1,100000.00	65000.00

Determined number of fungi in all three feed mixtures was above the one regulated by Serbian Rule Book (Official Gazette of RS/Sl. Glasnik RS 4/10).

Mycotoxicological analyses have shown that feed mixtures used for feeding broilers in this study contained mycotoxins in following amounts:

	Aflatoxin (mg/kg)	Zearalenone (mg/kg)	Ochratoxine (mg/kg)
PT-1-starter feed	0.060	0.100	0.030
PT-2-grower feed	0.040	0.150	0.025
PT-3-finishing feed	0.040	0.100	0.025

All three feed mixtures used in this study have contained higher amount of Aflatoxin than the one provided by Serbian Rule Book (Official Gazette of RS/ Sl. Glasnik RS 4/10).

A change of body mass of broilers during phases is shown in *Table 1.*

Table 1.- *Average body mass of broilers during study (g)*

	Days of the study		
Group	**1st to 21st**	**21st to 42nd**	**1st to 42nd**
Control	39.46±2.10	769.00±70.78	2.138.00±499.3
Experimental	40.02±2.42	736.10±107.2	2.393.00±254.1

On the beginning of the study, all animals had appropriate body mass for provenience which was evenly distributed between control and experimental group. At the end, 42nd day of the study average body mass of experimental group of broilers fed diet containing Detoxin-V® preparation was 2.393.00±254.1 g and was higher than a body mass of the control group of broilers (2.138.00±499.3 g), with a not that determined differences were not statistically significant ($p<0.05$).

Table 2. - *Average daily gain of broilers during study (g)*

	Days of the study		
Group	**1st to 21st**	**21st to 42nd**	**1st to 42nd**
Control	34.74	65.19	49.95
Experimental	33.15	80.81	56.02

Average daily gain of broilers of experimental group (*Table 2.*) was in borders predicted by technological normative. At the end, 42nd day of the study control group of broilers have achieved lower daily gain (49.95), which was not statistically significant ($p>0.05$) than the gain achieved in the experimental group of broilers (56.02) where feed was supplemented with Detoxin-V®.

Table 3. - *Average consumed amount of feed of broilers during study (g)*

	Days of the study		
Group	**1st to 21st**	**21st to 42nd**	**1st to 42nd**
Control	61.82	128.01	94.92
Experimental	57.38	143.93	100.65

Daily consumed amount of feed is shown in *Table 3.* where it can be seen that control and experimental group have consumed usual amounts of feed. Summarizing the whole study the experimental group of broilers which feed was supplemented with 0.5% of Detoxin-V® had consumed higher amount of feed (100.65g) compared to the control group of feed (94.92g).

Table 4. - *Feed efficiency of broilers during study (g)*

	Days of the study		
Group	**1st to 21st**	**21st to 42nd**	**1st to 42nd**
Control	1.78	1.93	1.90
Experimental	1.73	1.78	1.80

Feed efficiency (feed conversion ratio) as a ratio of daily gain and amount of daily consumed feed is shown in *Table 4.* where it can be seen that feed efficiency of experimental groups of broilers (supplemented Detoxin-V®) in was better than the feed efficiency of control group of broilers during all phases of the study.

Discussion

Mycotoxins are a chemically diverse group of fungal metabolites that have a wide variety of toxic effects. Where action is necessary to detoxify contaminated materials, the choice depends on a consideration of the mycotoxins and species involved, in order to secure safety and performance of the farm animals in general and the whole food chain in particular. The addition of feed additives, based on adsorptive and, more recently, enzymatic modes of action, are widely used strategies to reduce mycotoxin-induced performance impairment. Detoxin-V® contains extracts of *Cynara cardunculus subsp. Scolymus, Helichrysum italicum* and *Silybum marianum*. Besides it contains modified zeolite and activated

charcoal (*Carbo medicinalis*). The addition of Detoxin-V® positively influenced average daily gain and feed efficiency. These can be attributed to the fact that flavones present in preparation exhibit positive effects. Galangin, a member of flavonol class of flavonoid, present in honey, *Alpinia officinarum*, *Helichrysum aureonitens* and in propolis (Natural composite balsam produced by honeybees from the gum of various plants) (Patel *et al.*, 2012). Galangin showed various pharmacological activities such as anti-mutagenic, anti-clastogenic, anti-oxidative, radical scavenging, metabolic enzyme modulating and anticancer activity. Galangin prevented rise in plasma glucose, insulin and triglycerides and improved insulin sensitivity, however, treatment with galangin down regulated the expression of these cytokines. Translocation of NF-kappa B into the nucleus was also increased in fructose diet-fed animals, which was prevented by galangin (Sivakumar and Anuradha, 2011). Activated charcoal can adsorb and decrease bioavailability of phytochemicals in the gastrointestinal tract through the interaction of its positively charged surface with negatively charged toxins, allowing them to be excreted in the faeces, and therefore van prevent detrimental effect of toxins (Poage *et al.*, 2000).

Conclusion

Obtained results show that the broilers of experimental group, which were feed by mixtures supplemented with plant-mineral preparation Detoxin-V®, have achieved better production results (higher gain, better feed efficiency) compared to the control group. The use of Detoxin-V® preparation has doubtless lead to the increase in immune defence and resistance of the animals exposed to the permanent negative effect of feed mycotoxins, which lead to increased production results of experimental group of broilers. Based on these results we can conclude that the use of Detoxin-V® preparation in broiler nutrition has its nutritive, medical and economic rationale.

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