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Research Article

Supplementation of Toxin Binders in Broiler to Study its Performance

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Abstract

Toxin generally refers to the metabolite products that are either produce from the fungus and molds, bacteria and virus. Molds are present throughout the environment. They are filamentous fungi that occur in many feedstuffs like grains and forages. Some molds can produce mycotoxin and can be formed on crops in the field, during harvest, or during storage, processing or feeding.

Keywords: Toxin Binders; Broiler; Mycotoxin

Introduction

Mycotoxin can cause a toxic response or mycotoxicosis in animals that consumed mycotoxin-contaminated feeds. Significant economic losses due to the presence of mycotoxin are associated with their impact on animal productivity, human health, and both domestic and international trade. According to Food and Agriculture Organization (FAO), it is estimated that 25% of the world's food crops are affected by fungi that produce mycotoxin. Global losses of foodstuffs due to mycotoxins are estimated to be in the range of 1000 million tons per year [1]. Mycotoxins are produced by fungi during growth, handling and storage of agricultural commodities. The diversity of the chemical structures of mycotoxins accounts for their different biological effects. In broilers, the presence of mycotoxins can result in decreased performance, poor feed conversion, feed refusal, diminished body weight gain, reproductive disorders, immune suppression, and residues in animal food products. Increasing number of reports on mycotoxin contamination in feeds has given rise to a demand for practical and economical detoxification procedures, though only a few have real practical application. One way to reduce uptake of mycotoxin is the use of mycotoxin binding agents [2].

Objective

General objectives

To improve the performance in broiler production through inclusion of toxin binder.

Specific objective

- To determine the effects of supplementation of different toxin binders (TB) on aflatoxin-contaminated diets on the performance of broilers.
- To determine the effects of TB on growth performance (body weight).
- To determine the dressing percentage and relative weights of internal organs (liver) of broilers.
- To determine the serum total protein, total albumin and to tal globulin level.

Material and Methods

Time and Place of Study

The feeding trial will be conducted at the Institute of Agriculture and Animal Science, Tribhuwan University, Bhairawaha from January 2015 to March 2015.

Experimental Design and Birds

A total of 200-day-old chicks will be used in the study. The chicks will be randomly distributed in deep litter system with 10 chicks each and randomly distributed to 4 treatments following a completely randomized design (CRD). Each treatment will be replicated 5 times with 10 chicks per replicate. Dietary treatments as follows: The dose of toxin binders will be used according to standard dose as recommended.

Treatment Description

1. Basal/control diet without toxin binders.
2. Treatment diet with toxin binder type 1 (activated charcoal based).
3. Treatment diet with toxin binder type 2 (dipolar phyllosilicates).
4. Treatment diet with toxin binder type 3 (hydrated sodium calcium aluminosilicate).

Management Procedure

Prior to the arrival of the chicks, broiler house, feeders and waterers will be cleaned and disinfected. Upon the arrival of the day-old chick, they will be group-brooded and fed with chick booster for 7 days. On the 7th to 21st day, the birds will be given the broiler starter, followed by broiler finisher diet (experimental diet) until 45 days of age. Diets will be made available in mash form. Clean drinking water will be provided regularly. Artificial light was provided to allow birds to eat and drink at night. The birds will be vaccinated against New Castle Disease (NCD) at the 7th day and La Sota strain on 21st day. The same management practices will be provided for all the treatments throughout the feeding period.

Data collection

Performance Parameters

Body weight and weight gain

The live weight of the broilers at 42nd (final) day will be determined and recorded on a lot basis. Average body weight for each replicate will be determined by dividing group weight by the number of birds in each lot.

Dressing percentage

At the end of the feeding trial, a representative bird from each replicate of each treatment will be randomly selected for the determination of dressing percentage. Dressing percentage (without giblets) will be determined by dividing the dressed weight by the live weight of the bird multiplied by 100.

Relative weights of the internal organs

The internal organs (liver) of the representative chicken will be 40 individually weighed. The relative weights of each internal organ will be determined by dividing their weight by the live weight of the bird multiplied by 100.

Total Protein, Albumin and globulin amount: Around 20 birds will be taken randomly from each treatment group. The blood serum will be taken for analysis for the total protein albumin and globulin determination. The ratio of albumin and globulin will also be calculated from obtained data.

Statistical Analysis

The obtained data was calculated by using SPSS (statistical package for social science) and will interpret and analysis the result accordingly. CRD (completely randomized design) will be used in SPSS package.

Results and Discussion

The relation between final weight and dressing weight is strongly correlated (r = 0.976) which is significant at 0.01 level. The relation between level of alanine and total protein level is strongly correlated (r = 0.616) which is significant at 0.01 level. Also, there exists strong positive correlation between level of globulin and total protein (r = 0.924). However, there is moderate positive correlation between weight before the test and the final weight (r = 0.390). The mean initial weight among birds in different treatment do not differ significantly (p-value = 0.894) at 5% level of significance. This signify the selection of birds to be homogeneous. The mean final weight among different treatment vary significantly (p-value = 0.008) at 5% level of significance. Duncan Multiple Range Test is used to find the mean weight that differs significantly among the four treatments. DMRT shows that the mean final weight of control group is significantly lower than that of other treatments. This shows use of various toxin binder affects significantly in final weight gain. The mean final weight of the birds is highest in groups that were treated with dipolar phyllosilicate followed by groups treated with HSCAS and activated charcoal. However, the effect of different toxin binder is statistically non-significant. The mean dressing weight among different treatment vary significantly (p-value = 0.002) at 5% level of significance. The mean dressing weight for group 1; 2; 3 and 4 is 1192.0 gm, 1358.0 gm, 1500 gm and 1525 gm respectively. Duncan Multiple Range Test is used to find the mean weight that differs significantly among the four treatments. DMRT shows that the mean final weight of control group is significantly lower than that of treatments 3 and treatment 4 and is alike with treatment 2. This shows use of dipolar phyllosilicate and HSCAS toxin binder affects significantly in dressing weight. The dressing yield of the birds is highest in groups that were treated with dipolar phyllosilicate followed by groups treated with HSCAS and activated charcoal. However, the effect of different toxin binder is statistically non-significant. The mean dressing weight among different treatment vary significantly (p-value = 0.002) at 5% level of significance. The mean dressing weight for group 1; 2; 3 and 4 is 1192.0 gm, 1358.0 gm, 1500 gm and 1525 gm respectively. Duncan Multiple Range Test is used to find the mean weight that differs significantly among the four treatments. DMRT shows that the mean final weight of control group is significantly lower than that of treatments 3 and treatment 4 and is alike with treatment 2. This shows use of dipolar phyllosilicate and HSCAS toxin binder affects significantly in dressing weight. The dressing yield of the birds is highest in groups that were treated with dipolar phyllosilicate followed by groups treated with HSCAS and activated charcoal. However, the effect of different toxin binder is statistically non-significant. The mean level of total protein among different treatment do not vary significantly (p-value = 0.486) at 5% level of significance. The mean level of total serum protein for group 1; 2; 3 and 4 is 4.35, 4.10, 4.48 gm and 4.66gm respectively. The level of serum total protein (TP) is highest in group treated with HSCAS followed by group treated with dipolar phyllosilicate and control group and lowest in group fed with activated charcoal.

The mean level of total serum Albumin among different treatment do not vary significantly (p-value = 0.671) at 5% level of significance. The mean level of serum albumin for group 1; 2; 3 and 4 is 1.97, 1.71, 1.83 and 2.17 respectively. The level of serum albumin level is highest in group treated with HSCAS and lowest in group fed with activated charcoal.

The mean level of total serum Globulin among different treatment do not vary significantly (p-value= 0.257) at 5% level of significance. The mean level of serum albumin for group 1; 2; 3 and 4 is 2.474, 2.530, 2.860 and 2.868 respectively. The level of serum total globulin level is highest in group treated with dipolar phyllosilicate and lowest in control group.

Discussion and Summary

Average Body Weight

In the initial phase there was no significant difference in the weight assigned to the different treatment group. This indicate homogeneity in the experiment units. At the end of the finisher and starter period growth was not found to have normal growth. Many factors could have affected the behavior and performance of broilers during the feeding trial. But since the broilers were of similar breed, housed in the same house, experienced the same weather condition, experienced same management procedures but given different diets, the treatment effects were considered based on the differences in the performance of the broilers.

At the end of the research the broiler feed without out toxin binders (control diet) had a significant poor body weight. There was not so much difference in broiler weight that are fed with different toxin binders. At the end of the feeding trial, broiler feeding with control diet shows poor performance and had low body weight as compared to the other treatment group. Broiler feed with different types of toxin binders had body weight that was somewhat statistically similarly with each other. The toxin binders present in the broiler feeds would have counteract the effect of the aflatoxins on the body weight of the broilers.

In case of chronic mycotoxicosis we can see reduced feed intake, impaired nutrient utilization with depressed in the body growth uptake and subsequent distribution of the toxins to target organs [3]. When we add toxin binders in the broiler feeds it prevent uptake and subsequent distribution of the toxins to target organs [4].

Average Body Weight Gain

In the starter period, body weight gain of birds fed without the toxin binders was significantly lesser than the gain of broilers given other treatments. Growth rate of broilers fed diets with TB was not different from GC-fed broilers. Growth rate of broilers fed with different types of toxin binders shows do difference in the initial phase.

During the finishing period, broilers fed without the toxin binders also had a smaller gain in body weight compared with toxin binders in feeds. The phyllosilicate-based toxin binder show well performance among the activated charcoal based and hydrated aluminio-silicate based toxin binders. Overall period showed that broilers fed without toxin binder had a significantly poorer body weight gain compared to birds fed other treatments. The response of birds fed among different types of toxin binders on the weight gain was more or less statistically similar. This only indicates that adding the aflatoxin-contaminated diet with TB was able to prevent adverse effects of aflatoxicosis on the body weight gain of broilers.

In other studies, done, only the work of Solis [5] reported a significant difference in the body weight gain of broilers with the use of toxin binders in the broiler feeds. Studies done by Oguza., *et al.* [6] and Ali., *et al.* [7] reported a significant decrease in body weight gain of broilers after feeding diet with 100 ppb aflatoxin for 42 and 35 days, respectively, compared with aflatoxin-free diet. Aflatoxins interfere with the 49 normal metabolic pathways by inhibiting protein synthesis and enzyme system involved in carbohydrate metabolism and energy release, thus affecting the normal rate of growth for broilers [7]. However, Giambrone., *et al.* [8] stated in their study that weight gain of broilers was not affected by feeding aflatoxin up to 200 ppb. Another experiment done by Giambrone., *et al.* [9]. reported that dietary aflatoxin contamination between 100 and 800 ppb had no significant effect on body weight gain of broilers. Huff [10] observed that aflatoxin concentration below 2.5 ppm had no adverse effect on growth of broiler chicks. These differences in the body weight gain response could be due to differences in the origin of aflatoxin used.

Aflatoxins used in experiments could originate from cultured materials, naturally contaminated feed or purified aflatoxin. In addition to this, inconsistent responses observed across studies could also be affected by different exposure periods to the toxin applied, different amount of contaminated materials added in the diet, physical condition, health status of the animal, number of replications used in the studies, method of sampling used, and the existence of large within-group variation like differences in the responses between animals. Animal responses can be influenced by factors like species, sex, age, health status, nutritional balance and hormonal status of the broilers used [11].

Dressing Percentage

The result shows that the control group without toxin binders had the least dressing percentage among the treatment group. Susceptibility of the toxin binders in the broiler varies with the bred strain, age, nutritional status, amount of toxin intake, and capacity of liver microsomal enzymes to detoxify aflatoxin [12]. It could be that during sampling, the chickens selected for this treatment were the ones susceptible to the effect of toxin and also had aflatoxin level beyond the limits set for animal consumption. Thus, a reduction in the average dressing percentage for GC-fed broilers was obtained.

Comparing the dressing percentage of broilers fed with different types of toxin binders shows no significant difference. Broilers exposed to aflatoxin have decreased dressed weight due to a lesser fat and protein in the carcass [13]. Thus, the result for dressing percentage of broilers in this study was inconsistent from the results in the literature. It was probable that the level of aflatoxin in this study was low for the effect on dressing percentage to be manifested. Different treatments showed no difference in the relative weights of small intestine, gizzard, liver, pancreas, spleen and proventriculus. The weight of these organs was not affected by the presence of molds in the diet. The level of aflatoxin for this study was not high enough to cause a change in relative weights of the mentioned organs. Different studies had been done in the past that liver is the target organ for aflatoxicosis. An increase in the liver weight was observed by different authors [14-16]. This change in the size of the liver was due to lipid accumulation [16]. However, in this study, the organ most susceptible to the aflatoxin was not affected and was not different among treatments.

For the relative weight of the heart of broilers, the result was inconsistent from literatures. There was a significant reduction in the weight of the heart of broilers when fed MC. Other studies reported an increase in the weight of heart when broilers were fed high aflatoxin diet. Stanley., *et al.* [17] fed diet with 5 ppm aflatoxin while Kubena., *et al.* [18] fed 3.5 ppm aflatoxin and both studies had observed an increase in the relative weight of heart. Since the liver was not affected, it was probable that the difference observed in the heart weight was a sampling error and not an aflatoxin effect. The level of aflatoxin used for this study was below 1 ppm and thus, effects on the relative weights of internal organs were not manifested.

The total protein concentration in blood was 18% lower ($P < 0.05$) in broilers challenged by aflatoxins compared with that of the unchallenged ones.

Total Proteins, Total albumin and Total globulin Level

The overall study of total protein level, albumin and globulin level was found to be somewhat normal in 3 different normal condition. But the level of the proteins was not found below normal range. Feeding a diet contaminated with high levels of mycotoxins (experimental 2) resulted in decreased plasma potassium, magnesium, total protein, albumin, triglycerides, free glycerol concentrations and increased plasma ALP, alanine aminotransferase (ALT) and AST enzyme activities. The total protein concentration in blood was 18% lower ($P < 0.05$) in broilers challenged by aflatoxins compared with that of the unchallenged ones. The acute toxicosis decreased body weight, serum alpha-amylase activity, total protein, and albumin; whereas, serum beta-glucuronidase activity and the coefficients of variation for each parameter were increased. Correlations between measurements made prior to dosing and parameters reflecting aflatoxin susceptibility were not significant.

Conclusion and Recommendation

1. The toxin binders must be used either in poultry feeds or in another animals feed. The research shows that the broiler feds without toxin binders in feeds shows poor performance as compared to toxin binders mixed feeds. As animals are usually provided low and less quality feed prepared from inferior feed ingredient that are not used for human consumption toxin binders help to bind different toxins present in the feeds and prevent absorption in the body system.
2. There are several types of toxin binders available and many toxin binders are still in research. In my research toxin binders from phyllosilicate shows best performance among activated charcoal based, hydrated sodium aluminosilicate. I personally do not recommend the use of phyllosilicate-based toxin binders as the research was done in limited birds with less replication and less treatment.
3. The research which i have conducted will be pathway for other researcher who are interested to explore more about the benefit of toxin binders.

4. The research must be done on different types of toxin binders based on the different region and species and bred variation. The research success in tropics region may not be feasible in another belt.
5. Nutrient composition of each feed ingredient must be found so that we can find changes on nutritional effect caused by moulds and their toxins.
6. Furthermore, research should be conducted in the toxin binders in different animal species and confirmed only to poultry industry. More publication should be done to emphasis on use of toxin binders so that the feed industry knows about the importance of toxin binders in the feeds.

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