Effect of Feeding Different levels of Aflatoxin in the Diets on Production Performance of Broiler Breeders

Milad Manafi

Department of Animal Science, Chaloos Branch, Islamic Azad University, Chaloos, Iran.

ABSTRACT

A study was conducted to investigate the effect of feeding diets containing different levels of aflatoxin B_1 (AF) viz., 0, 300, 400, and 500 ppb on the performance of broiler breeders. The breeder hens aged 28 weeks were fed with four treatment diets: Control (0 ppm), (300 ppb), (400 ppb) and (500 ppb) for three periods, each with a duration of three weeks from 28 to 36 weeks of age. Feeding of AFB_1 at 300 and 400 ppb did not reveal any significant changes in the performance. However, Inclusion of 500 ppb AF in the diet significantly (P ≤ 0.05) reduced feed consumption, feed efficiency, egg production, fertility and hatchability. The results indicated no significant (P ≥ 0.05) effect of AF on body weight of breeders.

Key words: Aflatoxin, Broiler breeder, performance.

Introduction

Cereal grains and their by-products constitute an important source of energy for poultry. There is an increasing evidence that global supplies of cereal grains for animal feedstuffs are commonly contaminated with mycotoxins especially the aflatoxins. Aflatoxins are secondary toxic metabolites produced by certain strains of fungi, more frequently by Aspergillus flavus and Aspergillus parasiticus species. Aflatoxin B_1 (AFB_1), the most toxic of all aflatoxins (AFB_1, AFB_2, AFG_1 and AFG_2), is produced by certain strains of fungi in greater quantities than in others. The presence or production of aflatoxins in agricultural commodities depends on many factors, including the time and methods of harvesting, and storing and transporting conditions. Their toxicity in animals depends on different factors including the concentration of aflatoxin, the duration of exposure, the species, gender and age and immune status of animals [25]. The effects of AF exposure include poor growth and feed conversion, increased mortality, decreased egg production, leg problems, and carcass condemnations in poultry [35,13,16] resulting in economic loss of poultry farmers. The objective of the current experiment was to study the effects of graded levels of aflatoxin on performance and production parameters of broiler breeders.

Materials and Methods

Forty-eight 28-wk-old broiler breeder hens and eighteen 28-wk-old broiler breeder cocks of a commercial strain were weighed and randomly assigned to individual cages, in a Completely Randomized Design manner forming a total of 4 dietary treatments with 3 replicates consisting 4 birds per replicate in each group.

AF was produced using the pure culture of Aspergillus parasiticus MTCC 411 (Source: Microbial Type Culture Collection and Gene Bank, IMT, Chandigarh, 160 036, India) grown on potato dextrose agar. Then the AF produced on rice and toxin was extracted as described by Rukmini & Bhat [32] and quantified by thin layer chromatography (TLC) as described by AOAC [1].

Hens and cocks were fed with the diet containing maize, soybean meal, de-oiled rice bran and sunflower extraction following standard breeder diet. The diet was fed to different groups as follows: (1) control, (2) 300 ppb AF and (3) 400 ppb AF and (4) 500 ppb AF for 3 periods of each 3 weeks.

Compounded feed was analyzed for the presence of AF before including the rice culture material, then the diets (table 1) were prepared by incorporating required quantities of rice culture powder containing AF into the diet so as to give the different levels of AFB_1. The given toxin levels were finally cross checked by TLC method of analysis. Basal diet was formulated and compounded to meet the nutrient requirements of commercial broiler breeders (2690 Kcal/kg ME and 17.42% CP) feed. All birds received the control diet for 2 weeks to become environmentally acclimated and then were fed experimental diets.

A restricted daily feeding regimen, with unlimited access to water from channel drinkers, was followed throughout the experiment. The hens were provided 130 g/bird per day and increased based on
the recommendation of the primary breeder to 160 g/bird per day by the end of the experiment. The corresponding values for roosters were 135 and 145 g/bird per day, respectively.

**Experimental Parameters Measured:**

**Body weight:**

Hens were weighed individually at the start of the experiment (28th week) and at the end of the experiment (36th week).

**Feed consumption:**

Feed consumption was measured with trays set under each feeder, enabling feed spills to be weighed weekly during the experiment. The cocks were also fed with corresponding treatment diets ad libitum throughout the study as that of hens.

**Feed efficiency:**

Based on the egg production and quantity of feed consumed, the average feed efficiency was computed as the unit feed consumed to produce a unit of egg mass (kg feed/kg egg).

**Egg production:**

Daily egg production record on each hen was maintained in all the groups of birds throughout the experimental period. The eggs were labeled and stored for estimating other parameters at a later stage. The per cent hen-day egg production was calculated for each experimental period using the formula given by North, [29].

**Fertility and hatchability:**

Hens were individually inseminated twice a week with 50µL of fresh, pooled semen from cocks fed corresponding diets. All the eggs laid by each treatment groups during the third week of each period were collected and stored in the egg holding room. The eggs were incubated in a conventional forced-air incubator (Dayal Electric Automatic Incubation, New Delhi, India). The incubator was maintained at 37.5°C and 50% RH. All the fertile eggs were transferred on the 18th day of incubation to the Hatcher (Blue Star Poultry Equipments, Hyderabad, India) maintained at 36°C and 85% RH until 21st day of incubation. Hatchability was expressed as the percentage of chicks hatched out of the total number of fertile eggs set.

**Statistical analysis:**

The data were analyzed using the General Linear Model procedure of Statistical Analysis System (SAS®) software (SAS Institute, USA, 2000). Period wise data were analyzed by 2 x 2 factorial manner. Overall period data were analyzed by repeated measurement design [11]. Duncan multiple range test at 0.05 probability level was employed for comparison of the means [7].

**Results:**

**Changes in body weight:**

Breeder hens were weighed on 28th week and subjected to statistical analysis no significant (P≥0.05) difference between body weights of broiler breeder hens belonging to different treatment groups. This indicated the uniformity of birds selected for the experiment. At the end of the experiment, the analysis of variance indicated a non significant (P≥0.05) difference in the body weights of breeders at 36 weeks of age pertaining to different treatments (data not shown).

**Feed consumption:**

There was significant (P≤0.05) decrease in feed consumption (g/day) in all AF fed groups compared to the control group during the first period. However, in the second period, only in 300 and 500ppb AF groups and in the third period only in 500ppb AF group showed a significant (P≤0.05) decrease in feed consumption.

**Feed efficiency:**

There was a significant (P≤0.05) poor feed efficiency in all AF fed groups during all the three periods. The poorer feed efficiency was observed as the level of AF in the diet is increased.

**Egg production:**

There was a significant (P≤0.05) decrease in egg production (per cent) in 400 and 500ppb AF fed groups compared to the control group during the first and third periods. However, in the second period, decrease in egg production was observed in all AF fed groups compared to the control group.

**Fertility and hatchability:**

There was a significant (P≤0.05) reduction in the per cent fertility and hatchability of eggs from birds fed with AF at different levels during all the three periods.
Table 1: Per cent nutrient composition of basal diet of breeder’s ration.

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Analytical values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculated Values</td>
<td></td>
</tr>
<tr>
<td>Metabolizable Energy (Kcal/kg)</td>
<td>2690</td>
</tr>
<tr>
<td>Crude protein (%)</td>
<td>17.42</td>
</tr>
<tr>
<td>Crude fibre (%)</td>
<td>5.61</td>
</tr>
<tr>
<td>Crude fat (%)</td>
<td>2.63</td>
</tr>
<tr>
<td>Calcium (%)</td>
<td>2.87</td>
</tr>
<tr>
<td>Av, Phosphorous (%)</td>
<td>0.45</td>
</tr>
<tr>
<td>Lysine (%)</td>
<td>0.88</td>
</tr>
<tr>
<td>Methionine (%)</td>
<td>0.34</td>
</tr>
<tr>
<td>Analyzed values</td>
<td></td>
</tr>
<tr>
<td>Crude protein (%)</td>
<td>17.50</td>
</tr>
<tr>
<td>Crude fat (%)</td>
<td>2.5</td>
</tr>
<tr>
<td>Crude fibre (%)</td>
<td>5.4</td>
</tr>
</tbody>
</table>

Table 2: Effect of dietary Aflatoxin on body weight of broiler breeders.

<table>
<thead>
<tr>
<th>Description</th>
<th>28 weeks</th>
<th>36 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 ppb</td>
<td>2959.58±12.67</td>
<td>3394.58±14.85</td>
</tr>
<tr>
<td>300 ppb AF</td>
<td>2964.75±10.67</td>
<td>3340.25±27.79</td>
</tr>
<tr>
<td>400 ppb AF</td>
<td>2989.08±10.77</td>
<td>3345.67±18.61</td>
</tr>
<tr>
<td>500 ppb AF</td>
<td>2974.83±7.40</td>
<td>3403.75±24.19</td>
</tr>
</tbody>
</table>

Table 3: Effect of dietary Aflatoxin on feed consumption, feed efficiency, egg production, fertility and hatchability of broiler breeders.

<table>
<thead>
<tr>
<th>Item</th>
<th>P I</th>
<th>P II</th>
<th>P III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feed consumption (g/day)</td>
<td>157.00±0.28</td>
<td>158.00±0.28</td>
<td>158.66±0.16</td>
</tr>
<tr>
<td>Feed efficiency (kgs feed/kg egg mass)</td>
<td>3.33±0.04</td>
<td>3.42±0.03</td>
<td>4.08±0.02</td>
</tr>
<tr>
<td>Egg production (%)</td>
<td>80.97±1.01</td>
<td>79.70±0.85</td>
<td>68.65±0.69</td>
</tr>
<tr>
<td>Fertility (%)</td>
<td>96.32±0.13a</td>
<td>94.79±0.09a</td>
<td>93.26±0.17a</td>
</tr>
<tr>
<td>Hatchability (%)</td>
<td>86.14±0.06a</td>
<td>85.22±0.06a</td>
<td>83.47±0.18a</td>
</tr>
</tbody>
</table>

Discussion:

Changes in body weight:

The AF levels of 300, 400 and 500 ppb fed broiler breeders from 28 to 36 weeks of age did not significantly (P≥0.05) affect the body weight at 36 weeks of age. This is in agreement with the findings of Yegani et al. [44] who reported no significant change in BW of broiler breeders fed with mycotoxin. Similar observation on body weight was also reported many investigators [18,45,30,39] in layer chicken when fed with 1.00 to 5.00 ppm of AF from 4 to 40 weeks. However, Sims et al. [34] found significant (P<0.05) decrease in body weight in laying hens fed with 2.0 to 8.00 ppm of AF for 29 days. Similarly, feeding AF (500 ppb) to layer chicken from 15 to 67 weeks of age reduced the body weight [22].

Feed consumption:

The results of the present investigation showed significant (P≤0.05) decrease in feed consumption at all AF levels in the diet of breeder hens during the first period (28-30 weeks) whereas in the second period, 300 and 500 ppb AF showed significantly (P≤0.05) decreased feed consumption (31-33 weeks) and in the third period (34-36 weeks) only 500 AF group showed a significant (P≤0.05) reduction. This could be due to the fact that the birds get used to the toxic effect of the lower levels from the time of
initiation until the third period of experiment. Further, feeding of 500ppb AF significantly (P≤0.05) reduced feed consumption clearly indicates toxic effect on the breeders. The reduced cumulative feed consumption in the AF fed groups over the mycotoxin free groups was due to the impaired hepatic metabolism and interference with phosphoenolpyruvate carboxylase [41].

Feed efficiency:

The results of the present investigation on feed consumption among all AF fed hens (300, 400 and 500ppb) showed significant (P≤0.05) poorer in feed efficiency in the all three periods. Poor feed conversion efficiency noted with the AF seems to have been mediated decreased nutrient utilization. Numerous other researchers have reported, that poultry are sensitive to the feeding of mycotoxins with respect to feed efficiency. This is similar to the findings of Yegani et al. [44] in broiler breeders and Iqbal et al. [18], Muthiah et al. [28], and Pandey and Chauhan [30] in commercial layers. The reason for this discrepancy might be attributed to differences in the source of contamination (natural and purified), using a single source of contaminated grain compared with a blend of contaminated grains, with the level and duration of exposure. The present studies have also been conducted under different experimental conditions, which might be responsible for variation in performance of birds.

Egg production:

There was a significant (P≤0.05) decrease in egg production (%) in 400 and 500ppb AF fed groups compared to the control group during the first and third periods. However, in the second period, decrease in egg production was observed in all AF fed groups compared to the control group. Low level of AF did not affect egg production when fed for longer duration in the present study.

The decrease in egg production coincided with a transient decrease in feed consumption. According to Garlich et al. [9] drop in egg production with AF feeding appears to be due to reduced liver synthesis and transport of yolk precursors, which may cause prolongation in maturation of ova. Further, they stated that reduced plasma protein levels, triglycerides and calcium with AF feeding, might have also contributed partly to the detrimental effects on egg production. The possible reason for reduced egg production could be attributed to decreased feed consumption by the breeder hens. Howarth and Wyatt [15] reported significant (P≤0.05) drop in egg production after three weeks when broiler breeder hens fed 5.00 to 10.00ppm AF. Hafez et al. [12] recorded complete cessation of egg production with follicular atresia in egg type breeders, which were fed with AFB1 for three weeks. Muthiah [28] also reported a significant drop in egg production in egg type breeder hens fed with 0.50, 1.00 and 1.50ppm AF for six weeks. These observations adequately lend support to the findings of present study. Similarly in layers, many scientists reported significant reduction in egg production due to aflatoxicosis [17,43,10,8,38,3,27,24,31,42,37,30,39]. Based on these reports, it could be construed that the AF has got influence on the egg production.

Fertility and hatchability:

Fertility and hatchability values during all the periods of study showed a significant (P≤0.05) reduction as the dietary AF level increased as a dose dependent response.

The overall male-related fertility data in this experiment suggested a toxic effect on the testes. Conner et al. [5] suggested a progressive and long-term mycotoxin feeding affects spermatozoal production. Poorer-quality spermatozoa produced could be responsible for both lower fertility and reduced hatchability of those eggs that were fertilized.

Previous findings indicated that the aflatoxin-induce degeneration and necrosis of testicular tissue [6,36]. Detrimental effects of dietary AF on fertility have been reported by Jayakumar et al. [19] in duck, Johri et al. [20] in Japanese quail and Afzali and Devegowda, [2] in broiler breeder hens. On the contrary, Howarth and Wyatt [15], Sharlin et al. [33] and Muthiah [28] recorded no influence of dietary AF on fertility percentage in breeder hens. However, Howarth and Wyatt [15] noticed a significant drop in hatchability in broiler breeder hens by feeding AF in a levels equal to or higher than 5.00ppm. Johri et al. [20] also recorded significant reduction in hatchability in breeding Japanese quails with AF feeding. On the contrary, reports with WL breeder hens indicated no effects on hatchability [14,26,23,4]. Tiwari et al. [40], while comparing the hatchability of AF containing eggs and AF free eggs, noticed low hatchability in the former category. However, previous reports with White Leghorn breeder hens indicate no effects of feeding on hatchability [14,26,4].

Acknowledgments

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