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ORIGINAL ARTICLES

Effect of Aflatoxicosis on Hatching Egg Quality Parameters of Broiler Breeders

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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 500ppb on the hatching egg quality of broiler breeders. The breeder hens aged 28 weeks were fed with four treatment diets: Control (0ppm), (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 400ppb did not reveal any significant changes in the hatching egg quality. However, Inclusion of 500ppb AF in the diet significantly ($P \leq 0.05$) reduced feed consumption, feed efficiency, egg production, fertility and hatchability. The results indicated no significant ($P \geq 0.05$) effect of AF on body weight of breeders.

Key words: Aflatoxin, Broiler breeder, egg production.

Introduction

Poultry production is one of the fastest growing sectors of Indian agriculture. Contamination of poultry feeds and feed ingredients with aflatoxins is one of the major problem with the poultry production. Aflatoxins are secondary toxic metabolites produced by certain strains of fungi, e.g. *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. Analyses of Indian feeds and feedstuffs for mycotoxin have shown Aflatoxin (AF) is a common problem (Chandrashekharan, 2000). Several researchers reported that there is no safe levels of AF in the food and feedstuff. However, observed reduced performance and altered immune function of broiler breeders fed diets containing different levels of aflatoxin was frequently reported. There is an increasing evidence that global supplies of cereal grains for animal feed manufacturing are commonly contaminated with mycotoxins. Their toxicity in animals depends on various factors including the concentration of aflatoxin, the duration of exposure, the species, gender and age and health status of animals (Mohanamba *et al*., 2007). Economic losses associated with AF exposure include in the form of poor growth and feed conversion, increased mortality, decreased egg production, leg problems, and carcass condemnations in poultry (Smith and Hamilton, 1970; Hamilton and Garlich, 1971; Huff *et al*., 1983). The objective of the current experiment was to study the effects of graded levels of aflatoxin on production parameters of broiler breeders.

Materials and Methods

Froty-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 (1978) and quantified by thin layer chromatography (TLC) as described by AOAC. (1995).

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) 300ppb AF and (3) 400ppb AF and (4) 500ppb 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

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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:

Egg weight:

The weight of eggs laid by all the hens were recorded during the first five consecutive days at the commencement of each period using electrical balance with 0.05g sensitivity. Then, the average weight of eggs was computed for each of the treatments.

Shell thickness:

For the assessment of shell thickness, two eggs from each replicate were collected daily for three days at the end of each period. Shell thickness was measured without the shell membrane at three different locations on the egg (air cell, equator, and sharp end) using digital screw gauge (Ames 25M-5). The average for each treatment was obtained.

Haugh unit score and Yolk color index:

Eggs collected during the last two days of each period from each treatment were weighed individually. Three of those eggs per treatment were broken and the entire contents were carefully placed on a glass slab, then the height of albumen was recorded at two places (one near to yolk and the other at the end of dense albumen) using Ames Haugh unit meter. All the eggs broken to measure Haugh unit were only utilized to determine yolk color visually by matching with Roche Yolk Color Fan as described by Roche Company (1969).

Residues in egg:

The aflatoxin B1 concentration was determined in the eggs produced by the hens from each of the experimental groups during the last week of each period. Aflatoxin residue estimated using HPLC – fluorescence method with a detection limit of 5 ppb in accordance with the Association of Official Analytical Chemists (AOAC, 1995) including modifications described by Gregory and Manley (1981) (Appendix II) and the averages for each replicate was calculated.

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 (Gill, 1985). Duncan multiple range test at 0.05 probability level was employed for comparison of the means (Duncan, 1955).

Results:

Egg weight:

There was a significant ($P \leq 0.05$) decrease in egg weight (g) in 500ppb AF fed group during all the three periods.

Shell thickness:

Shell thickness was not significantly affected in any of the AF levels in the diet.

Haugh unit and Yolk color index:

Haugh unit score and yolk color index was not significantly affected at different concentrations of AF in the diet.

Residues in egg:

The eggs collected on the last day of each period when subjected to HPLC analysis for AF indicated no detectable residue levels in any of the treatments and/or periods (data not showed).

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Discussion:

Egg weight:

The decrease in egg production coincided with a transient decrease in feed consumption, probably associated with reduced-feed consumption. However, the greater metabolic reserves and lower egg production rate of broiler breeders could explain the lack of effect on egg production. A cumulative depletion of metabolic reserves due to slightly reduced feed intake is suggested by decreased yolk weight being the major contributing factor to the reduced egg weight.

Lack of significant effect of dietary AF on egg weight was reported by Sims *et al.* (1970) and Iqbal *et al.* (1983) in WL layers, Johri *et al.* (1990) in Japanese quail, Stephen *et al.* (1991) in layer chicken fed with 5.00 and 10.00ppm AF for three weeks, Chowdhury and Smith (2004), Verma *et al.* (2004) by feeding 2.00ppm AF for 50 days in 42 week old laying hens and Yegani *et al.* (2006) who reported that there was no effect of *Fusarium* mycotoxin contaminated diets on egg weight of layers and broiler breeders. On the contrary, Hamilton and Garlich (1971), Huff *et al.* (1975) and Washburn *et al.* (1985) recorded a significant reduction in egg weight with AF feeding in commercial layers. The probable reason for these conflicting reports on this aspect might be due to differences in the levels of AF tested by these workers.

Shell thickness:

The results of the present investigation showed that feeding of AF in the diets did not significantly ($P \geq 0.05$) alter the shell thickness of eggs obtained from breeders during the whole experimental period. The study indicated that the level of toxin included in the diets may not be sufficient enough to alter shell thickness. This is in agreement with the known phenomenon of inverse relationship between age of bird and egg shell thickness (McDaniel *et al.,* 1979). Garlich *et al.* (1973) reported a significant reduction in plasma calcium in WL layers fed with AF. Reduced availability of plasma calcium for egg shell calcification during aflatoxicosis may impair the normal egg shell calcification and thereby lowered shell thickness. Several earlier trials also indicated lack of significant effect of dietary AF on egg shell thickness (Hamilton and Garlich, 1971; Iqbal *et al.,* 1983). Chowdhury and Smith (2004) reported lack of *Fusarium* mycotoxins contaminated diets influence on shell thickness of 45 week-old layers. Denli *et al.* (2008) reported lack of effect of feeding 2 mg/kg of ochratoxin A on shell thickness parameter of 47 week old layers.

Haugh unit score and yolk color index:

The results of the present investigation showed that feeding of AF in the diets of broiler breeder hens did not significantly ($P \geq 0.05$) alter the Haugh unit scores and yolk color index of eggs. These findings are comparable with those of Chowdhury and Smith (2004) who reported that there was no effect of *Fusarium* mycotoxins contaminated diets on Haugh units or eggshell deformation in 45 week old layers. Denli *et al.* (2008) also reported that feeding 2 mg/kg of ochratoxin A did not show any significant difference on Haugh unit score of 47 week old layers.

Table 1: Per cent nutrient composition of basal diet of breeder's ration

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

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Table 2: Effect of dietary Aflatoxin on feed consumption, feed efficiency, egg production, fertility and hatchability of breeders

Item	P I	P II	P III
egg weight (g)			
Control	57.20±0.28[a]	57.73±0.34[a]	58.86±0.25[a]
300ppb AF	57.16±0.16[a]	57.09±0.28[a]	58.11±0.29[a]
400ppb AF	56.98±0.09[a]	57.56±0.31[a]	58.53±0.30[a]
500ppb AF	56.08±0.28[b]	56.50±0.31[b]	57.73±0.28[b]
shell thickness (g)			
Control	0.33±0.00[a]	0.33±0.00[a]	0.31±0.00[a]
300ppb AF	0.33±0.00[a]	0.33±0.00[a]	0.31±0.00[a]
400ppb AF	0.33±0.00[a]	0.33±0.00[a]	0.31±0.00[a]
500ppb AF	0.33±0.00[a]	0.33±0.00[a]	0.31±0.00[a]
Haugh unit score			
Control	73.17±0.24[a]	73.57±0.19[a]	73.35±0.36[a]
300ppb AF	73.72±0.15[a]	73.25±0.26[a]	73.45±0.25[a]
400ppb AF	73.40±0.18[a]	73.15±0.25[a]	73.33±0.39[a]
500ppb AF	72.95±0.35[a]	72.88±0.21[a]	72.98±0.28[a]
yolk color index			
Control	8.70±0.05[a]	8.76±0.17[a]	8.63±0.16[a]
300ppb AF	8.81±0.08[a]	8.74±0.11[a]	8.60±0.16[a]
400ppb AF	8.76±0.07[a]	8.74±0.13[a]	8.68±0.06[a]
500ppb AF	8.65±0.02[a]	8.36±0.15[a]	8.92±0.07[a]
P = Period			
AF = Aflatoxin			

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