Effect of fortifying Aflatoxin-contaminated feeds with Ugandan bentonite on performance of broiler birds

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ABSTRACT

One hundred fifty day-old commercial broiler chicks were reared in six groups with each group containing 25 chicks. The chicks were maintained on two diets namely BSA: broiler starter feed containing 25-35 ppb of aflatoxin and BSB: broiler starter feed containing 25-35 ppb of aflatoxin+0.5% Ugandan bentonite (UB). After three weeks, broiler starter diets were replaced with two diets of broiler finisher mash namely BFA (broiler finisher feed containing 25-35 ppb of aflatoxin) and BFB (broiler finisher feed containing 25-35 ppb of aflatoxin+0.5% UB). During starter and finisher growth phases, highest weight gains (t-test; P<0.0001, df=2) were observed in groups fed of diets containing UB. During the starter phase, the mean weight gained by chicks fed on BSB was 29% higher than the mean weight gained by chicks fed on BSA. Also, feed intake for chicks fed BSB was 15% higher than the mean feed intake for chicks fed on BSA. A similar trend was observed during the finisher phase with the mean weight gain and feed intake for birds fed BFB being 22 and 14% respectively higher than values for birds fed BFA. The mortality in groups fed the diet containing UB was 141% lower than the percentage mortality for groups maintained on diets without UB. These findings are suggestive that UB can be incorporated in animal feeds to detoxify the aflatoxins, reduce mortality, improve dressing percentage of broiler chickens and eventually boost profitability of broiler production systems.

Introduction

Aflatoxicosis, the syndrome resulting from ingestion of feeds contaminated with aflatoxins (AFs) is a serious constraint undermining the productivity of broiler production systems not only in Uganda but worldwide (Bryden, 2012). Aflatoxin is a collective term for a group of toxic and carcinogenic secondary metabolites produced by some strains of Aspergillus falavus and Aspergillus parasiticus on feeds and foods (Nageswara-Rao and Chopra, 2001). The fungal spores are found worldwide in air and soil and infest both living and dead plants and animals. Based on fluorescence properties on thin layer plates, four types of aflatoxins (B1, G1, B2 and G2) are recognized (Wogan, 1977). Among all aflatoxin, B1 (AFB1) is the most potent hepatotoxin and it exhibits a variety of biological effects such as carcinogenicity, teratogenicity and mutagenicity in farm animals (Applebaum et al., 1982).

Aflatoxicosis is associated with growth depression owing to reduced feed intake, impaired nutrient utilization and decline in feed quality. Dersjant-Li et al. (2003) estimated that with each mg/kg increase of AF in the diet, the growth rate for pigs and broiler birds would be depressed by 16% and 5%, respectively. Several scholarly studies have also reported the devastating effects of aflatoxicosis on egg production and hatchability in intensive poultry production systems. Hamilton (1971) reported that ingestion of AF by layers reduced egg production by 5% in addition to significantly reduction in egg size. Also, aflatoxicosis was noted to impair semen quality in White Leghorn strains (Sharlin et al., 1980). Additionally, AFs can be immunosuppressant and aflatoxicosis has been shown to escalate the susceptibility of animals to infectious diseases such as Newcastle disease (CAST, 2003). In terms of carcass quality, broilers have been shown to have decreased dressed weight with the carcass containing less fat and protein. Such detrimental effects of aflatoxicosis on animal growth, immune system and carcass quality translate into low productivity and market value and hence low profitability of intensive animal production systems.
The mean aflatoxin concentration in broiler starter, broiler finisher, layer mash and dairy meal is 100.2%, 114%, 237% and 202% higher than the acceptable minimum limit (20 ppb). Such alarming levels of AFs in animal feeds not only undermine animal performance and productivity but also present huge health risks to consumers of animal tissues and products. Numerous strategies such as physical separation, thermal inactivation, irradiation, microbial degradation and treatment with a variety of chemicals have been used for the detoxification or inactivation of AF-contaminated feedstuffs (Anderson, 1983). None of these methods seem to fulfill the efficacy, safety, safeguarding of nutritional elements and cost requisites of a detoxification process (Piva et al., 1995). The most recent approaches to the problem has been the use of nutritionally inert sorbents that sequester AFs and reduce the absorption of these mycotoxins from the gastrointestinal tract, avoiding toxic effects for livestock and the carry-over effects to animal products. Examples of nutritionally inert sorbents widely used to bind AFs in animal feeds are bentonites. Bentonites are natural adsorbent colloidal clays chemically made of silicates or aluminosilicates. They are inorganic porous material harboring rings of silicate tetrahedrons, each made of a silica molecule with a positive charge surrounded by four oxygen molecules with a negative charge, that produce a sheet-like structure. The mycotoxins can be adsorbed onto this porous structure and are trapped by electric elementary charges. The mycotoxins are immobilized and hence rendered inactive. This reaction disarms AFs and eventually alleviates any potential adverse effects on animal productivity.

Uganda is endowed with huge deposits of Calcium bentonite (CaB) in the Albertine valley located in Hoima District which heightens the impetus to exploit this resource in the mitigation of AF-induced declines in animal productivity. The study therefore sought to establish the effect of fortifying aflatoxin-contaminated feeds with Ugandan bentonite on performance of broiler birds.

Materials And Methods

One hundred fifty day-old commercial broiler chicks were reared in six groups with each group containing 25 chicks. The chicks were maintained on two diets namely BSA (broiler starter feed containing 25-35 ppb of aflatoxin) and diet BSB (broiler starter feed containing 25-35 ppb of aflatoxin+0.5% CaB). After three weeks, broiler starter diets were replaced with two diets of broiler finisher mash namely BFA (broiler finisher feed containing 25-35 ppb of aflatoxin) and BFB (broiler finisher feed containing 25-35 ppb of aflatoxin+0.5% CaB). The feeds were formulated using ingredients obtained from local suppliers of animal feed ingredients. Upon mixing of the various ingredients to formulate broiler diets, the diets were analyzed for aflatoxins and the values ranged between 25-35 ppb for all formulated diets. Body weights and feed intake was recorded weekly while mortality was recorded as it occurred. Two birds per replicate were randomly selected at 21st, 28th, 35th and 42nd day of experiment for estimation of antibody titres against Newcastle disease (ND). The blood samples (3 ml) were collected from wing veins and the serum was separated and analyzed by Haemagglutination inhibition (HI) method described by Sever (1962). All the birds were vaccinated against ND on 3rd and 21st day of experiment. At the end of experiment, two birds from each group were selected for estimation of dressing percentage and organ (liver, heart and gizzard) weights. The t-tests were used to separate means for the two diets during starter and finisher growth phase. Also, means were used to develop graphs using XLSTAT (2013).

Results And Discussion

Growth performance of broiler birds

In both starter and finisher phase, highest weight gains (t-test; P<0.0001, df=2) were observed in groups fed diets containing Calcium bentonite (Figures 1 and 2). During the starter phase, the weight gained by chicks fed on BSB was 29% higher than the mean weight gained by chicks fed on BSA. Also, feed intake for chicks fed BSB was 15% higher than the mean feed intake for chicks fed on BSA. A similar trend was observed during the finisher phase with the mean weight gain and feed intake for birds fed BFB being 22 and 14% respectively higher than values for birds fed BFA. These results are in agreement with the findings of Ghosh et al. (1990) and Giroir et al. (1991) who reported that contamination of feeds with aflatoxin significantly reduced the daily body weight gain of broiler birds. Similarly, Santurio et al. (1999) reported that incorporation of Sodium bentonite in aflatoxin infested feed at 5.0 g/kg increased feed intake by 23.8%.

Effect of Uganda bentonite on Newcastle Antibody titre values

The geometric means of antibody titres against Newcastle disease at 21st, 28th, 35th and 42nd day of different groups are presented in Figure 3. The highest titre was observed in groups fed with diets containing CaB. This result indicates that aflatoxin severely inhibited the immune system of the birds and this resulted to reduce the titre of Newcastle disease. Aflatoxin causes regression of the Bursa of Fabricius so the low titre against the Newcastle disease may be attributed to the regression of Bursa of Fabricius.
Effect of Ugandan bentonite on mortality and dressing percentage of broiler birds

The results of the present study as indicated in Figure 4, showed that minimum mortality was obtained in groups fed on diets containing CaB. The mortality in groups fed diets containing CaB was 141% lower than the mortality for groups maintained on diets without CaB. These results are in agreement with those presented by Mussaddeq et al. (2000) who reported that the addition of toxin binder resulted in 70% reduction in mortality. Huff et al. (1986) and Fukal et al. (1989) also
reported high mortality rates due to addition of aflatoxins in animal diets. A similar trend was observed for dressing percentage. These results are in line with findings of Awan (1997) who reported a decrease in dressing percentage due to contamination of feeds with aflatoxins.

Figure 4. Mortality and dressing percentage of birds fed different diets

Conclusions And Recommendations

Findings on the utilization of Ugandan bentonite in animal nutrition are suggestive that the clay can be incorporated in animal feeds to detoxify aflatoxins and eventually reduce mortality of broiler chickens as well as improving their dressing percentage. This is in turn is expected to translate into improved profitability of chicken production systems. Also, the clay has an overwhelming potential to boost the immunity of birds to diseases particularly Newcastle disease that is responsible for decimation of chicken populations in intensive and scavenging systems. However, these results are not conclusive and more research is needed to establish the appropriate inclusion level of CaB in broiler feeds as well as to establish the marginal benefits accruing from incorporation of the product in broiler feeds.

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References