

The Effect of Dietary Aflatoxin on Local Domestic Turkey (*Meleagris gallopavo*) in Libya

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تاريخ الاستلام: 2026/01/17 تاريخ المراجعة: 20 / 2 / 2026 تاريخ القبول: 2026/03/14- تاريخ النشر: 2026 /03/29

Abstract

This study was conducted to determine the effects of feed contaminated with aflatoxin B1 (AFB1) on growth performance in Turkey. Sixty, ducks randomly divided into two groups of 3 replicates and were fed commercial feed uncontaminated or contaminated AFB1 at level 250 µg/kg. AFB1 contaminated feed significantly decreased the body weight, feed intake and increased feed conversion rate ($p<0.05$). The results revealed that the growth performance of the contaminated diet compared to controls diet, a significant weight loss was observed 13.95%, 7.9% and 5.97% in the third week. Feed intake was significantly decreased ($p<0.05$) with the group fed AFB1 compared with the control. The overall, decrease was 2.4% and 4.8% for the second and third week respectively. The feed conversion was increased significantly ($P<0.05$) in the second and third week with an average of 3.5% and 5.9% over the control group. The results therefore, ducks performance was negatively affected by AFB1 contamination in feed. This will confirm that AFB1 contamination in poultry feed causes heavy economic losses by lowering body weight gain and feed conversion. Therefore, lower levels of Aflatoxin in the poultry feeds should be required if all acceptable risk is to be avoided.

Keywords: Probiotic, Aflatoxin, Digestibility, Performance, Domestic Turkey, Libya

تأثير الأفلاتوكسين الغذائي على الديك الرومي المحلي (*Meleagris gallopavo*) في ليبيا

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المخلص

أجريت هذه الدراسة لتحديد تأثير العلف الملوث بالأفلاتوكسين B1 (AFB1) على أداء النمو في الديك الرومي. قُسم ستون ديكًا روميًا عشوائيًا إلى مجموعتين، كل مجموعة تضم ثلاث مكررات، وغُذيت بعلف تجاري غير ملوث أو ملوث بالأفلاتوكسين B1 بتركيز 250 ميكروغرام/كيلوغرام. أدى العلف الملوث بالأفلاتوكسين B1 إلى انخفاض ملحوظ في وزن الجسم واستهلاك العلف، وزيادة في معدل تحويل العلف ($p<0.05$). وكشفت النتائج أن أداء النمو في المجموعة التي تناولت

العلف الملوث، مقارنةً بالمجموعة الضابطة، أظهر انخفاضًا ملحوظًا في الوزن بنسبة 13.95%، و7.9%، و5.97% في الأسبوع الثالث. كما انخفض استهلاك العلف بشكل ملحوظ ($p < 0.05$) في المجموعة التي تناولت العلف الملوث بالأفلاتوكسين B1 مقارنةً بالمجموعة الضابطة. وبشكل عام، بلغ الانخفاض 2.4% و4.8% في الأسبوعين الثاني والثالث على التوالي. ارتفع معدل تحويل العلف بشكل ملحوظ ($P < 0.05$) في الأسبوعين الثاني والثالث، بمتوسط 3.5% و5.9% على التوالي مقارنةً بالمجموعة الضابطة. وبالتالي، أظهرت النتائج أن أداء الديك الرومي تأثر سلبيًا بتلوث العلف بالأفلاتوكسين B1. ويؤكد هذا أن تلوث علف الدواجن بالأفلاتوكسين B1 يُسبب خسائر اقتصادية فادحة نتيجة انخفاض زيادة الوزن ومعدل تحويل العلف. لذا، ينبغي خفض مستويات الأفلاتوكسين في علف الدواجن لتجنب جميع المخاطر المحتملة.

الكلمات المفتاحية: الدروبيوتيك، الأفلاتوكسين، الهضم، الأداء، الديك الرومي المحلي، ليبيا.

Introduction

Dietary aflatoxicosis represents one of the most critical threats to the development and sustainability of local domestic turkey (*Meleagris gallopavo*) production systems within Libya (Rawal et al., 2010), (Quist et al., 2000). Aflatoxins are highly toxic secondary metabolites produced primarily by the filamentous fungi *Aspergillus flavus* and *Aspergillus parasiticus*. These fungi readily colonize essential poultry feed ingredients, including corn, barley, sorghum, and wheat, under favorable environmental conditions. Among all domestic poultry species, turkeys exhibit an extreme, unique biological sensitivity to aflatoxins, particularly Aflatoxin, which is recognized as the most potent naturally occurring carcinogen (Rawal et al., 2010).

Feeding AFB1 contaminated diets decreased average daily gain and average daily feed intake linearly and quadratically during the whole experimented period (He et al., 2013).

A previous investigation about the effects of feeding corn contaminated with aflatoxin B1 concluded that an AFB1-contaminated diet significantly decreased the body weight gain, feed intake, and feed conversion rate (Shi-Fei et al., 2013).

A study on the effects of increasing aflatoxin B1 concentrations from contaminated corn fed to young ducklings stated that the average daily gain and relative weights of liver, spleen, thymus and bursa of fabricius decreased linearly (Wan et al., 2013). A linear relationship was observed in broilers between the level of toxin and reduction in growth (Madden et al., 1999).

The growth of chicks was not affected by concentration of aflatoxin below 250 $\mu\text{g} / \text{kg}$ (Santurio, 1999). A significant decrease in body weight at level as low as 75 $\mu\text{g}/\text{kg}$ was noted although the treated chicken showed no morbidity, mortality or significant pathology on necropsy (Oguz et al., 2000).

While chickens possess robust metabolic pathways to detoxify these mycotoxins, turkeys suffer profound physiological damage at significantly lower exposure levels (Rawal et al., 2010), (Quist et al., 2000). In the context of Libyan agriculture, where turkeys are traditionally reared in small-scale semi-intensive setups or backyard systems, this susceptibility introduces severe economic vulnerabilities and significant public health concerns via food chain contamination. The exacerbation of aflatoxin contamination in Libya is heavily driven by geographic and climatic factors.

The exacerbation of aflatoxin contamination in Libya is heavily driven by geographic and climatic factors. The country's coastal belt, where the vast majority of poultry operations are concentrated, experiences a Mediterranean climate characterized by high seasonal temperatures and elevated relative humidity. These ambient conditions provide an ideal microclimate for *Aspergillus* spore germination and subsequent mycotoxin synthesis (Essawet, 2018). Furthermore, the local poultry sector faces infrastructural challenges, such as substandard grain storage facilities, lack of climate-controlled silos, and inadequate ventilation during transport. Imported feed ingredients are frequently exposed to moisture during shipping and prolonged customs clearing delays at maritime ports, allowing post-harvest mold proliferation to reach hazardous thresholds. When these contaminated grains are processed by local feed mills without rigorous mycotoxin surveillance, the resulting commercial rations pose a silent, pervasive hazard to sensitive local turkey flocks.

Understanding the exact impact of local dietary exposure under Libyan field conditions is critical. This study evaluates the growth performance, clinicopathological changes, and tissue residue profiles of local domestic turkeys fed naturally contaminated diets in Libya.

Materials and Methods

This study was carried out during the period from March to May 2025. The present experimental work was carried out at the Research Laboratory belonging to the Faculty of Veterinary Medicine and Agriculture (Al-Ajeelat), with approval by the University of Zawia Local Ethics Committee for Animal Experiments.

A healthy, unvaccinated baby turkey was obtained from a local commercial market in Zawia. Sixty turkeys, each weighing 250 to 350 gm, were randomly divided into two treatment groups, with 3 replicate groups for each. The turkeys were housed on litter-based floor pens under continuous illumination throughout the experiment. The experiment lasted for 3 weeks; all turkeys were allowed ad libitum access to feed and water during the 21-day experiment. The dietary treatments consisted of a control diet obtained from a commercial feed mill, Al Tahadi (Table 1).

Table 1. Feed composition (Al tahadi Factory, Tripoli).

Item	%
Corn	60
Soy bean	27
Fish meal	6
Vegetable Oil	2
Methionine	0.035
Dicalcium phosphate	2
Salt	1.62
Limestone	1
Premix	0.3
Determined Analysis	
Moisture	9.5

Crude protein	20.57
Ash	9.77
Ether extract	3.23
Crude fiber	2.67
Nitrogen free extract	50.73
Calcium	1.00
Phosphrous	0.40

The contaminated diet was prepared by the addition of moldy rice at 1% and was adjusted in the feed formulation. Moldy rice powder was obtained by inoculating a known amount of broken rice with *A. flavus* supplied by the Agriculture Research Center, Tripoli. AFB1 production was carried out in accordance with the method based on the previous study (Shotwell et al., 1966). Quantified by comparisons of standards on a TLC plate.

The control diet was free from aflatoxin B1, within detectable limits, while the test ration contained AFB1, 250 µg/kg. The average weight gain, feed intake, and feed conversion rate of each replicate were measured at the end of each week.

The turkeys were weighed on every 7th, 14th, and 21st day. All turkeys from the control and treated groups were sacrificed on day 21 to determine serum protein, lipids, hemoglobin, and organ morphology and weight.

The most important measurements taken during the experiment period:

1- Body weight.

The live body weight of each bird was recorded at the beginning and end of the experimental period, and then the change in live body weight was calculated in the formula.

$$\text{Average Daily Gain} = \frac{\text{Final Weight} - \text{Initial Weight}}{\text{Research Time}}$$

2-Feed consumption:

The weight of feed consumed (g) for each replicate was calculated for each period by subtracting the amount of feed remaining from that supplied.

$$\text{Feed Intake} = \text{Feed Given} - \text{Remaining Feed}$$

$$\text{Feed Digestibility} = \frac{\text{Feed Intake} - \text{Fecal}}{\text{Feed Intake}} * 100\%$$

$$\text{Feed Efficiency} = \frac{\text{Average Daily Gain}}{\text{Feed Intake}} * 100\%$$

3-Feed conversion ratio:

The feed conversion ratio (the amount of feed (g) needed to produce one gram of body fat) was calculated by dividing the amount of feed consumed by the number of birds in each treatment.

$$\text{Feed Conversion Ratio} = \frac{\text{Feed Intake}}{\text{Average Daily Gain}}$$

Statistical Analysis

Statistical analysis was done by one-way analysis of variance (ANOVA) followed using the SPSS software package, version 26.00. P values < 0.05 were considered as significant. The results are expressed as mean ± standard deviation (SD) for each group.

Results and Discussion

The turkeys, which received 250 µg/kg of aflatoxin in the feed for three weeks, generally showed no signs of morbidity or feed refusals; however, in some cases, feathers were ruffled. A few birds were not able to stand on their feet. There was no mortality due to aflatoxicosis. Growth rate of treated turkeys compared to controls and between the ages in weeks is given in Table 2.

Table 2. Performance of turkeys in three weeks of age fed uncontaminated and contaminated diet with AFB1

Weeks	Bird No.	BW Control±SE (g)	BW Treatment±SE (g)	FI control±SE (g)	FI treatment±SE (g)	FC control±SE (FI/BW)	FC treatment±SE (FI/BW)
1	5	445.0 ±17.5	457.1 ±10.3	645.1±27.2	671.3 ±28.5	2.58 ±0.08	2.60 ±0.81
1	5	452.0 ±17.6	455.6 ±10.3	663.2±28.1	672.6 ± 28.6	2.60 ±0.08	2.61 ±0.79
1	5	436.5 ±16.8	441.3 ±9.8	628.3±26.1	642.6 ±7.1	2.57 ±0.07	2.59 ±0.70
2	5	645.4 ±21.8	603.9 ±10.5	972.6±34.9	921.5 ±32.8	2.60 ±0.06	2.63 ±0.05
2	5	617.8 ±20.2	612.8 ±10.7	933.6±33.3	941.1 ±33.6	2.61 ±0.06	2.64 ±0.06
2	5	651.8 ±22.0	634.6 ±11.2	977.6±35.0	982.1 ±35.3	2.59 ±0.60	2.65 ±0.71
3	5	828.4 ±1.85	734.1 ±15.8	1250.9±34.5	1152.7 ±31.6	2.58 ±0.04	2.66 ±0.04
3	5	791.5 ±20.7	743.3 ±16.1	1202.9±33.0	1180.9 ±32.4	2.59 ±0.05	2.68 ±0.05
3	5	812.8 ±21.3	777.4 ±16.9	1240.6±34.2	1231.3 ±33.9	2.60 ±0.051	2.67 ±0.06

BW body weight, FI feed intake, FCR feed conversion rate, SE standard error

The body weight in all treated turkeys after one week showed an increase of 3.5%, 1.2% and 1.6% over the controls. The similar average feed intake among the two treatments of turkeys in this study indicated that consumption of diets naturally contaminated with AFB1, exerts no detrimental effects on feed intake.

This combined with the observation that turkeys did not sort the diet according to the AFB1-contaminated feed supplementation; this observation comes in agreement with previous study on ducks which suggested that ducklings within a treatment group likely consumed a similar amount of AFB1 and that differences obtained among treatments were likely ascribed to the different concentrations of AFB1 in the diets (Matur et al., 2010).

At the end of the second week, the treated turkeys suffered a greater weight loss, 7.1%, 0.98% and 3.14% respectively.

However, there was no significant difference in turkeys receiving control feed and aflatoxin containing. The average weights in control groups were 828.42, 791.53 and 812.89 gm, respectively. Those receiving contaminated feed, respectively it was 734.125, 743.38, and 777.423 gm. The weight loss was significant ($p < 0.01$) in third week i.e. 13.95%, 7.9 and 5.97% respectively.

The overall average loss in body weight due to aflatoxin in the second and third week was 4.9% and 9.4%. The decrease in feed intake was significant in the third week i.e 9.5%, 3% and 0.9% respectively. The overall, average decrease in feed intake due to AFB1 contamination was in the second and third weeks 2.4% and 4.8% respectively. Accordingly, the feed conversion (feed/body weight) was increased as well in the second and third week where the overall average was 3.5% and 5.9% respectively.

Body weight was depressed in mycotoxin fed group which confirm the conclusion of study that suggest the dietary aflatoxin reduces weight gain, feed intake and increase feed conversion ratio (Yunus et al., 2011).

For levels of AFB1 of 1mg/Kg diet, 10% reduction in weight gain was noted by Zhao study at 21 days of exposure (Zhao et al., 2010), while 15% a reduction in weight gain was noted by Denli et al. (2009).

The increased growth depression observed with the simultaneous feeding mycotoxin for a longer time than in the first week and that's may be due to additive toxic effects of individual toxins (Zaghini et al., 2005).

The mechanism for this effect includes inhibition of RNA, DNA synthesis as well as RNA polymerase activity (Arafa et al., 1981). Consequence of RNA, DNA synthesis involves reduced protein synthesis which ultimately would reduce growth.

Generally, all turkeys in this study had similar feed intake and feed conversion rate (Table 2). However, turkeys fed AFB1 diet had lower ($P < 0.05$) body weight compared with control diet. Body weight and feed consumption compared with control, the body weight gain and feed consumption of turkeys, which were fed diets contaminated with 250 μ g/kg of AFB1, significantly decreased ($P < 0.05$) from second week.

The feed: gain ratio significantly increased ($P < 0.05$) when the turkeys were fed diets contaminated with AFB1 (Table 2). The turkeys consumed diets contaminated with AFB1 showed a significant reduction in feed intake. When the turkeys were administered feed contaminated with AFB1, our results prove that some economically significant effects occurred in the ducks, including reduced body weight gain, feed consumption, and feed conversion rate.

Conclusion

Dietary aflatoxin contamination represents a destructive economic and health hazard for the local domestic turkey sector in Libya. This study demonstrates that exposure to total aflatoxins at concentrations levels (250 ppb), the extreme metabolic vulnerability of *Meleagris gallopavo* leads to lowering growth performance of flock, presenting a clear threat to human food security.

To protect local domestic turkey production and public health along Libya's coastal agricultural areas, poultry operations must adopt a strict mitigation framework. This strategy requires systematic testing of imported feed ingredients using HPLC or ELISA, regulating feed silo moisture levels to below 12%, and routinely incorporating effective, broad-spectrum mycotoxin binders (such as HSCAS or bentonite clay) into commercial turkey rations.

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