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DIETARY SUPPLEMENTATION OF VITAMIN A AND VITAMIN E ON GROWTH PERFORMANCE AND CARCASS QUALITY IN BROILER CHICKENS EXPOSED TO AFLATOXIN B₁

By

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Abstract

A total of one hundred and ninety-two chicks were acclimatized over two weeks of feeding after which the birds were randomly allocated to six different treatments: T1 (basal diet + 35 µg aflatoxin B₁ + 10 g vitamin A/kg feed), T2 (basal diet + 35 µg aflatoxin B₁ + 15 g vitamin A/kg feed), T3 (basal diet + 35 µg aflatoxin B₁ + vitamin E), T4 (basal diet + 35 µg aflatoxin B₁ without vitamin supplementation), and T5 (basal diet without aflatoxin and without vitamin supplementation, serving as the control). Each treatment was replicated three times with sixteen birds per replicate. Growth performance parameters including initial weight, final weight, body weight gain (BWG), average daily gain (ADG), feed intake (FI), average daily feed intake (ADFI), and feed conversion ratio (FCR) were evaluated. At the end of the experiment, two birds per replicate were randomly selected for carcass analysis.

The results showed significant differences ($p < 0.05$) in feed intake (FI) and average daily feed intake (ADFI) among treatments, while no significant differences ($p > 0.05$) were observed in BWG, ADG, and FCR. Birds in the control group (T5) and those fed 10 g vitamin A/kg (T1) recorded higher body weight gain (946.3 g and 918.9 g, respectively) compared to other treatments. Feed intake was significantly higher ($p < 0.05$) in vitamin A supplemented groups (T1, T2, and T3) than in the aflatoxin-only group (T4). Feed conversion ratio was more efficient in the control (T5; 2.03) than vitamin A-supplemented group (T1; 2.13), while vitamin E supplementation (T3) showed comparable but non-significant improvement.

No significant differences ($p > 0.05$) were observed in carcass characteristics across treatments. The findings suggest that dietary supplementation with vitamins A and E may help alleviate the adverse effects of aflatoxin B₁ on feed intake and performance, with vitamin A at 10 g/kg showing relatively better response, although effects on carcass traits were not significant.

Keywords: aflatoxin, vitamin A, vitamin E, broiler, growth performance

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1.2 Introduction

The poultry industry is one of the most vibrant and fastest growing branches of the world livestock production, which contributes to the food security, nutrition and economic growth. Poultry meat, especially, broiler chicken, is also highly consumed as it is cheap, contains high-quality protein, and it is relatively low in fat as compared to red meat (FAO, 2022). With the growing demand of animal protein in the world, the efficiency and sustainability of broiler production systems have become the question of more importance.

Nevertheless, the industry is characterized by a great number of limitations, such as the outbreak of diseases, the price fluctuations of feed, environmental issues, and contamination of the feed with mycotoxins (Jinadu and Salihu 2024; Daramola, 2025).

Aflatoxin contamination is one of the most significant among them, and it has been a critical issue especially in the tropical and subtropical areas, where climatic factors favour the growth of fungi. The most common and toxic mycotoxin in poultry feeds is aflatoxin B₁ (AFB₁) which is produced by



Aspergillus flavus and *Aspergillus parasiticus* (Quadri *et al.*, 2012; Yunus *et al.*, 2015). It may cause severe economic losses because of low growth rate, low feed conversion ratio, immunosuppression, and high mortality rates in broiler chicken when included in their feeds like maize and groundnut cake (Kana *et al.*, 2010; Yunus *et al.*, 2011). In addition to animal health effects, aflatoxin contamination has severe health implications for the population because it is carcinogenic, and there is a risk of the residues finding their way into the human food chain (Marroquín-Cardona *et al.*, 2014; Wu *et al.*, 2017).

Vitamin A is a fat-soluble micronutrient that is important in epithelial integrity, immune competence and cellular differentiation (Shojadoost *et al.*, 2021; Guo *et al.*, 2023). Maintaining sufficient levels of vitamin A is necessary to achieve optimal growth, efficient use of nutrients, and better carcass quality in broiler chickens (Savaris *et al.*, 2012). Recent data suggests that vitamin A can offset aflatoxin-induced toxicity through several mechanisms, including the improvement of antioxidant defenses, stabilization of cell membranes, and support of hepatic function. Studies indicate that supplementation with vitamin A helps restore antioxidant parameters (such as superoxide dismutase and glutathione) that are depleted by aflatoxin B1 (AFB1) exposure, while also reducing oxidative stress. Furthermore, vitamin A has been shown to reduce the binding of AFB1-DNA adducts, protecting cellular genetic material and aiding in the reduction of liver lesion histopathology (Jobe *et al.*, 2023). Such properties have the potential of alleviating oxidative stress and enhancing physiological resilience in birds fed contaminated diets.

Vitamin E, another fat-soluble antioxidant, plays a crucial role in protecting cellular membranes from oxidative damage by scavenging free radicals. It is widely recognized for its ability to enhance immune response, improve antioxidant status, and mitigate mycotoxin-induced oxidative stress in poultry (Surai and Fisinin, 2016). Studies have demonstrated that vitamin E supplementation can alleviate the deleterious effects of aflatoxin by reducing lipid peroxidation and improving liver function in broiler chickens (Okusanya *et al.*, 2025).

Compared to vitamin A, vitamin E is considered more directly involved in oxidative stress control, which is a key mechanism of aflatoxin toxicity. However, comparative data on the efficacy of vitamins A and E under aflatoxin challenge remain limited, particularly in tropical production systems. Nevertheless, although these benefits are being reported, the results are still inconsistent on how effective vitamin A supplement can help alleviate the negative impact of AFB 1, especially concerning growth performance and carcass trait. Thus, the given research is expected to compare the impact of vitamin A dietary supplementation on growing broilers that are given a contaminated feed containing aflatoxin B 1 with the perspective of availing the information about the practical use of this specific substance in the realm of poultry nutrition and management.

2.0 MATERIALS AND METHOD

2.1 Experimental area

The experiment was conducted at the Poultry Unit, Department of Agricultural Technology Department, The Federal Polytechnic, Ilaro.

2.2 Source of Vitamin A and Aflatoxin B1:

Aflatoxin B1 was gotten from a reputable laboratory, while Vitamin A, and E were sourced from a reputable veterinary pharmacy within Ilaro metropolis.

2.3 Experimental animal and management

Ninety-six (96) day-old Arbor Acres strain chicks bought from a reputable commercial hatchery were utilized in the research. The birds were acclimatized to a period of fourteen (14) days in the brooding enclosure. Two weeks prior to the arrival of the chicks, the pen and all the equipment were cleaned and disinfected and allowed to rest. After arrival, the chicks were weighed and placed randomly in four treatment groups. The treatments were repeated thrice with sixteen birds in each case. There was rigorous compliance with normal routine and infrequent (vaccinations and medications schedules) management in chicken.

2.4 Preparation of experimental diets

The birds were fed on commercial broiler starter between day old and 3 weeks and then changed to commercial broiler finisher. The starter diet was fed to the birds between the day old and 2 weeks old to help the birds get used to the environment as well as allow the development of all the organs of the birds to mature before the aflatoxin, vitamin E and vitamin A was introduced. The starter phase using the test ingredients will take 2 weeks after which it will be replaced by the finisher phase that will take another 2 weeks. Water was fed ad libitum with vitamin A and E being varied at 10g and 15g in diet in combination with 35µi of aflatoxin.

2.5 Experimental design

The experiment was structured based on a completely randomized design (CRD). The treatment was as follows:

Treatment 1: Basal diet + 35µi of Aflatoxins + 10g of Vitamin A

Treatment 2: Basal diet + 35µi of Aflatoxins + 15g of

Treatment 3: Basal diet + 35µi of Aflatoxins + 5g of Vitamin E

Treatment 4: Basal diet + 35µi of Aflatoxins + 10g of Vitamin E

Treatment 5: Vitamin A Basal diet + 35µi of Aflatoxins + 0g of Vitamin

Treatment 6: Basal diet + 0µi of Aflatoxins + 0g of Vitamin

2.6 Data collection

2.6.1 Daily feed intake (DFI)

This was calculated by deducting feed leftover from total feed supplied.

$$DFI = \frac{\text{Total feed supplied (g)} - \text{Total feed left over (g)}}{\text{Total number of days}}$$

2.6.2 Daily weight gain

Daily weight growth was calculated by dividing its weight gain by the number of days.

$$DWG = \frac{\text{Final weight (kg)} - \text{initial weight (kg)}}{\text{Total number of days}}$$

2.6.3 Feed conversion ratio

This was determined by calculating birds feed intake and divide it by weight gain of the birds.

$$FCR = \frac{\text{Total Feed Intake(g)}}{\text{Total weight gain (g)}}$$

2.7 Carcass quality

At the completion of the experiment, two birds were randomly chosen in each treatment, one (1) per replicate to analyse carcass characteristics. The birds chosen were starved overnight and their live weights noted. The birds were slaughtered by bleeding them through the left jugular vein. They were eviscerated, defeathered and the weight of the carcasses and organs was measured. Measurements made

included: thigh, wing, breast, drumstick, gizzard, liver, and heart.

2.8 Statistical Analysis

The Turkey test, a function of IBM SPSS 26, was utilized to distinguish the treatment means after the gathered data was subjected to an ANOVA analysis. According to (SPSS 2022), statistical significance was considered when $P < 0.05$.

3.0 RESULT

As observed in table 1, the treatments differed significantly ($p < 0.05$) in feed intake (FI), average daily feed intake (ADFI) and did not differ significantly in body weight gain (BWG), average daily gain (ADG) and feed conversion ratio (FCR). Also, the growth performance of birds fed vitamin E did not show any significant differences ($p > 0.05$) (Table 3). The carcass parameters of vitamin A and E showed no significant differences ($p > 0.05$) in all parameters except in duodenum weight of vitamin E group (table 4) with T2 (33g) having the highest duodenum weight and T1 and T4 (23g) having the lower duodenum weight as seen in table 2 and table 4.

Table 1. Effect of vitamin A dietary supplementation on growth performance of broilers fed aflatoxin B1 contaminated feed.

Parameters	T1	T2	T3	T4	SEM	P-Value
Initial Weight	399.9	408.3	385.1	385.0	5.99	0.403
Final Weight	1318.8	1206.3	1247.3	1331.3	22.9	0.159
BWG (g)	918.9	798.0	862.2	946.3	22.71	0.068
ADG (g/day)	43.8	38.0	41.1	45.1	1.08	0.068
Feed Intake (g)	1954.9 ^a	1950.4 ^a	1929.2 ^b	1923.3 ^b	4.52	0.003
ADFI (g)	93.09 ^a	92.88 ^a	91.87 ^b	91.58 ^b	0.22	0.003
FCR	2.13	2.45	2.26	2.03	0.06	0.059

Table 2: Effect of Vitamin E on Growth Performance of broiler chickens fed aflatoxin B1 contaminated feed

Parameters	T1	T2	T3	T4	SEM	SIG.
Initial Weight	426.1	395.4	413.4	385.0	13.1	0.79
Final Weight	1418.9	1287.5	1247.3	1331.3	43.2	0.65
BWG (g)	992.8	892.1	833.9	946.3	33.6	0.45
ADG (g/day)	47.3	42.5	39.7	45.1	1.60	0.45
ADFI (g)	744.7	743.0	734.9	732.7	2.31	0.21
FCR	0.81	0.94	0.86	0.77	0.03	0.46



Table 3: Effect of Vitamin E dietary supplementation on growth performance of broiler chickens fed aflatoxin B1 contaminated feed

Parameters	T1	T2	T3	T4	SEM	P-Value
Live Weight (g)	1766.0	1548.0	1601.0	1376.0	86.20	0.56
Dressed Weight (g)	1602.0	1362.0	1388.0	1192.0	74.1	0.31
Eviscerated Weight (g)	1305.0	1095.0	1138.0	962.0	64.49	0.36
Breast (g)	395.0	339.0	342.0	272.0	19.67	0.15
Drumstick (g)	84.0	73.0	76.0	67.0	4.23	0.66
Thigh (g)	95.0	71.0	76.0	69.0	4.64	0.15
Back (g)	227.0	204.0	204.0	209.0	10.04	0.09
Neck (g)	57.0	45.0	55.0	48.0	3.21	0.61
Wings (g)	77.0	54.0	52.0	54.0	4.50	0.11
Shank (g)	43.0	34.0	33.0	28.0	2.32	0.88
Heart (g)	9.00	10.00	7.00	8.00	0.98	0.82
Lungs (g)	13.00	10.00	9.00	6.00	1.18	0.21
Spleen (g)	2.00	3.00	2.00	3.00	0.33	0.62
Gizzard (g)	43.0	33.0	35.0	33.0	2.20	0.38
Liver (g)	50.0	43.0	42.0	27.0	4.61	0.42
Kidney (g)	11.00	10.00	9.00	9.00	0.60	0.69
Bursa (g)	4.00	3.00	5.00	3.00	0.45	0.41
Thymus (g)	8.00	9.00	5.00	3.00	1.30	0.82
Head (g)	43.0	38.0	39.0	32.0	1.93	0.26
Duodenum Length (cm)	33.75	33.25	34.25	30.25	0.71	0.16
Duodenum Weight (g)	33.00	22.00	30.00	23.00	2.30	0.26
Jejunum Length (cm)	85.25	75.00	88.50	74.50	3.58	0.49
Jejunum Weight (g)	38.00	37.00	45.00	32.00	2.33	0.30
Ileum Length (cm)	91.00	79.00	72.50	71.00	3.75	0.22
Ileum Weight (g)	38.00	28.00	27.00	21.00	3.10	0.31

Table 4: Effect of Vitamin E dietary supplementation on carcass quality of broiler chickens fed aflatoxin B1 contaminated feed

Parameters	T1	T2	T3	T4	SEM	Sig.
Live Weight (g)	1732.0	1545.0	1601.0	1376.0	71.42	0.44
Dressed Weight (g)	1530.0	1378.0	1388.0	1192.0	64.69	0.39
Eviscerated Weight (g)	1288.0	1131.0	1138.0	962.0	61.63	0.38
Breast (g)	401.0	343.0	342.0	272.0	24.01	0.36
Drumstick (g)	86.0	83.0	76.0	67.0	4.00	0.41
Thigh (g)	65.0	80.0	76.0	69.0	7.04	0.93
Back (g)	240.0	188.0	204.0	209.0	11.15	0.51
Neck (g)	61.0	48.0	55.0	48.0	2.88	0.37
Wings (g)	64.0	54.0	52.0	54.0	2.73	0.49
Shank (g)	38.0	37.0	33.0	28.0	1.81	0.18
Heart (g)	9.00	9.00	7.00	8.00	0.60	0.69
Lungs (g)	8.00	8.00	9.00	6.00	0.80	0.71
Spleen (g)	1.00	3.00	2.00	3.00	0.45	0.41
Gizzard (g)	33.0	40.0	35.0	33.0	1.41	0.27
Liver (g)	39.0	40.0	42.0	27.0	2.95	0.30
Kidney (g)	8.00	14.00	9.00	9.00	1.20	0.32
Bursa (g)	5.00	3.00	5.00	3.00	0.54	0.38
Thymus (g)	7.00	9.00	5.00	8.00	1.41	0.86
Head (g)	39.0	42.0	39.0	32.0	2.14	0.49
Duodenum Length (cm)	27.75	34.25	34.25	30.25	1.25	0.15
Duodenum Weight (g)	23.00	33.00	30.00	23.00	1.81	0.05
Jejunum Length (cm)	67.00	80.25	88.50	74.50	3.87	0.27
Jejunum Weight (g)	36.00	45.00	45.00	32.00	2.47	0.10
Ileum Length (cm)	59.50	71.25	72.50	71.00	2.53	0.23
Ileum Weight (g)	25.00	32.00	27.00	21.00	1.67	0.07

4.0 DISCUSSION

The current study compared the growth performance and carcass traits of aflatoxin B 1 exposed broiler chickens that were dietary supplemented with vitamins A and E. The results showed that there were no significant differences ($p > 0.05$) in most of the performance and carcass parameters in all treatments; nevertheless, there were uniform numerical improvements in birds fed with vitamin supplements suggesting a possible protective effect against aflatoxin-induced stress.

The numerical growth performance enhancement in vitamin A-supplemented groups supports the proven role of vitamin A in the preservation of epithelial integrity, immune competence, and cellular differentiation (Shojadoost et al., 2021; Guo et al., 2023). These body processes play a critical role in effective use of nutrients and development. In a similar manner, other research studies have indicated increased

growth performance and feed efficiency in broiler chicken fed with vitamin A during stressful situations (Kumar et al., 2011; Sakamoto et al., 2012). This may be due to the higher feed intake in supplemented groups, which could have been a result of a healthier gut and an adaptive response to counteract the harmful aflatoxin, which is known to inhibit appetite and liver activity (Yunus et al., 2011; Marroquin-Cardona et al., 2014).

The positive numerical outcomes of vitamin E supplementation were also observed on the growth performance and carcass characteristics. Vitamin E is a powerful lipid-soluble antioxidant that is essential in saving cell membranes against oxidative damage and increases physiological stability in toxin-exposed birds (Surai and Fisinin, 2016). The increased final weight, body weight gain and feed conversion ratio of the vitamin E-supplemented groups indicate increased metabolic efficiency and minimized oxidative stress. These data are in line with the evidence that

vitamin E supplementation increases antioxidant status, immune response, and overall performance of broiler chickens exposed to environmental or dietary stressors (Hassan et al., 2020).

Even though carcass traits did not differ significantly, the fact that both vitamin A- and E-supplemented groups had numerically significant increases of dressed and eviscerated weights indicates better nutrient partitioning and muscle growth. This could be explained by the synergistic effects of these vitamins to preserve cell integrity and protein metabolism. The lack of statistical significance may be due to variability among experimental units or the relatively short duration of the study.

The paper also validates the negative effect of aflatoxin contamination on poultry production. Aflatoxin B1 is also infamous to affect the growth, decrease the feed efficiency, and inhibit immune activity of broiler chickens (Yunus et al., 2011). This is especially acute in developing nations, where the storage environment makes feedstuffs vulnerable to fungal infections (Daramola and Omokpariola, 2025; Jinadu and Salihu, 2024). Besides the health effects on animals, aflatoxin contamination has critical public health effects and is carcinogenic, which can be embedded in the human food chain (Wu et al., 2017).

Mitigating effects of vitamins A and E may be attributed to antioxidant property of vitamins A and E, as well as their functions in hepatic and immune stability. Antioxidants also aid in balancing reactive oxygen species formed during aflatoxin metabolism and hence lessening cellular injury and enhancing physiological functionality (Surai et al., 2019). A combination of these vitamins can thus be a feasible approach to nutrition to increase resilience among broiler chickens undergoing mycotoxin-contaminated diets.

5.0 Conclusion

This experiment revealed that vitamins A and E dietary supplementation did not significantly affect most growth performance and carcass parameters of aflatoxin B1-exposed broiler chicken. Nevertheless, sustained numerical benefits were seen in groups supplemented, which is indicative of a possible ameliorative effect of the vitamins against the stress-induced by aflatoxins. Vitamin A helped in better nutrient use and immune system and vitamin E helped protect the antioxidants and cells. As these effects were not statistically significant, they suggest that both vitamins can have supportive effects on improving the performance of broilers when challenged with mycotoxins.

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