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Ameliorative effect of hog plum and vitamin A on growth performance of broiler chicken Inoculated with Aflatoxin B1

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ABSTRACTS: A feeding trial of 56 days was carried out on broiler chickens to evaluate the growth-enhancing effects of one millilitre (ml) of ethanolic extract of hog plum (EHP) and vitamin A per litre of water when they are fed aflatoxin B1 (AF) per kilogram of feed. Two hundred and eighty day old arbor acre broiler chicks were purchased and allowed to acclimatise for 2 weeks, the birds were then randomly allotted into seven treatments (T). At the starter phase, each T received: T1: 0 ml of Vit A + 0 ml of EHP + 0 µg/kg of AF, T2: 35 µg/kg of AF, T3: 1 ml of EHP, T 4: 1 ml of EHP + 35 µg/kg of AF, T5: 35 µg/kg of AF, T6: 1 ml of Vit A, T7: 1 ml of Vit A + 35 µg/kg of AF. At the finisher phase, each treatment received: T1: 0 ml of EHP + 0 µg/kg of AF, T2: 1 ml of EHP, T3: 35 µg/kg of AF, T4: 0 ml EHP + 0 µg/kg of AF, T5: 1 ml of Vit A, T6: 35 µg/kg of AF, T7: 0 ml Vit A + 0 µg/kg of AF. Feed intake, body weight gain, feed conversion ratio, carcass characteristics, and lymphoid organs percentage weights were recorded and subjected to analysis of variance. The least significant difference was used to assess the significant difference among groups. The result reveals that the final weights of the treatment groups were statistically comparable with the control at the starter (757.89 to 821.16 g) and best in T6: 35µg/kg of AF (2074.00 g) at the finisher phase. The FCR values indicate that treatment 6: 1 ml of Vit A (1.79) had the best feed conversion at the starter phase while treatments 4: 0 ml EHP + 0 µg/kg of AF, T6: 35 µg/kg of AF and T7: 0 ml Vit A + 0 µg/kg of AF had the best FCR at the finisher phase. The study concluded that administration of Vitamin A before the introduction of aflatoxin might mitigate the adverse effect of aflatoxin contamination on growth performance, thereby improving the growth and healthy gut of broiler chickens.

Keywords: Aspergillus, chicken, contamination, growth, vitamins.

INTRODUCTION

One prominent contamination of several grains used in poultry diets has been identified as *Aspergillus*, a kind of soil fungus that includes different species such as *Aspergillus flavus (*Produces aflatoxin B_1), *Aspergillus parasiticus* (aflatoxins B_1, B_2, G_1, G_2), *Aspergillus ochraceus* (ochratoxin A). They produce biologically active, hepatotoxic aflatoxins and develop quickly in high-moisture environments (Naveed *et al*., 2022). These fungi contaminate a variety of feed materials, including maize, rice, wheat, pistachios, cottonseed, copra, and groundnuts. Furthermore, when aflatoxin-contaminated feed is consumed by chickens, it metabolises and has detrimental effects on their body, including stunted growth, harm to internal organs like the liver and kidney, immunosuppression from damaged lymphoid organs, increased susceptibility to microbial and environmental stresses, and a high death rate (Ulaiwi, 2018).

Aflatoxin contamination prior to harvest can occur when crops' resistance to Aspergillus species is reduced due to drought stress or insect damage. Aflatoxin generation and Aspergillus colonization are further encouraged by warm, humid circumstances during crop maturation, harvest,

transportation, or storage (Monson *et al.,* 2015).

Aflatoxin-related issues mostly affected the poultry sector, resulting in significant financial losses substantially correlated with high rates of illness and death. Because of this, horizontal transmission (through milk, meat, and eggs from poultry that consume contaminated feed) (Monson *et al.,* 2015) can occur between humans and animals, making it a serious public health concern (Attia *et al.,* 2016). Aflatoxin-induced aflatoxicosis in livestock and poultry is mostly to blame for the disease's severe immune system suppression and decreased productivity (Yang, *et al*., 2020).

Admits the different types of aflatoxins, aflatoxin B1 (AFB1) stands out as a frequent contaminant in poultry feed in tropical and subtropical areas. AFB1 biosynthesis thrives under temperatures around 30°C and a water activity level of 0.99, though factors like substrate, duration, Co_2 levels, and other environmental conditions are also crucial. The detrimental effects of this aflatoxin on the health of chickens have been extensively studied over the course of the previous fifty years. Aflatoxin B1 can have a negative impact on grill performance even at low doses, as evidenced from previous studies (Fawaz *et al.,* 2022).

Furthermore, a number of research have demonstrated the hepatotoxic and carcinogenic properties of aflatoxins (Chen *et al.,* 2016; Gan *et al*., 2018; Nazhand *et al*., 2020). Decontamination techniques for lowering aflatoxins in feed materials come in a variety of forms and include chemical, physical, and biological approaches. Chemical methods entail changing aflatoxins via different chemical processes. It has been demonstrated that methods like ozonation, ammonization, and peroxidation are efficient against one or more aflatoxins. These procedures run the risk of changing the toxicity of the food, which could affect its flavour and nutritional value (Ab Aziz *et al*. 2020).

Immunological reactions and disease risk in hens have been linked to vitamin A deficiency (Pimpukdee *et al*., 2004). In fact, there is a noteworthy correlation between the overall health of hens and the availability or status of vitamin A (Aye *et al.,* 2000 a,b; Dalloul *et al.,* 2002). According to investigations, immune defenses against coccidiosis-challenged broilers were weakened due to a vitamin A shortage in their diet, as evidenced by lymphocyte profiles, oocyst shedding, and interferon-γ levels (Dalloul *et al*., 2002).

Phytobiotics, which are natural substances derived from plants and known for their positive effects on animal health and growth, are being explored as a natural approach to counteract the harmful effects of aflatoxins in animal feed. Hog plum, (Iyeye in Yoruba) is a kind of plant that is indigenous to the tropical Americas, and widely distributed over tropical Asia and Africa, its extracts function as a broad spectrum antifungal and are effective against enterobacteria that produce beta-lactamases (Osuntokun, 2018).

Hog plum (*Spondias mombin*) attracts research interest because of its multiple nutritional aspects together with medical uses while demonstrating promising applications in animal farming, especially poultry. The nutritional content of hog plum exists in both the leaves and the fruits. The leaves of Hog plum contain 94.57% dry matter alongside 13.36% crude protein, 9.86% ash and 67.87% nitrogen-free extract. The valuable nutritional characteristics of hog plum serve as an important feed resource during times of scarce conventional fodder availability in dry seasons (Bishir *et al*., 2022). These functional properties of hog plum stem from bioactive compounds including saponins and tannins as well as phytates and oxalates (Bishir *et al*., 2021).

MATERIALS AND METHODS

Experimental animals

The experiment was carried out at the Poultry Unit Teaching and Research Farm, The Federal Polytechnic Ilaro, Ogun State, Nigeria. Two hundred and eighty (280) day-old arbor acre broiler chicks were used for this study. The chicks were bred at complete hygiene conditions where standard brooding procedure was adhered. Feed and water were provided *ad libitum*. The birds were allotted to seven (7) treatments, each treatment has four replicates of ten birds each making forty birds per treatment. All birds were subjected to complete vaccination programs during the period of the experiment (56 days).

Aflatoxins, Vitamin A, and Hog plum extract

AF B1 and Vit A were purchased from a reputable laboratory in Ibadan, Nigeria, while fresh hog plum leaves were harvested from the Federal Polytechnic, Ilaro community, dried under room temperature, and then ground into powder using a blender (Pyramid® PM-B999) (10). Ten grams of the hog plum blend was added to 100 ml of pure ethanol (1:10) in an airtight container and allowed to stay for 24 hours. The solution was filtered using a muslin filter and the extract of hog plum (EHP) was stored in a container and used for the experiment**.** Commercial feed was used for the purpose of the study.

Experimental design

The experiment lasted for 6 weeks and 1 week of rest in between the treatment. Each treatment received aflatoxin B1 contamination, Hog plum, and vitamin A as shown in Table 1.

Feed intake

This was recorded daily for each replicate. Feed leftover was subtracted from the amount of feed offered to the birds over 24 hours using the formulas below;

Table 1. Experimental design.

Treatment	First 3 weeks (before)	3-6 weeks (after)
Treatment 1	0 ml of Vitamin A +0 ml of EHP + 0 µg/kg of Aflatoxins	0 ml of EHP + 0 µg/kg of Aflatoxins
Treatment 2	35 µg/kg of Aflatoxins per kg of feed + 0 ml of EHP	1 ml of EHP per litre of water + 0 µg/kg of Aflatoxins
Treatment 3	1 ml of EHP per litre of water + 0 µg/kg of Aflatoxins	35 µg/kg of Aflatoxins per kg of feed
Treatment 4	1 ml of EHP per litre of water + 35 µg/kg of Aflatoxins per kg of feed	0ml EHP per litre of water + 0 µg/kg of Aflatoxins per kg of feed
Treatment 5	35 µg/kg of Aflatoxins per kg of feed + 0 ml Vit A.	1ml of Vitamin A per litre of water + 35 µg/kg of Aflatoxins per kg of feed
Treatment 6	1 ml of Vitamin A per litre of water + 0 µg/kg of Aflatoxins	35 µg/kg of Aflatoxins per kg of feed + 0 ml Vit A.
Treatment 7	1 ml of Vitamin A per litre of water + 35 µg/kg of Aflatoxins per kg of feed	0ml Vitamin A per litre of water + 0 µg/kg of Aflatoxins per kg of feed.

Feed Intake (g/bird/day) = Feed given – Total Feed Left

$$\text{Average Feed Intake (g/bird)} = \frac{\text{Feed Intake}}{\text{No of birds per replicate}}$$

Body weight gain

Weight gain per bird was measured by deducing the difference between the final body weight and initial body weight and dividing this value by the number of birds per replicate.

$$\text{Body weight Gain (g/bird)} = \frac{\text{Final Weight (g)} - \text{Initial Weight (g)}}{\text{No of Birds Per replicate}}$$

Feed conversion ratio

The feed conversion ratio was calculated by dividing the feed intake by weight gain.

$$\text{FCR} = \frac{\text{Total Feed Intake (g)}}{\text{Weight Gain}}$$

Carcass characteristic and weight of lymphoid organs

At the end of the experiment, two birds were chosen at random from each replication (near the average weight of each replication) to undergo carcass and bodily organ examination. To guarantee that the digestive tract was empty, the feed was stopped for six hours before slaughter. The birds were slaughtered through neck decapitation, the birds were then eviscerated after plucking. Dressing percentage, breast, thigh, abdominal fat, gizzard, and the weights of the heart, liver, and lungs were used to assess the responses of the carcass and bodily organs. By dividing the dressed weight (without viscera) by the live weight and multiplying the result by 100, the dressing percentage (DP) was determined. Together with visceral weight, the weights of the gizzard, heart, liver, lungs, and digestive organs were computed as a proportion of overall weight.

Statistical analysis

All data collected in this study were subjected to one-way Analysis of Variance (ANOVA) as contained in the Minitab software Version 17.1.0. Significantly, ($P < 0.05$) different means among variables were separated using a Tukey test contained in the same software.

RESULTS AND DISCUSSION

Table 2 shows the starter phase results with significant treatment effects ($p<0.05$) that influenced broiler growth parameters under AFB1 exposure conditions together with protective supplements administration. T5 (AFB1 alone) started with 310.53 g weight yet achieved the lowest final weight at 757.89 g indicating delayed toxic effects of AFB1. The toxicity of AFB1 becomes visible in week 3 according to research by Huff *et al*. (2016) which showed progressive weight loss in poultry due to hepatic damage and protein synthesis inhibition.

The significant ($p<0.05$) final weights in T6 (Vit A, 821.05 g) and T1 (control, 821.16 g) underscore vitamin A's protective role (Table 3). Vit A effectively maintains intestinal tract viability through its protective mechanism for tight junctions as Dalloul *et al*. (2020) reported as well as lowering AFB1 entry (Zhang *et al*., 2022) and driving hepatic detoxification mechanisms by activating cytochrome P450 enzymes (Gan *et al*., 2018).

The superior feed conversion ratio of 1.79 in T6 demonstrates that Vitamin A optimization plays a dominant role in proper nutrient metabolism. Surai *et al.* (2019) demonstrated that Vitamin A helps the body produce bile acids to boost lipid digestion along with regulating gut microbes to enhance short-chain fatty acids for energy production.

Table 2. Effect of vitamin A and hog plum in preventing aflatoxicosis on growth of broiler chicken at 3 weeks.

Parameters	T1	T2	T3	T4	T5	T6	T7	SEM±
Initial Weight (g)	266.77^{cd}	274.56^{cd}	265.79^{d}	263.16^{d}	310.53^{a}	294.74^{ab}	278.95^{bc}	101.37
Final weight (g)	821.16^{a}	786.55^{bc}	800.00^{ab}	778.95^{bc}	757.89^{cd}	821.05^{a}	810.53^{ab}	306.83
Weight gain (g)	554.39^{a}	511.98^{ab}	534.21^{a}	515.79^{ab}	447.36^{bc}	526.31^{a}	531.58^{a}	101.37
Feed Intake (g)	1672.88^{a}	1601.32^{bc}	1576.68^{bcd}	1563.07^{cd}	1573.34^{bcd}	1546.73^{d}	1570.76^{bcd}	666.79
FCR	2.77^{a}	2.30^{c}	2.18^{c}	2.48^{b}	2.50^{b}	1.79^{b}	1.92^{d}	0.005

^{a,b,c} Means in the same column by factor with different superscripts are significantly (P<0.05) different, SEM: Standard error of means.

Table 3. Effect of Vitamin A and hog plum in preventing aflatoxicosis on carcass and weight of lymphoid organs of broiler chicken at 3 weeks.

Parameters	T1	T2	T3	T4	T5	T6	T7
Live weight (g)	1126.00^{a}	982^{abc}	871.00^{c}	1039.50^{ab}	908.50^{bc}	1046.50^{ab}	971.50^{ab}
Dressed weight (g)	1027.50^{a}	866.33^{bc}	792.00^{c}	933.50^{ab}	812.50^{bc}	945.50^{ab}	868.50^{bc}
Eviscerated Weight (g)	799.50^{a}	662.33^{bc}	639.50^{bc}	676.50^{bc}	581.00^{c}	727.50^{ab}	645.00^{bc}
Drum stick (g)	55.50^{a}	42.33^{bc}	40.00^{bc}	45.50^{b}	34.50^{c}	43.00^{bc}	43.50^{bc}
Back (g)	127.00	112.67	105.00	107.00	96.00	122.00	105.50
Head (g)	49.00^{a}	45.33^{ab}	41.00^{bc}	37.50^{c}	40.00^{bc}	42.00^{bc}	39.50^{bc}
Thigh (g)	46.00^{ab}	43.67^{ab}	40.00^{b}	40.50^{ab}	38.50^{b}	48.50^{a}	41.50^{ab}
Breast (g)	172.00^{ab}	189.67^{ab}	173.50^{ab}	188.50^{ab}	145.50^{b}	195.00^{a}	182.00^{ab}
Wings (g)	48.00^{ab}	37.00^{c}	37.00^{c}	43.50^{abc}	37.00^{c}	49.50^{a}	40.50^{c}
Shank (g)	27.00^{a}	22.67^{ab}	23.00^{ab}	22.50^{b}	21.50^{b}	25.00^{ab}	23.50^{ab}
Neck (g)	30.50^{a}	21.50^{b}	21.67^{b}	24.00^{ab}	20.50^{b}	26.00^{ab}	24.00^{ab}
Kidney (g)	5.50^{a}	4.67^{a}	2.50^{c}	4.50^{ab}	4.50^{ab}	5.50^{a}	3.50^{bc}
Lungs (g)	8.50^{a}	5.33^{b}	5.00^{b}	5.50^{b}	4.50^{b}	8.00^{a}	4.50^{b}
Heart (g)	4.50^{bc}	4.67^{bc}	4.00^{c}	3.50^{d}	4.50^{bc}	4.50^{bc}	5.00^{ab}
Gizzard (g)	25.50^{abc}	21.00^{c}	22.00^{bc}	28.50^{a}	21.50^{bc}	28.00^{a}	21.00^{c}
Proventiculus (g)	6.50^{a}	5.00^{b}	5.00^{b}	5.50^{ab}	6.50^{a}	6.00^{ab}	5.50^{ab}
Liver (g)	29.50^{ab}	24.67^{c}	21.50^{c}	25.50^{bc}	22.50^{c}	25.50^{bc}	21.00^{c}
Thymus (g)	4.500^{a}	3.667^{ab}	2.500^{abc}	1.500^{bc}	1.000^{c}	5.000^{a}	1.500^{bc}
Bursa (g)	2.000	2.000	1.000	2.000	1.500	2.000	1.500
Spleen (g)	1.00	1.00	1.00	1.00	1.00	2.00	1.00
Duodenum (g)	19.50^{abc}	17.67^{abc}	15.50^{c}	20.50^{ab}	20.50^{ab}	21.50^{a}	18.00^{abc}
Dudenum (cm)	34.00^{a}	33.00^{a}	28.00^{b}	36.00^{a}	34.50^{a}	31.50^{ab}	32.25^{ab}
Ileum (g)	37.50^{ab}	39.00^{a}	24.50^{b}	42.00^{a}	34.50^{ab}	34.50^{ab}	35.50^{a}
Ileum (cm)	95.50	86.00	76.00	88.50	92.50	84.00	88.00
Jejunum (g)	44.00^{ab}	42.67^{ab}	20.00^{c}	47.50^{a}	48.50^{a}	40.00^{ab}	34.00^{b}
Jejunum (cm)	95.50^{a}	83.00^{ab}	74.50^{bc}	89.00^{ab}	89.00^{ab}	75.50^{bc}	59.50^{c}

^{a,b,c} Means in the same column by factor with different superscripts are significantly (p<0.05) different.

Research demonstrates that animals in T6 consumed less feed than those in T1 (1546.73 vs. 1672.88 g) indicating that vitamin A increases nutrient accessibility which leads to lower consumption. The study findings agree with Wang *et al*. (2021) who reported that antioxidant supplementation delivered about 18% performance improvement in broiler chickens fed AFB1-contaminated feeds.

The experiment revealed an 18.6% decrease in dressed weight between T2 (AFB1 alone, 866.33 g) and T1 (1027.50 g) indicating the catabolic nature of AFB1 toward muscle protein synthesis. A study conducted by Amici *et al*. (2007) showed that aflatoxins bind to the 20S proteasome, which in turn affects its functional capabilities. The proteasome functional modification caused by aflatoxins disrupts protein turnover and induces protease activity that can damage muscles thereby leading to a decrease in weight of birds administered aflatoxin alone. Both EHP + AFB1 in T4 and Vit A + AFB1 in T7 managed to restore protein loss to some extent but Vit A demonstrated better protective results.

While AFB1 demonstrates immunosuppressive properties through its reduction of thymus weight from 1.00 g in T5 to 5.00 g in T6 according to results, which support Hussein and Brasel's (2001) findings. The better preservation of lymphoid organs by Vitamin A comes from its ability to regulate T-cell differentiation through retinoic acid receptors and decrease immune cell oxidative DNA damage (Pimpukdee *et al.,* 2004; Yang *et al.,* 2020).

The difference between T5 (22.50 g) and T6 (25.50 g) liver weights shows vitamin A's protection of the liver

Table 4. Effect of vitamin A and hog plum in preventing aflatoxicosis on growth of broiler chicken at 6 weeks.

Parameters	T1	T2	T3	T4	T5	T6	T7	SEM
Initial Weight (g)	821.16^{a}	786.55^{bc}	800.00^{ab}	778.95^{bc}	757.89^{cd}	821.05^{a}	810.53^{ab}	306.83
Final weight (g)	1967.67^{a}	1947.67^{a}	1953.00^{a}	2030.50^{a}	1747.00^{b}	2074.00^{a}	2037.50^{a}	11950.55
Weight gain (g)	1146.51^{ab}	1161.12^{ab}	1153.00^{ab}	1251.55^{a}	989.11^{b}	1252.95^{a}	1226.97^{a}	12215.32
Feed Intake (g)	2723.42^{b}	2734.17^{b}	2608.32^{bc}	2558.32^{c}	2633.32^{bc}	2628.32^{bc}	2854.51^{a}	4364.04
FCR	2.39^{ab}	2.37^{ab}	2.27^{b}	2.04^{b}	2.67^{a}	2.09^{b}	2.33^{ab}	0.038

^{a,b,c} Means in the same column by factor with different superscripts are significantly ($p<0.05$) different.

Table 5. Effect of vitamin A and hog plum in preventing aflatoxicosis on carcass and weight of lymphoid organs of broiler chicken at 6 weeks.

Parameters	T1	T2	T3	T4	T5	T6	T7	T8	SEM
Live Weight (g)	1967.67^{a}	1947.67^{a}	1953.00^{a}	2030.50^{a}	1747.00^{b}	2074.00^{a}	2037.50^{a}	2066.50^{a}	11950.55
Dressed weight (g)	1717.00^{ab}	1742.00^{a}	1656.00^{ab}	1767.00^{a}	1528.00^{b}	1780.50^{a}	1846.50^{a}	1835.50^{a}	11473.97
Eviscerated weight (g)	1528.00^{a}	1513.67^{ab}	1487.50^{ab}	1559.50^{a}	1352.50^{b}	1540.50^{a}	1649.50^{a}	1571.00^{a}	8562.57
Drum stick (g)	90.33^{ab}	94.00^{ab}	90.50^{ab}	96.00^{ab}	84.50^{b}	94.50^{ab}	103.50^{a}	87.50^{b}	48.197
Back (g)	218.67	247.00	223.50	220.50	210.00	229.00	254.50	243.00	812.885
Head (g)	48.667^{ab}	46.33^{bc}	44.00^{cd}	51.00^{a}	48.00^{ab}	40.50^{d}	42.00^{d}	40.50^{d}	4.771
Thigh (g)	99.667^{ab}	93.667^{abc}	92.000^{bc}	106.50^{ab}	82.00^{c}	100.00^{ab}	109.00^{a}	96.000^{abc}	67.614
Breast (g)	366.67^{ab}	368.00^{ab}	361.00^{ab}	420.00^{a}	313.00^{b}	368.50^{ab}	386.50^{a}	397.00^{a}	993.72
Wings (g)	71.33^{ab}	74.67^{a}	60.50^{ab}	59.50^{ab}	54.00^{b}	73.00^{ab}	74.00^{a}	59.00	99.645
Shank (g)	41.33^{a}	36.00^{b}	42.00^{a}	41.00^{a}	39.00^{ab}	41.50^{a}	41.50^{a}	36.00^{b}	4.22
Neck (g)	61.33^{cd}	49.33^{d}	68.00^{bc}	74.00^{ab}	47.50^{e}	71.50^{bc}	82.500^{a}	53.00^{de}	35.80
Kidney (g)	6.33^{b}	4.66^{cd}	4.50^{cd}	6.50^{b}	4.00^{d}	4.00^{d}	9.00^{a}	6.00^{bc}	0.77
Lungs (g)	10.00	10.67	9.500	10.00	7.500	7.500	9.500	9.500	2.94
Heart (g)	8.33^{abc}	7.00^{dc}	7.50^{bcd}	7.50^{bcd}	6.50^{d}	9.50^{a}	9.00^{ab}	6.50^{d}	0.69
Gizzard (g)	32.33^{b}	32.33^{b}	42.50^{ab}	42.50^{ab}	35.50^{ab}	39.50^{ab}	35.00^{ab}	44.00^{a}	30.33
Proventiculus (g)	6.33^{ab}	6.33^{ab}	7.00^{ab}	6.50^{ab}	3.50^{b}	7.50^{a}	9.50^{a}	6.00^{ab}	3.58
Liver (g)	32.33^{abc}	37.66^{a}	33.00^{abc}	30.00^{bc}	28.00^{c}	36.50^{ab}	39.50^{a}	38.50^{a}	15.42
Thymus (g)	11.67^{a}	7.67^{ab}	6.00^{b}	6.00^{b}	7.67^{b}	4.50^{b}	4.50^{b}	11.50^{a}	6.67
Bursa (g)	0.00^{c}	0.00^{c}	0.00^{c}	0.00^{c}	1.00^{ab}	1.50^{a}	0.50^{bc}	0.00^{c}	0.18
Spleen (g)	1.00^{b}	1.33^{b}	1.50^{ab}	1.00^{b}	1.00^{b}	2.00^{a}	1.50^{ab}	2.00^{a}	0.10
Duodenum (g)	20.33^{ab}	18.00^{abc}	20.00^{ab}	16.50^{abc}	15.00^{c}	16.00^{bc}	21.00^{a}	20.00^{ab}	5.57
Dudenum (cm)	30.33^{ab}	27.00^{b}	37.25^{a}	29.50^{b}	26.50^{b}	26.50^{b}	31.25^{ab}	30.50^{ab}	14.96
Ileum (g)	20.33^{b}	25.66^{ab}	28.50^{ab}	21.50^{ab}	21.00^{ab}	27.00^{ab}	23.50^{ab}	32.00^{a}	32.92
Ileum (cm)	70.00^{bc}	77.00^{ab}	76.00^{abc}	76.00^{abc}	86.25^{a}	64.50^{c}	78.00^{ab}	72.50bc	41.53
Jejunum (g)	28.00	29.00	29.00	26.50	31.50	25.50	32.50	27.50	31.03
Jejunum (cm)	70.333^{ab}	78.16^{ab}	71.00^{ab}	71.75^{ab}	79.75^{a}	62.50^{b}	75.75^{b}	68.00^{ab}	69.85

^{a,b,c} Means in the same column by factor with different superscripts are significantly ($p<0.05$) different.

function because it strengthens glutathione synthesis and blocks DNA from AFB1-epoxide binding (Chen *et al*., 2016, Nazhand *et al*., 2020).

Table 4 shows the long-term growth performance assessment from weeks 1 to 6. Cows in T6 received the maximum final weight of 2074.00 g, which indicated that dietary Vitamin A delivery achieved long-term sustainability. Antioxidants according to Ledoux *et al.* (1998) sustain muscle deposition through their ability to stimulate IGF-1 secretion and prevent chronic oxidative stress, which preserves metabolic efficiency.

The FCR advantage in T4 (EHP + AFB1, 2.04) and T6 (Vit A, 2.09) vs. T5 (2.67) underscores their synergistic potential. Recent research conducted by Sarker *et al*. (2023) established that polyphenols from EHP like gallic acid augment amylase activity by 27% alongside Vit A increasing the function of intestinal nutrient transporters such as SGLT1.

The findings presented in Table 5 indicate that in the study on broiler chickens given several treatments, Vitamin

A and EPH contained Aflatoxin B1 (AFB1) at six weeks. The overall body weight of birds differed from the lowest in Treatment 5 (1747.00 g) to the highest in Treatment 4 (2030.50 g). This implies that EHP together with AFB1 may offset some of the post-toxin pathology consequences.

It is evident from the study that AFB1 reduces the live weight gain in broilers. Sarker *et al*. (2023) in their report found that feeding broilers on diets containing AFB1 reduced average daily gain significantly. Nevertheless, the findings of the present study are supported by the results reported by Radwan *et al*., (2013) to some extent regarding dietary interventions like vitamins, which may be effective in reducing the impacts of AFB1 on the live weight of birds.

The dressed weights obtained varied between 1528.00 g in Treatment 5 to 1846.50 g in Treatment 7, this showed that supplementing with EHP or vitamin A improves carcass yield. In various trials, it has been shown that aflatoxin contamination reduces dressing percentages. For instance, Raju and Devegowda (2000) pointed out that AFB1 of 0.5 mg/kg or higher could lower the dressing yield as was seen in the current study. Using the same figure, the eviscerated weights also experienced disparity where Treatment 4 recorded a high weight (1559.50 g). This means that dietary supplements may assist in enhancing the general body status rather than compromise it due to AFB1. Sarker *et al* (2023) who reported that AFB1 reduced the eviscerated weights due to poor nutrient assimilation and growth rate demonstrated similar findings.

Breast weights were notably higher in Treatments 4 and 7 compared to others, indicating enhanced muscle development under certain dietary conditions. Zain *et a*l. (2020) noted a decrease in breast meat yield when exposed to high levels of AFB1 has reported the impact of AFB1 on breast muscle yield. This contrasts with current findings where dietary interventions appeared to improve breast weight, especially with birds who received vitamin A before the introduction of AFB1-contaminated feed.

One of the functions of AFB1 is its ability to accumulate in organs such as the heart, kidney, and liver, thereby leading to hypertrophy or organ damage over a period causing mortality in the end (Hussein and Brasel, 2001). From the result in Table 5, the heart and liver weights were observed to show significant variation, particularly with Treatment 7 recording the highest liver weight (39.50 g). Previous research has also shown the potential of AFB1 to cause severe liver damage this is majorly due to the liver being the primary point of absorption according to Yunus *et al*., (2011).

Diffusion is the process by which digested nutrients enter the bloodstream through the intestinal wall. Indicators such as villus height (VH), crypt depth (CD), and the villus-to-crypt ratio (VCR) reflect the health and structure of the intestine, which can be used to assess gut health. The growth of birds is heavily reliant on nutrient absorption occurring in the intestinal crypts and villi (Hernandez *et al*., 2006).

From the result, a significant reduction was observed in the weight of the jejunum with treatment 3 (EHP) recording a very low weight compared to other treatment groups in the first 3 weeks of the study. This variation could be due to the stress of the birds adapting to the dosage of the hog plum administered as hog plum has been reported to contain high levels of tannins and saponins (Osuntokun, 2018), this might temporarily cause the reduced gut organ size seen in Treatment 3 (EHP).

In addition, other variations in duodenum and ileum weights and length in this study suggest that dietary treatments may influence gut health, which is critical for nutrient absorption. Studies have shown that AFB1 negatively affects intestinal morphology, reducing villus height and increasing crypt depth, which compromises nutrient absorption (Zhang *et al*., 2022).

Conclusion

The study concluded that administration of Vit A might mitigate the adverse effect of aflatoxin contamination if administered before feeding birds with aflatoxin-contaminated feed. Studies suggest that Vitamin A shows better results in treating fungi due to its immune system regulation capabilities combined with antioxidant actions. EHP showed antifungal capability but its effectiveness remained lower than Vitamin A since bioactive compound concentrations varied.

This observation was evident in the improved weight gain, feed conversion ability, and overall performance of the treatment groups thereby improving their growth and healthy gut environment.

Recommendation

From the results of the study:

1. Administer vitamin A before aflatoxin exposure to enhance resistance.
2. Include Vit A in premixes at levels above standard requirements (e.g., 8,000–15,000 IU/kg feed) if aflatoxin risk is high.
3. Further research should be conducted to determine the optimal Vit A dosage for different poultry breeds.
4. Further studies are also required to ascertain at what level will EHP be effective in significantly mitigating the effect of aflatoxicosis

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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