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Response of Pullet Chicks to Dietary FumonisinB_1: Growth Indices and Haematological Parameters

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Abstract: Growth indices and heamatological parameters of 180 Isa brownpullet chicks fed graded levels of dietary fumonisin B_1 (an environmental mycotoxin produced by *Fusariumverticillioides*) were studied in a feeding trial that lasted nine weeks. The chicks, having similar initial average weights were randomly assigned to four experimental diets containing 0.2, 5.2, 10.2, and 15.2 mgFB_1/kg constituting diets 1(control), 2, 3, and 4 respectivelyin a completely randomized design. Each dietary treatment had three replicates of 15 chicks each. The feed intake was monitored daily and the chicks weighed weekly. Blood samples were collected at the end of the trial and analyzed. Results revealed a non-significant ($P>0.05$) but FB_1 concentration dependent decrease in daily feed intake, final live weight and daily weight gain of chicks fed diets 2, 3, and 4 when compared with those on diet 1. Crude protein and ether extract digestibility decreased significantly ($P < 0.05$) as the dietary FB_1 levels increased. The dry matter digestibility of chicks on diets 2, 3, and 4 were 94.77, 95.07 and 94.81 % respectively of the control value. Chicks fed diets containing 10.2 and 15.2 mg FB_1/kg suffered significantly ($P < 0.05$) reduced concentration of erythrocytesand mean corpuscular heamoglobin concentration (MCHC). Lymphocytes significantly decline (lymphopenia) while heterophils significantly increased with increase in dietary FB_1 suggesting a condition of immunosuppression and tissue degeneration respectively in chicks fed diets 3 and 4. The study demonstrated that pullets chicks exposed to dietary fumonisin concentration of 10.20mg/kg diet and above would suffer depressed apparent crude protein and ether extract digestibility and decreased synthesis of erythrocyte, MCHC and lymphocytes.

Keywords: Mycotoxin, Poultry, Digestibility, Blood Profile

1.Introduction

Poultry production is an enterprise recognized as a quick means of generating income and improving animal proteins in human diets. The presence of mycotoxin and anti-nutritional factors in most of the ingredients used in formulating rations for this specie of animal is of great concern to the poultry farmersand professionals (12). Fumonisin B_1, a novel mycotoxin produced by the fungus *Fusariumverticillioides,*has been reported to be a major contaminant of maize intended for use in poultry ration formulation and human consumption. The importance of maize, a feed ingredient of high caloric value, in formulation of poultry ration can not be overemphasized.

Fumonisins have been shown to decreased body weight and average daily weight gain of broiler chicks (7), rats (1), rabbits (3) and pigs (4).

Additionally, ingestion of FB_1 contaminated diets has been shown to depress the syntheses of serum parameters and reduce the relative weights of some organs in laying hens (12).

In view of these, and findings from other literatures showing increasing wave of fumonisin contamination of feeds and feedstuffs (4), this study was designed to assess the growth and haematological parameters of pullet chicks fed graded levels of dietary FB_1

2.Materials and Methods

The innocular of toxigenic strain of *F. verticillioides* (MRC 286) obtained from the Mycotoxin laboratory of the International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria were introduced to autoclaved maize grains to produce FB_1 according to the method described by Nelson *et.*

al.,(10).The inoculated maize grains were air-dried, ground and quantified for FB_1 usingCD-ELISA. Four experimental diets containing 0.2, 5.2, 10.2 and 15.2 mg/kg FB_1 were formulated by replacing autoclaved, non-cultured maize with the ground cultured maize at graded levels. The gross composition of the diets are shown in Table 1. 180 day-old pullet chicks having similar initial average weights were randomly assigned to the experimental diets in a completely randomized design such that each experimental diet had 45 chicks replicated thrice with15 chicks per replicate in a feeding trial that lasted for 9 weeks.

Table 1. *Gross composition (%) of the pullet chicks experimental diets.*

Ingredients	Diet 1	Diet 2	Diet 3	Diet 4
	0.2mg/Kg FB_1	**5. 2mg/Kg FB_1**	**10. 2mg/Kg FB_1**	**15. 2mg/Kg FB_1**
Non inoculated Maize	43. 00	41. 26	39. 52	37. 78
Inoculated Maize	-	1 . 74	3 . 48	5 . 22
Soybean meal	23. 00	23. 00	23. 00	23. 00
Wheat offal	28. 00	28. 00	28. 00	28. 00
Fish meal	2 . 00	2 . 00	2 . 00	2 . 00
Bone meal	2 . 00	2 . 00	2 . 00	2 . 00
Oyster shell	1 . 00	1 . 00	1 . 00	1 . 00
Premix	0 .25	0 .25	0 .25	0 .25
Methionine	0 .20	0 .20	0 .20	0 .20
Lysine	0 .30	0 .30	0 .30	0 .30
Salt	0 .25	0 .25	0 .25	0 .25
Total	100. 00	100. 00	100. 00	100. 00
Calculated nutrients	-	-	-	-
Crude protein (%)	20. 02	20. 02	20. 02	20. 02
Crude fibre (%)	4 .90	4 .90	4 .90	4 .90
ME (Kcal/kg)	2678. 42	2678. 42	2678. 42	2678. 42
ME =	Metabolisable energy			

3.Results and Discussion

3.1. Growth Parameters of Pullet Chicks Fed Graded Concentrations of Dietary FB_1

The initial and final live weights, daily fed intakes, daily weights gains and feed conversion ratios (FCR) of the pullets are shown in Table 2. The performance indices of the chicks apparently decreased, except FCR, as the concentration of dietary FB_1 increased, however, the parameters were not significantly ($P > 0.05$) influencedby the dietary treatments. The non –significant reduction in daily feed intake and consequently, the daily weight gains and final live weight of the chicks obtained in this study are consistent with the resultof Voss *et.al.,*(17) and US NTP(16) and could be due to feed refusal effect occasioned by the repellant taste or odour of the contaminated feed as observed by Gelderblom*et. al.,* (6), Ewuola*et. al.,* (3) and Gbore*et. al.,* (5). The reduction in overall feed efficiency over the nine weeks feeding trial suggests the ability of the dietary FB1 to impede nutrient metabolism. However, the findings of Ewuola*et. al.,*(3) and Gelderblom*et.al.,*(6) that dietary fumonisin B_1 significantly reduced body weight gain in rabbits and rats respectively are contrary to the results obtained in this study. This may be due to variations in the sensitivity of different specie of animals to fumonisin(15)

3.2. Nutrient Digestibility of Pullet Chicks Fed Graded Levels of Dietary FB_1

The result of apparent nutrient digestibility of the chicks (Table 3) showed a dietary FB_1 concentration dependent decline in crude protein and ether extract. The dry matter digestibility of chicks on diets 2, 3 and 4 were 94.77, 95.07, and 94.81 % respectively of those on control diet (1). The nutrient digestibility values were an indication of nutrients absorption and utilization. The significant decline in crude protein and ether extract digestibility particularly for chicks on diets 3 and 4 suggests an inhibition of sphingolipid biosynthesis by FB_1 (18) resulting in alteration of epithelial morphology of the chicks and poor digestion, absorption, and utilization of protein and other nutrients (11). Since the pullet chicks were fed *ad-libitum*, and all the experimental diets were iso-nitrogenous and satisfied the protein requirement for pullet chicks(13), the significant decline in crude protein digestibility of the chicks across the dietary treatments is an indication of the ability of fumonisin B_1 to impede protein metabolism. These results may also justify the apparent reduction in the daily feed intake, weight gain and poorer feed conversion ratio obtained for chicks on higher levels of dietary fumonisin.

Table 2. *Growth Indices of pullet chicks fed graded levels of dietary Fumonisin.*

Parameters	Diet 1	Diet 2	Diet 3	Diet 4	SEM*
	0.2mg/Kg FB_1	5.2mg/Kg FB_1	10.2mg/Kg FB_1	15.2mg /KgFB_1	
Initial Live Weight (g)	179.00	180.67	182.00	181.00	1.25
Daily Feed Intake (g)	32.09	31.92	31.44	30.81	3.09
Final Live Weight (g)	484.67	475.67	447.00	428.00	34.24
Weight Gain (g/day)	5.40	5.27	4.50	4.41	0.90
Feed Conversion Ratio	6.10	6.10	6.89	7.00	0.67

Values shown are means. SEM* =Standard Error of Means.

Table 3.*Apparent Nutrient Digestibility (%) of chicks fed graded levels of dietary FB_1.*

Nutrient	Diet 1	Diet 2	Diet 3	Diet 4	SEM*
	0.2mg/KgFB_1	5.2mg/Kg FB_1	10.2mg/Kg FB_1	15.2mg/Kg FB_1	
Dry Matter	66.14^a	62.68^b	62.88^b	62.71^b	0.68
Crude Protein	64.07^a	58.07^b	50.11^c	46.82c	0.97
Crude Fibre	58.10	56.18	55.14	55.02	2.49
Ether Extract	72.80^a	66.00^{ab}	61.65^b	50.00	1.80
Ash	47.03	49.05	45.00	45.00	2.19
Nitrogen Free Extract	84.12	83.50	83.29	81.29	1.07

a, b, c: Means differently superscripted across the rows are significantly different (P < 0.05) .SEM = Standard Error of Means

3.3. Effect of Graded Levels of Dietary FB_1 on Haematology of Pullet Chicks

The haematological indices of the pullets as shown in Table 4 reveals that the erythrocytes, MCHC and Lymphocyte values decreased significantly (P < 0.05) while the heterophils value significantly (P < 0.05) increased with increased dietary FB_1 concentration. Other haematological parameters were not significantly influenced by dietary FB1. Although, all the haematological values were within the reported range for normal female chicken (9), pullets exposed to diets 3 and 4 suffered a significant depression in the synthesis of red blood cells (erythrogenesis).The significant reduction in mean corpuscular haemoglobin concentration(MCHC) and red blood cells(RBC) with increasing levels of dietary fumonisin B_1suggested that the red blood cells were hypo chromic. Since the principal function of lymphocytes is in relationship to its immunological activity, it therefore appeared in this study that dietary FB_1 suppressed immune response in pullets fed diets 3 and 4 and induced tissue destruction in the bird as indicated by a significantly higher values of heterophil(2). Similar result of immune suppression in chicken fed maize cultured with *F. verticillioides* was reported by Marijanovic*et.al.,*(8). However, these results are contrary to the reports of Parent-Massin and Parchment(14) and Zomborsky-Kovac*et.al.,*(19) that fumonisin is a non-haematotoxicmycotoxin. This may be due to variations in the sensitivity of different specie of animals to fumonisin(15)

Table 4.*Haematological Values of Pullet Chicks Fed graded Levels of Dietary Fumonisin.*

Parameters	Diet1	Diet2	Diet3	Diet4	SEM*
	0.2mg/KgFB_1	5.2mg/KgFB_1	10.2mg/KgFB_1	15.2mg/KgFB_1	
Erythrocytes (x 10^6/mm^3)	2.63^a	2.50^{ab}	2.38^b	2.45^b	0.06
Haemoglobin(g/dl)	10.53	10.23	10.07	10.00	0.28
Mean Cell Volume (μ3)	119.33	127.33	123.33	126.67	2.17
MCH (μμg)	40.00	41.00	40.33	41.00	0.63
MCHC (%)	33.00^a	32.33^{ab}	31.00^b	32.33^{ab}	0.49
Packed Cell Volume (%)	31.67	31.67	30.67	31.00	0.58
Platelets (x 10^3/L)	243.67	22.67	238.67	243.33	35.65
Leukocytes(x 10^3/mm^3)	12.90	12.26	11.90	11.30	1.93
Lymphocytes (x 10^3/mm^3)	8.89^a	8.13^a	6.08^b	6.28^b	1.87
Heterophils (x 10^3/mm^3)	3.35^c	3.82	4.76^a	4.69^a	3.01
Monocytes (x 10^3/mm^3)	0.12	0.11	0.22	0.11	0.39
Eosinophils (x 10^3/mm^3)	0.26	0.19	0.26	0.23	0.49

a, b, c: Means differently superscripted across the row are significantly different (P < 0.05)
SEM: Standard Error of Means
*MCH: Mean Corpuscular Haemoglobin
*MCHC: Mean Corpuscular Haemoglobin Concentration

4. Conclusion

This study demonstrated that FB_1 of 10.20 mg/kg and above in the diet of pullet chicks will reduce dry matter, crude protein and ether extract digestibility, suppress RBC, MCHC and lymphocytesyntheses and induce liberation of heterophils from the tissues.

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References

[1] Bondy, G.S., Suzuki, C.A.M., Mueller, R.W., Fernie, S.M., Armstrong, C.L., Hierlihy, S.I., Savard, M.E and Barker, M.G. (1998). Gavage administration of the fungal toxin fumonisin B_1 to female Sprague-Dawley rats. *J. Toxicol. Environ. Health,* 53: 135-151.

[2] Coles, E.H.(1986). Veterinary clinical pathology.4th ed. W.B. Saunders company, Philadelphia, London and Toronto. Pp 99-148

[3] Ewuola, E.O., Ogunlade, J.T., Gbore, F.A., Salako, A. O., Idahor, K.O. and Egbunike, G.N. (2003). Performance evaluation and organ histology of rabbits fed *Fusariumverticillioides* culture material. *Trop. Anim. Prod.* 6 (2): 111-119

[4] Fazekas, B., Bajmocy, E., Glavics, R. and Fenyvesi, A. (1997). Fumonisinmycoticoses in Hungary. Leuco-encephalomalacia in horses, fattening pulmonary oedema in pigs. *Magy. Allartov. Lapja*., 119 : 137-139

[5] Gbore, F.A, Ogunlade, J.T, Ewuola, E. O. and Egbunike G.N. (2010). Growth indices and haematological parameters of weanling pigs fed dietary fumonisin B_1.*Nig. J. Anim. Prod.* 37 (1) : 123-134.

[6] Gelderblom, W. C. A., Cawood, M. E., Snyman, S. D., and Marasas, W. F. O. (1994). Fumonisin B_1dosimetry in relation to cancer initiation in rat liver. *Carcinogenesis*, 15 : 209-214

[7] Ledoux, D.R., Brown, T. P., Weibking, T.S. and Rottinghaus, G. E. (1992). Fumonisin toxicity in broiler chicks. *J. Vet. Diagn. Invest.* 4: 330-333

[8] Marijanovic, D.R., Holt, P.,Norred, W.P., Bacon, C.W., Voss, K.A., Stancel, P.C. and Ragland, W.L.(1991). Immunosuppressive effects of *F. moniliforme* corn culture in chickens. *Poult. Sci.*, 70: 1895-1901

[9] Mitruka, B. M and Rawnsley, H. M. (1977). Clinical biochemical and haematological reference values in normal experimental animals. Masson Pub. USA Inc., N. Y. pp. 21-84

[10] Nelson, P. E., Juba, J. H., Ross, P. F. and Rice, L. G. (1994). Fumonisin production by Fusarium species on solid substrates. *J. Assoc. Off. Anal. Chem. Int.*, 77: 522-524.

[11] Ogunlade, J. T., Gbore, F. A., Ewuola, E. O., Idahor, K. O., Salako, A. O. and Egbunike, G. N. (2004). Biochemical and Haematological Responses of Rabbits Fed Diets containing micro doses ofFumonisin .*Trop. J. Anim. Sci*. 7 (1) : 169-176

[12] Ogunlade, J. T. and Egbunike, G. N. (2013). FumonisinMycotoxicity in laying hens: Haematology, serum biochemistry and organ characteristics. *Glob. Adv. Res. Jour. Of Env. Sc. and Toxicol*. 2(2) : 47 – 53

[13] Oluyemi, J.A. and Roberts, F.A. (2000). Poultry production in warm wet climates. 2nd ed. Spectrum Book Ltd. (Publ.), Ibadan, Nigeria. pp. 1-7.

[14] Parent-Massin, D. and Parchment, R.E.(1998). Haematotoxicity of mycotoxins. In: Le Bass, J., Galties, P. (eds.). Mycotoxins in the food chain, MYCOTOX '98, Toulouse, July 2-4, pp. 591-598.

[15] US FDA (2000). Background paper in support of fumonisin levels in animal feed. US Food and Drug Administration Center for Veterinary Medicine, June 6, 2000.

[16] US NTP (1999). NTP technical report on the toxicology and carcinogenesis studies of fumonisin B_1(CAS No. 116355-83-0) in F344/N rats and B6C3F1 mice (feed studies). Research Triangle Park, North Carolina, US Department of Health and Human Services National Toxicology Program (NTP TR 496; NIH Publication No.

[17] Voss, K.A., Chamberlain, W.J., Bacon, C.W. and Norred, W.P. (1993). A preliminary investigation on renal and hepatic toxicity in rats fed purifiedfumonisin B_1. *Nat. Toxins.*, 1: 222-228.

[18] Yoo, H. S., Norred, W. P., Wang, E., Merill, A. H. Jr., and Riley, R. T. (1992). Fumonisin inhibition of de novo sphingolipid biosynthesis and cytotoxicity are correlated in LLC-PK_1 cells. *Toxicol. Appl. Pharmacol.*, 114 : 9-15

[19] Zomborszky-Kovacs, M., Kovacs, F., Horn, P., Vetesi, F., Repa, I., Tornyos, G. and Toth, A.(2002). Investigation into the time-and dose-dependent effect of fumonisin B_1 in order to determine tolerable limit values in pigs. *Livestock Production Science*, 76:251-256.