EFFECTS OF SYNBIOTIC SUPPLEMENTATION OF HIGH FIBRE DIET ON GROWTH PERFORMANCE AND INTESTINAL HISTOMORPHOLOGY OF BROILER CHICKENS

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Abstract

This study investigated the effects of synbiotic dietary supplementation on growth performance and intestinal histomorphology of broiler chickens fed high fibre diets. A total of three hundred and twenty (320) three-week old chicks were used for the study consisting of eight (8) treatments (T1-T8) replicated four (4) times and ten (10) birds per replicate and the study lasted for five weeks. The experimental design was a 2×2×2 factorial design, consisting of two agro-industrial by-products at two inclusion levels, with or without synbiotic (containing mannan oligosaccharide and Saccharomyces cerevisae) supplementation. Birds on T1 to T4 receivedwheat offal based diet at 20% (without synbiotic), 20% (with synbiotic), 40% (without synbiotic) and 40% (with synbiotic) respectively, while those on T5 to T8 receivedpalm kernel cake based diet at 20% (without synbiotic), 20% (with synbiotic), 40% (without synbiotic) and 40% (with synbiotic) respectively. Birds fed diets supplemented with synbiotic had lower (P<0.05) final body weight, body weight gain and feed conversion ratio. Birds fed diets without synbiotic supplementation had higher (P<0.05) villi height, crypt depthand full mucosal in the jejunum than the birds fed diets supplemented with synbiotic. It was concluded that synbiotic had negative effect on the growth performance and intestinal health of broilers fed high fibre diets.

Introduction

Previous studies on the use of antibiotics as growth promoters in broiler dietshigh in agro-industrial by-products have indicated that, antibiotics enhanced the utilisation of fibrous feedstuffs which were poorly digested by birds (Onifade and Babatunde, 1997; Onifade and Odunsi, 1998). Synbioticscontaining mannan oligosaccharide and *Saccharomyces cerevisae* has been reported to enhance growth performance and gut health of broilers fed low fibre diets(less than 3% crude fibre; Sherief *et al.*, 2012), but the probable beneficial effect of synbiotic has not been systematically investigated using high fibre diets in broilers. The objective of the present study was to determine, the effect of synbioticsupplementation on the growth performance and intestinal histomorphology of broiler chicken fed high fibre diets based on palm kernel cake and wheat offal meals.

Materials and Methods

A total of three hundred and twenty (320) three-week old chicks were used for this study, consisting of eight (8) treatments (T1- T8) replicated four (4) times and ten (10) birds per replicate. The experimental design was a 2×2×2 factorial design, consisting of two agro-industrial by-products at two inclusion levels (table 1) with or without synbiotic (containing mannan oligosaccharide and *Saccharomyces cerevisae*) supplementation and the study lasted for five weeks. The synbiotic was supplemented at 1g/kg of feed at the expense of maize and birds on T1-T4 receivedwheat offal based diet at 20% (without synbiotic), 20% (with synbiotic), 40% (without synbiotic) and 40% (with synbiotic) respectively, while T5-T8 receivedpalm kernel cake based diet at 20% (without synbiotic), 20% (with synbiotic), 40% (without synbiotic) and 40% (with synbiotic) respectively. Wheat offal at 20% and 40% level of inclusion resulted in 4.5% and 5.81% calculated crude fibre content respectively, while that of palm kernel cake at 20% and 40% level of inclusion had 4.74% and 6.28% respectively.Birds were weighed individually with precision scale at the onset of the study andweekly till the end of the experiment and feed intake was measured weekly, while feed conversion ratio was calculated and mortality was recorded as it occurred.

Three birds with weight representative of each treatment were fasted for 12 hours and slaughtered and the jejunum and ileum sections were excised for histomorphological examination. The jejunum sample of 2cm length was collected 5cm distal to the end of duodenal loop, while ileum sample of 1cm length was collected up to 5cm proximal to the ileo-cecal junction.Jejunum and ileum samples were fixed into 10% neutral buffered formalin solution. The fixed intestinal sections were subsequently dehydrated by transferring through a series of alcohol with increasing concentrations (70, 80, 90 and 100%), cleared with xylene, and embedded in paraffin wax. Tissue sections (5µm) were cut by microtome, placed on glass slides, and

stained with hematoxylin and eosin. The photographs of the slides were taken using a laboratory microscope (connected with a monitor screen and computer) at 40× magnification and measurements of histomorphological parameters weremade using the Open office.org™3. Ten well-oriented villi height, crypt depth, full mucosal and sub mucosal from jejunum and ileum were measured. The villus height (VH) was measured from the crypt-villus junction to the brush border at the tip. The crypt depth (CD) was measured from the base near the lamina propria to the crypt-villus junction. All measurements were made to the nearest micrometer.

Results and Discussion

Birds fed synbiotic (containing mannan oligosaccharide and *Saccharomyces cerevisae*) supplementation did not differ *(P>0.05)* in feed intake from the non- supplemented group but synbiotic supplementation decreased *(P<0.05)* final body weight, daily weight gain and resulted in higher *(P<0.05)* feed conversion ratio (table 2). The result of the present study wasnot in agreement with that of Jung *et al.* (2008), who reported that, there was no effect *(P<0.05)*of synbiotic supplementation(containing a combination of 0.6% galacto-oligosaccharides and 12% pure culture of *Bifidobacteria lactis*) on the growth performanceof broiler chickens of age 7, 28 and 40 days. Similarly, Sherief *et al.* (2012) reported that 0.5% synbiotic supplementation containing mannan-oligosaccharide and *Saccharomyces cerevisae* improveddaily weight gain,cumulative final body weight,and feed conversion ratio in broilers reared up to 42 days. In terms of fibre sources, experimental birds fed wheat offal based diets (WO) had higher *(P<0.05)* feed intake than those fed palm kernel cake (PKC) based diets but did not translate to significant change in body weight gain (BWG). The differences in feed intake might be attributed to the varying density of the diets as earlier reported that diets of lower density enhance gut capacity to increase feed intake (Meremikwu *et al.*, 2013). Higher level of fibre source (40%) also resulted in higher *(P<0.05)* feed intake. Sundu *et al.* (2006) had reported that fibrous feedstuffs tend to increase the contraction of the gizzard and may speed up the peristaltic movement of digesta in the duodenum and throughout the small intestine. This could therefore shorten the residence time of the digesta in the intestine.

Table 3 shows theintestinal histomorphological values of broiler chickens fed high fibre diets with or without synbiotic supplementation. Birds fed diets without synbiotic had higher (*P<0.05*) villi height, crypt depth, and full mucosal in the jejunum than the birds fed diets supplemented with synbiotics. Birds fed WO increased (*P<0.05*) in crypt depth and sub-mucosal than those fed PKC. Birds fed 40% levels of fibre source had higher (*P<0.05*) villi height, crypt depth and villi:crypt ratio than those fed at 20%. Geyra *et al.* (2001) reported that, longer villi provide greater absorptive surface and deeper crypt indicate enhanced capacity for replenishing of enterocytes. Therefore, reduced *(P<0.05)* crypt depth in synbiotic supplemented birds could be an indication of reduction in the activity of those cells at the brush border of the villi resulting from the poor utilization of nutrients ingested by birds, consequently lowering the proliferation of the enterocytes. It was concluded that synbiotic supplementation had negative effect on the growth performance and intestinal health of broilers fed high fibre diets.

References

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Table 1: Gross composition of experimental diets (%, as fed basis)

Feed Ingredients (%)	T1	T2	T3	T4	T5	T6	T7	T8
Maize	52.58	52.48	29.35	29.25	54.35	54.25	39.65	39.55
Soybean meal	10	10	8	8	10	10	5	5
Groundnut cake	10.5	10.5	10.45	10.45	10.45	10.45	10.4	10.4
Wheat offal	20	20	40	40	-	-	-	-
Palm kernel cake	-	-	-	-	20	20	40	40
Palm oil	1.77	1.77	7	7	-	-	-	-
Synbiotic	-	0.10	-	0.10	-	0.10	-	0.10
Fixed ingredients[1]	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
Total	100	100	100	100	100	100	100	100
Calculated values (%)								
ME, Kcal/kg	2850	2850	2844	2844	2865	2865	2800	2800
Crude protein	18.0	18.0	17.9	17.9	18.8	18.8	18.0	18.0
Crude fibre	4.49	4.49	5.81	5.81	4.74	4.74	6.28	6.28
Analysed values (%)								
Crude protein	19.06	19.06	18.68	18.68	19.31	19.31	18.94	18.94
Crude fibre	4.58	4.58	5.92	5.92	5.08	5.08	7.00	7.00
Ash	5.31	5.31	5.17	5.17	4.94	4.94	6.73	6.73
Ether extract	5.38	5.38	10.35	10.35	4.51	4.51	6.27	6.27

[1]2% fish meal, 2% bone meal, 0.5% oyster shell, 0.1% DL-methionine, 0.1% L-lysine, 0.25% Vitamin/mineral premix, 0.25% salt; T=Treatments.

Table 2. Growth performance of Broiler chickens fed high fibre diets with or without synbiotic supplementation

Parameters	IBW (g)	FBW (g)	DWG (g)	DFI (g)	FCR	Mortality (%)
T1 (WO20%)	503.67	1708.27	32.52	93.27	2.87	0
T2(WO20%+)	504.48	1532.83	27.76	88.55	3.19	0
T3 (WO40%)	504.17	1644.96	30.65	95.13	3.11	0
T4 (WO40%+)	505.1	1555.85	28.81	97.567	3.39	5
T5 (PKC20%)	504.67	1720.5	32.21	86.68	2.75	7.94
T6 (PKC20%+)	503.75	1544.39	27.01	84.32	3.16	2.5
T7 (PKC40%)	503.65	1588.58	29.26	89.24	3.05	7.5
T8 (PKC40%+)	504.13	1484.35	25.83	88.12	3.42	7.5
Pooled SEM	7.36	50.2	0.58	1.12	0.16	1.01
P-values						
Syn	0.97	0.01	0.01	0.46	0.02	0.96
Fibre	0.92	0.48	0.47	0.02	0.48	0.02
level	0.92	0.17	0.16	0.02	0.02	0.27
S×F×L	0.97	0.92	0.91	0.96	0.96	0.96

T=Treatments; SEM=Standard error of mean; S=Synbiotic; S×F×L=interaction between synbiotic×fibre×level; IBW=initial body weight; FBW=final body weight; DWG=Daily weight gain; DFI=Daily feed intake; FCR=Feed conversion ratio.

Table 3 : Intestinal Histomorphology of broiler chickens fed high fibre diets with or without synbiotic supplementation (µm)

Treatments	Villi height		Crypt depth		Full mucosal		Sub mucosal		Villi crypt ratio	
	Jejenum	Ileum	Jejenum	Ileum	Jejenum	Ileum	Jejenum	Ileum	Jejenum	Ileum
T1 (WO20%)	1792	851	643	288	2409	1153	305	338	3.09	2.96
T2(WO20%+)	1400	643	379	249	1926	868	284	337	3.66	2.60
T3 (WO40%)	2165	913	534	474	2644	1265	279	458	4.11	1.96
T4(WO40%+)	2173	596	266	283	2592	846	247	299	8.14	2.13
T5(PKC20%)	2223	674	368	193	2576	849	275	251	6.08	3.72
T6(PKC20%+)	2020	747	403	292	2314	1053	191	340	5.02	2.53
T7(PKC40%)	2277	732	369	275	2582	1069	235	286	6.47	2.62
T8(PKC40%+)	1841	796	380	287	2254	1076	194	281	4.89	2.97
SEM	74.1	36	27.7	18.4	55.37	41.9	13.2	16	0.37	0.17
P-values										
Syn	0.04	0.19	0.01	0.22	0.02	0.09	0.09	0.45	0.28	0.42
Fibre	0.08	0.85	0.06	0.02	0.72	0.77	0.04	0.01	0.07	0.1
Level	0.04	0.67	0.12	0.01	0.07	0.25	0.32	0.56	0.01	0.11
F×L	0.01	0.76	0.2	0.14	0.04	0.59	0.79	0.29	0.01	0.54
S×F	0.58	0.03	0.01	0.01	0.89	0.01	0.47	0.02	0.01	0.6
S×F×L	0.18	0.73	0.89	0.50	0.27	0.83	0.59	0.52	0.04	0.43

T=Treatments; SEM=Standard error of mean ; Syn=Synbiotic; S×F×L=interaction between synbiotic×fibre× level; F×L=interaction bet ween fibre and level ; F×S=interaction between fibre and synbiotic.