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ORIGINAL RESEARCH ARTICLE

Effect of three proprietary growth promoters on performance, carcass characteristics and gut integrity of broilers

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ABSTRACT
A six-week feeding trial was conducted to investigate the effect of prebiotics and probiotics on the performance, carcass characteristics and gut integrity of broiler chickens. Two hundred and fifty one-day-old unsexed Arbor-acre broiler chicks were randomly allocated into 5 treatment groups of 5 replicates with 10 birds per replicate. A corn-soyabean meal based diet with no prebiotic or probiotic supplement was the control diet (basal diet). Other diets consisted the basal diet with 0.01% antibiotics, 0.06% probiotics (Bio grow promoter), 0.1% probiotics (Gro up) and 0.2% prebiotics. On day 42, birds were weighed and sacrificed by cutting the jugular vein. The weights of the primal cuts and visceral organs were taken and recorded. After flushing out the digesta samples, sections of the ileum (5cm posterior to Meckel's diverticulum) were removed for ileal morphological measurements. There was no significant difference (P>0.05) on weight of the primal cuts except for head, back and drumsticks which were significantly (P<0.05) improved across the diets. Diets supplemented with probiotics had higher weight of drumsticks (11.21%) than other treatments. Significant (P<0.05) difference was however observed in the weight gain with 0.06% probiotics and 0.1% probiotics having the highest means of 1218.15g and 1163.68g respectively. Supplementation with probiotics or prebiotics had no effect on growth performance, gut morphology and organ weights at the grower phase. It was observed, that birds fed with the two brands of probiotics used had the highest villus height and width than birds fed on other treatments. In summary, dietary inclusion of probiotics had a growth-promoting effect with improved growth performance and intestinal morphology. Probiotic could therefore serve as an alternative growth promoter to antibiotics.

Keywords: Gro up, Bio grow promoter, broiler, growth performance

INTRODUCTION

Poultry meat is an important source of animal protein in the world today. Infections caused by pathogenic microorganisms such as *Eimeria, Salmonella, Clostridium* etc. continue to threaten the poultry industry. Such infections are responsible for reduced growth rates and consequent economic losses in poultry. Unfortunately, the long term and extensive use of antibiotics for veterinary purpose eventually result in selection for the survival of resistant microbial species, thereby posing a threat to both animal and human health (Aarestrup, 1999). Consequently, some countries (Sweden- January 1986, limited use- European union- January 2000 and total withdrawal January 2006) have restricted the use of Antibacterial Growth Promoters (AGP) in poultry (Montagne et al., 2003). Antibiotics have been added to poultry and pig diets to maintain health and production efficiency in the last few decades (Rosen, 1995). However, because of the development of resistance by pathogenic bacteria, antibiotics are being taken out of poultry and pig diets around the world, beginning in Sweden in the year 1986 (Dibner and Richards, 2005). The search for alternatives to replace in-fed antibiotics has gained increasing interest in animal nutrition in recent years.

Prebiotic is defined as a non-digestible food ingredient that beneficially affects the host by selectively stimulating the growth and /or activity of one or a limited number of bacteria in the colon (Gibson and Roberfroid, 1995). Probiotics is defined as health-promoting bacteria inhabiting the gastrointestinal tract of humans and animals (Gong *et al*., 2002). The major probiotic strains include *Lactobacillus*, *Saccharomyces*, *Bacillus*, *Streptococcus* and *Aspergillus* (Tannock, 2001). Positive effects of probiotics on animals can result either from a direct nutritional effect of the probiotic or a health effect, with probiotics acting as bioregulators of intestinal micro flora and reinforcing the host's natural defenses (Guillot, 2001). There have been numerous studies in humans and animals on the ability of probiotics to change the types and numbers of gut micro flora (Endo and Nakano, 1999). It was the aim of this study to compare the effects of three proprietary growth promoters (Gro up, Bio grow promoter and Manna oligosaccharide) on performance, carcass characteristics and gut intergrity of broilers

MATERIALS AND METHODS

Experimental site, diets and management of birds

The research was carried out at the Poultry Unit of the Teaching and Research Farm, University of Ibadan, Nigeria. Two hundred and fifty, one-day-old broiler chicks were procured from a reputable hatchery. Upon arrival, the birds were tagged and randomised into five treatments and each treatment into five replicates with ten birds in each replicate. They were checked for signs of abnormalities before placing them in their allocated pens and were raised for 42 days. The experimental diets were formulated both at the starter and finisher phases. The inclusion of antibiotics (oxytetracycline hydrochloride added at the rate 0.105g/kg), prebiotics (Manna oligosaccharide) and probiotics (Gro up-*Lactobacillus sporogenes* 50 million CFU + *Saccharomyces cerevisiae 1.5* X *10^8 CFU* and Bio grow promoter) in the diet varies as follow:

Diet 1 = Control diet without antibiotics, probiotics and prebiotics (Negative control)
Diet 2 = Control diet + 0.01% antibiotics (Positive control)
Diet 3= Control diet + 0.06% probiotics 1 (Bio grow promoter)
Diet 4= Control diet + 0.1% probiotics 2 (Gro up)
Diet 5 = Control diet + 0.2% prebiotic (Manna oligosaccharide)

Data collection

Performance indices

Feed intake was calculated as difference between amount of feed given and left over. The birds were weighed at the end of the starter and finisher phases and values were used to calculate body weight gain and feed conversion ratio.

Table 1: Gross composition of experimental diet (starter phase)

Ingredients (%)	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
Corn	55.02	55.00	54.90	54.82	54.62
Soyabean meal	36.10	36.10	36.10	36.10	36.10
Soya oil	4.87	4.87	4.87	4.87	4.87
Dicalcium phosphate	1.85	1.85	1.85	1.85	1.85
*Vit-Min premix	0.16	0.16	0.16	0.16	0.16
Limestone	1.35	1.35	1.35	1.35	1.35
Methionine	0.30	0.30	0.30	0.30	0.30
Lysine	0.30	0.30	0.30	0.30	0.30
Salt	0.25	0.25	0.25	0.25	0.25
Antibiotics	0	0.01	0	0	0
Probiotics 1	0	0	0.06	0	0
Probiotics 2	0	0	0	0.10	0
Prebiotics	0	0	0	0	0.20
Total	100.00	100.00	100.00	100.00	100.00
Calculated analysis (%)					
Crude protein	22.17	22.17	22.17	22.17	22.17
Energy ME, (Kcal/kg)	3050.58	3050.23	3050.23	3050.23	3043.88
Ether extract	3.46	3.46	3.45	3.45	3.45
Crude fiber	3.73	3.73	3.73	3.73	3.73
Calcium	1.02	1.02	1.02	1.02	1.02
Total phosphorus	0.70	0.70	0.70	0.70	0.70
Non-phytase phosphorus	0.45	0.45	0.45	0.45	0.45
Ca:NPP	0.23	0.23	0.23	0.23	0.23
Ca:P	0.15	0.15	0.15	0.15	0.15

*Supplied the following per kg diet: vitamin A, 5484 IU; vitamin D_3, 2643 ICU; vitamin E, 11 IU; menadione sodium bisulfie, 4.38 mg; riboflavin, 5.49 mg; d-pantothenic acid, 11 mg; niacin, 44.1 mg; choline chloride, 771 mg; vitamin B_{12}, 13.2 ug; biotin, 55.2 ug; thiamine mononitrate, 2.2 mg; folic acid, 990 ug; pyridoxine hydrochloride, 3.3 mg; I, 1.11 mg; Mn, 66.06 mg; Cu, 4.44 mg; Fe, 44.1 mg; Zn, 44.1 mg; Se, 300 ug

Table 2: Gross composition of experimental diet (finisher phase)

Ingredients (%)	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
Corn	60.13	60.12	60.07	60.03	59.93
Soyabean meal	34	34	34	34	34
Soya oil	3	3	3	3	3
Dicalcium phosphate	1.2	1.2	1.2	1.2	1.2
*Vit-Min premix	0.16	0.16	0.16	0.16	0.16
Limestone	1.1	1.1	1.1	1.1	1.1
Methionine	0.08	0.08	0.08	0.08	0.08
Lysine	0.08	0.08	0.08	0.08	0.08
Salt	0.25	0.25	0.25	0.25	0.25
Antibiotics	0	0.01	0	0	0
Probiotics 1	0	0	0.06	0	0
Probiotics 2	0	0	0	0.01	0
Prebiotics	0	0	0	0	0.02
Total	100	100	100	100	100
Calculated analysis (%)					
Crude protein	20.07	20.07	20.07	20.06	20.05
Energy ME, (Kcal/kg)	3024.56	3024.2	3024.2	3024.21	3024.2
Ether extract	3.6	3.6	3.6	3.6	3.6
Crude fiber	3.7	3.7	3.7	3.7	3.7
Calcium	0.78	0.78	0.78	0.78	0.78
Total phosphorus	0.58	0.58	0.58	0.58	0.58
Non-phytase phosphorus	0.33	0.33	0.33	0.33	0.33
Ca:NPP	0.24	0.24	0.24	0.24	0.24
Ca:P	0.13	0.13	0.13	0.13	0.13

*Supplied the following per kg diet: vitamin A, 5484 IU; vitamin D_3, 2643 ICU; vitamin E, 11 IU; menadione sodium bisulfie, 4.38 mg; riboflavin, 5.49 mg; d-pantothenic acid, 11 mg; niacin, 44.1 mg; choline chloride, 771 mg; vitamin B_{12}, 13.2 ug; biotin, 55.2 ug; thiamine mononitrate, 2.2 mg; folic acid, 990 ug; pyridoxine hydrochloride, 3.3 mg; I, 1.11 mg; Mn, 66.06 mg; Cu, 4.44 mg; Fe, 44.1 mg; Zn, 44.1 mg; Se, 300 ug

Dissection for carcass traits

At the end of six weeks of feeding trial, two birds per replicate were selected, weighed and sacrificed by cutting the jugular vein. The weights of the primal cuts and visceral organs were taken and recorded.

Gut morphology

Approximately 5cm of the ileum (5cm after meckel diverticulum) were removed for ileal morphological measurements. Histological examinations were carried out according to the method of Iji *et al.* (2001).

Proximate analysis

The proximate composition of each diet was determined according to the methods of AOAC (2000).

Statistical analysis

Data obtained were analyzed using ANOVA of SAS (2008) and significant level of P<0.05 was used. The treatment means were compared using Duncan Multiple Range Test.

RESULTS AND DISCUSSION

Growth indices of broiler chickens fed experimental diets are shown in Table 3. The result revealed significant (P<0.05) difference in the final body weight

Table 3: Performance characteristics of broiler birds fed antibiotics, prebiotics and probiotics at starter phase (day 0-21)

Parameters	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	SEM
Initial weight (g/bird)	39.72	39.73	39.70	47.39	39.72	
Final weight (g/bird)	623.48^{ab}	624.78^{ab}	588.93^{b}	650.44^{a}	628.46^{ab}	57.19
Weight gain (g/bird)	583.40^{ab}	585.14^{ab}	549.62^{b}	610.78^{a}	588.90^{a}	57.18
Feed Intake (g/bird)	538.93^{b}	533.70^{b}	490.00^{c}	566.00^{a}	527.80^{b}	23.4
Feed Conversion Ratio	0.97	0.96	0.92	0.96	0.96	0.10

^{abc}Means on the same row with different superscripts are significantly different (p<0.05)

Table 4: Performance characteristics of broiler birds fed antibiotics, prebiotics and probiotics at finisher phase (day 22-42)

Parameters	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	SEM
Initial weight (g/bird)	623.48^{ab}	624.78^{ab}	588.93^{b}	650.44^{a}	628.46^{ab}	57.19
Final weight (g/bird)	1725.58	1775.00	1838.46	1821.95	1713.16	147.22
Weight gain (g/bird)	1108.65^{ab}	1140.55^{ab}	1218.15^{a}	1163.68^{ab}	1096.03^{ab}	105.97
Feed Intake (g/bird)	1960.12^{ab}	1880.89^{b}	1930.77^{b}	2070.24^{a}	1897.57^{b}	119.90
Feed Conversion Ratio	1.84^{a}	1.74^{ab}	1.64^{b}	1.84^{a}	1.77^{ab}	0.16

^{ab}Means on the same row with different superscripts are significantly different ($p<0.05$)

of birds fed dietary antibiotics, prebiotics and probiotics. Birds fed diet supplemented with probiotics (diets 3 and 4) had the highest final body weight of 1838.46 and 1821.95g respectively compared to diet 1 which served as the negative control with final weight of 1725.58g. Significant ($P<0.05$) difference was observed in the weight gain with diets 3 and 4 having 1218.15 and 1163.68g, respectively. The result presented in Table 5 showed the bird's primal cuts which were head, neck, breast, back, wings, drumsticks, thighs and shanks. There was no significant difference in weights of the primal cuts except for head, back and drumsticks which had significant ($P<0.05$) differences across the diets. Diets supplemented with probiotics had higher weight of drumsticks. Improved performance of chickens fed probiotics might be associated with the partial replacement of intestinal microflora by probiotics added (Jin *et al*., 2000). Supplementing diets of broilers did not affect the weights of different organs. In this experiment, significant ($P<0.05$) differences and numerical decreases were observed to be due to addition of antibiotics, probiotics and prebiotics to the diet. These findings are in agreement with results of Fethiere and Miles, (1987). However, it was concluded that intermittent feeding had no significant difference on carcass weight (Peter *et al*., 2005). The weight of gizzard, liver and bursa of fabricius did not show any significant difference among experimental groups. This is in agreement with Behrouz *et al*. (2012) and Agboola *et al*. (2014a) that weights of gizzard, liver and bursa of fabricius were not affected significantly by addition of prebiotics, probiotics and antibiotics in broilers and turkey poults respectively.

Also, it was seen that the spleen weight did not show any significant effect between probiotics, prebiotics and antibiotics. This is contrary to the findings of Awad *et al.* (2009) who reported significant difference in organ weight of broilers when probiotics, prebiotics and antibiotics were added to their diets. The result of gut morphology of broiler chickens is as shown in Table 5. It showed that the villus height of the birds fed with

Table 5: Carcass characteristics and organ weights of broiler birds fed antibiotics, prebiotics and probiotics

Parameters (g)	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	SEM
Live weight	2130.00^{ab}	2180.00^{a}	2080.00^{ab}	2100.00^{ab}	1960.00^{b}	84.14
Dressed weight	1870.00	1910.00	1860.00	1860.00	1760.00	80.90
Head	2.55^{a}	2.42^{ab}	2.24^{b}	2.40^{ab}	2.37^{ab}	0.13
Neck	4.87	5.06	4.82	5.21	4.80	0.55
Breast	19.81	20.54	20.32	19.81	20.10	1.00
Back	15.08	14.21	14.43	13.76	13.44	0.95
Wings	7.32	7.43	7.49	7.46	7.70	0.37
Drumstick	9.97	9.18	11.21	10.10	9.32	0.97
Thigh	9.10	9.46	9.38	9.74	10.02	0.58
Shank	4.08	4.04	3.93	4.26	4.24	0.19
Full gizzard	3.22	3.19	3.12	3.11	3.28	0.21
Empty gizzard	2.26	2.24	2.05	2.19	2.36	0.15
Lungs	0.50	0.50	0.53	0.45	0.43	0.04
Liver	2.05	2.15	2.07	2.04	2.23	0.10
Spleen	0.12	0.10	0.11	0.10	0.10	0.01
Heart	0.56	0.58	0.52	0.53	0.50	0.04
Bursa of fabricius	0.22	0.21	0.21	0.20	0.24	0.03

^{ab}Means on the same row with different superscripts are significantly different ($p<0.05$)

Table 6: Gut morphology of broiler birds fed antibiotics, prebiotics and probiotics

Parameters (µm)	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	SEM
Villus height	304.94	312.13	274.03	270.90	243.83	45.09
Crypt depth	134.49	61.79	58.91	49.29	61.03	28.49
Villus width	31.59	27.22	41.95	38.85	31.71	47.90
Epithelial thickness	6.04	4.92	6.42	4.14	5.82	1.36
Villus to crypt ratio	3.75	6.17	5.47	6.45	4.34	1.19

[ab]Means on the same row with different superscripts are significantly different ($p<0.05$)

antibiotics has the highest villus height and crypt height than the birds in the other diets, followed by the villus height of birds serving as the negative control and the birds fed with probiotics. The ileal villus height, crypt depth, villus width and villus height to crypt depth ratio were not significantly different as shown in Table 6. These results differ from those reported by Baurhoo *et al*. (2007); Awad *et al.* (2009) and Agboola *et al*. (2014b) who reported that supplementation with probiotics, in turkey poults significantly influenced intestinal villus height.

In a study conducted by Xu *et al*. (2003) dietary addition of a prebiotics significantly increased villus height. This is not in agreement with what was observed with diet containing prebiotics; a lower level of inclusion of prebiotics did not reveal an increase in goblet cell numbers but did show a decrease in crypt size and villus width, suggesting a potential reduction in mucosal turnover rate Ref. An example by Iji *et al.* (2001) produced similar results which stated that jejunum villi height can only be increased with high supplementation of prebiotics. They suggested that these changes may be related to the ability of prebiotics to create a more favorable intestinal microbial environment and are not a direct effect of prebiotics on the intestinal tissue. Presence of toxins results in some alteration in intestinal morphology (shorter villi and deeper crypts) as seen with diets containing prebiotics which agreed with the report of Awad *et al*. (2009) that the reduction in villi height could reduce nutrient absorption and poor performance due to decreased intestinal surface area for absorption. Diarrhea, reduction in nutrient absorption, decreased resistance to disease and lower growth performance and increase in secretion of gastrointestinal tract are the negative consequences of deeper crypt and shorter villi (Xu *et al*., 2003). Villus height was statistically lower in diet containing prebiotics contrary to the report of Ashraf *et al*, (2013) that prebiotics inclusion increased villus height and surface area in ileum.

CONCLUSION

Study showed that probiotics displayed a growth-promoting effect and offered a good alternative to improve performance and small intestinal morphology of broiler birds. Therefore, probiotics have the potential to be applied as effective substitutes for in-fed antibiotics.

CONFLICT OF INTEREST

Authors have declared that no conflict of interest exists.

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