NUTRIENT DIGESTIBILITY AND HAEMATOLOGICAL INDICES OF BROILER CHICKENS FED DIFFERENT INCLUSION LEVELS OF A SYNBIOTIC FEED ADDITIVE AS A REPLACEMENT FOR ANTIBIOTIC GROWTH PROMOTERS

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ABSTRACT
A feeding trial was conducted to evaluate the response of broiler chickens fed diets supplemented with a synbiotic feed additive, Poultrystar®, as replacement for antibiotic growth promoters (AGPs). A total of 225, day-old broiler chicks (Cobb 500) were allotted randomly to five dietary treatments each replicated thrice, with 15 chicks per replicate. Poultrystar® was included at 0, 40, 60 and 80g/100 kg diet for T1-T4, respectively while T5 had Oxytetracycline. Data was collected on digestibility and blood haematoligical indices. All data collected were subjected to analysis of variance and significant differences among treatment means were compared using the Dunnett test of significance. Values for PCV, Hb and WBC did not show differences (P>0.05) when the Poultrystar®-fed groups were compared to the control, but monocytes and eosinophils were significantly (P<0.05) higher in the 60 g/100kg fed group. The group of birds fed 60 g Poultrystar® had significantly (P<0.05) higher digestibility values in all the parameters compared to both oxytetracycline and control groups. Poultrystar significantly improved feed conversion in the starter and finisher phases and increased weight gain in the latter, similarly, it lowers feed cost and improves feed conversion ratio ultimately leading to more profit.

Keywords: **Poultrystar®, Antibiotic growth promoter, Digestibility, Broiler chickens**

INTRODUCTION

The intensification of livestock farming especially broiler production has made the use of antibiotics for growth promotion to rise. Antibiotics have been used at sub-therapeutic levels in the diets of animal for better growth performance (Allen *et al.,* 2012) to meet the demand for animal protein for the ever-increasing population.

The use of antibiotics in poultry as growth promoters has been limited due to the tendency to develop resistance to harmful bacteria (Van Boeckel *et al.,* 2015), and also residual antibiotics observed in the animal products such as meat, milk, and eggs (Nisha, 2008). In 2006 the use of antibiotics as growth promoters was prohibited by the European Union (Eckert *et al.*, 2010) and due to the continuing restriction on the use of long-term drugs, there was a need for alternatives to prevent digestive problems and also to keep the pace of animal protein production that is already in short supply in developing countries. Increasing global demand for animal protein, coupled with stricter regulations related to human health, animal welfare, and environmental protection, necessitates ongoing adaptations in the production process (Puvača *et al.*, 2013). Probiotics and phytogenic feed additives or plant extracts have been gaining increased popularity within the feed industry as potential natural alternatives to antibiotic growth promoters, and are believed to be safer and healthier. The feed intake, feed conversion ratio, and weight gain have been shown to improve in broilers fed probiotics either separately or in a mixture (Ertas *et al.,* 2005). Probiotics have no residual effect on poultry meat or any other products and have also not been associated with any form of resistance in human populations (Alkhalf *et al.*, 2010). The control (modulation) of the GIT microflora is the most important aspect of replacing antibiotic growth promoters. Poultrystar® is a well-defined, poultry-specific, multi-species synbiotic product that promotes a beneficial gut microbiota through the combined action of carefully selected probiotic microorganisms and prebiotic fructooligosaccharides (FOS) (Biomin, 2019).

Experimental Site

The experiment was conducted at the Poultry Unit of Animal Science Departmental Teaching and Research farm, Ahmadu Bello University, Zaria, Kaduna State, Nigeria. Zaria is located in the Northern Guinea Savannah ° Ecological zone on latitude 11^0 09' 06" N and longitude 70 38' 55" E and an altitude of 706m above sea level (GPS, 2020). The climate is characterized by a well-defined dry and wet season and relatively dry with annual rainfall ranging from 700- 1400mm.

Experimental Design and Management of Birds

Two hundred and twenty-five (225) day-old Ross broiler chicks were allocated to five (5) dietary treatments, each replicated three times with 15 chicks per replicate in a completely randomized design (CRD). The birds were housed in deep litter pens and managed with all necessary routine management practices and routine vaccinations.

Experimental Diets

Five maize-soybean cake-based diets were formulated at both the starter and finisher phases of the feeding trial. Diets had 2900 ME Kcals/Kg and 23% CP at the starter phase and 3000 ME Kcals/Kg DM and 20 % CP at the finisher phase. Poultrystar was added as a non-inclusive part of the diets as 0, 40, 60 and 80g/100kg for treatments 1-4, respectively. Oxytetracycline for treatment 5 at recommended dose by the manufacturer.

Haematological Analysis

Blood samples (2ml each) were collected from 3 birds per treatment at the end of the 8 weeks of experiment and transferred into well labeled EDTA bottles for haematological analysis. Parameters evaluated include packed cell volume (PCV), Heamoglobin concentration (Hb), red blood cells (RBC), white blood cells (WBC), and its differential counts (monocytes, lymphocytes, heterophils, eosinophils, and basophils). This was carried out according to the methods described by Lamb (1991), at the clinical pathology laboratory, Faculty of Veterinary Medicine, A.B.U, Zaria.

Digestibility Trial

At the end of the 8 weeks experimental period, three (3) chickens representing the average group weight were selected from each treatment and were housed individually in separate cages for fecal collection. The trial lasted for 7 days; however, there was two days adjustment period before the commencement of the trial. During collection, contaminants were removed from the faeces. Daily feed intake per bird was recorded. Faecal samples were oven-dried at 80 ^{0}C and proximate analysis using AOAC (2008) methods was conducted. The apparent nutrient digestibility was calculated using the formula below:

$$\text{Apparent Digestibility} = \frac{\text{Nutrient supplied in feed} - \text{Amount of nutrient in feces}}{\text{Nutrient supplied in the feed}} \times 100$$

Data Analysis

Data obtained from the experiments were statistically analyzed for variance using the General Linear Model procedure of the Statistical Analysis System (SAS, 2008) version 9.0. Significant differences among treatment means were separated using Tukey procedures.

Table 1: Chemical Composition of the Experimental Diets (Finisher 5-8weeks)

Ingredients (%)	Level of Poultrystar® (g/100 kg)				Oxytetracycline
	0	40	60	80	
Calculated Analyses					
ME Kcal/kg diet	2927.58	2927.58	2927.58	2927.58	2927.58
Crude protein (%)	20.68	20.68	20.68	20.68	20.68
Crude fiber (%)	3.52	3.52	3.52	3.52	3.52
Ether extract (%)	3.03	3.03	3.03	3.03	3.03
Calcium (%)	1.21	1.21	1.21	1.21	1.21
Available P (%)	0.83	0.83	0.83	0.83	0.83
Lysine (%)	1.03	1.03	1.03	1.03	1.03
Methionine (%)	0.53	0.53	0.53	0.53	0.53
Methionine + Cystine (%)	0.85	0.85	0.85	0.85	0.85

** Biomix Vitamin- mineral premix provided per kg of diet; vit. A, 13,340 i.u; vit. D_3, 2680 i.u;vit. E, 10 i.u; vit. K, 2.68 mg; calcium pantothenate, 10.68mg; vit. B_{12}, 0.022mg; folic acid, 0.668mg; choline chloride, 400mg; 26.68mg; manganese, 13mg; iron, 66.68mg; zinc, 53.34mg; copper, 3.2mg; iodine, 1.86mg; cobalt, 0.268mg; selenium, 0.108.*

RESULTS AND Discussions

Haematological Indices of Broiler Chickens Fed Diets Containing Different Levels of Poultrystar®

Table 2 presents the results of haematological indices of broiler chickens fed diets containing different levels of Poultrystar®. Significant (P<0.05) differences existed for all the measured parameters. Birds fed the control diet had higher values of PCV, Hb and RBC compared to the birds fed Oxytetracycline. They were, however, statistically (P>0.05) similar to those fed 40g, 60g and 80g of Poultrystar® per 100kg diet. WBC counts were significantly (P<0.05) higher in birds fed a diet containing 80g/100kg Poultrystar® compared to those fed Oxytetracycline, but were statistically (P>0.05) similar to birds fed other treatments. Lymphocytes were significantly (P<0.05) higher in birds fed the control diet compared to those fed 60g/100kg Poultrystar® but were statistically (P>0.05) similar to those fed other treatments. Birds fed a diet containing 60g/100kg Poultrystar® significantly (P<0.05) higher in monocytes compared with those fed Oxytetracycline and those fed the control diet. However, they were statistically the same with those fed 40g and 80g Poultrystar® per 100kg diet. For eosinophils, birds fed 60g of Poultrystar® and those fed Oxytetracycline were significantly (P<0.05) higher than those fed 80g and those fed 40g of Poultrystar® per 100kg diet and also those fed the control diet. Birds fed an 80g/100kg diet of Poultrystar® were significantly (P<0.05) higher in basophils compared to the control group, but were statistically (P>0.05) similar to the other treatment groups.

The results in Table 2 indicated that the Poultrystar® is safe to use as it does not negatively affect the haematological parameters of the fed broiler birds. Even though the parameters considered had shown significant (P<0.05) differences, however, Alam and Ferdaushi (2018) and Dimcho *et al.* (2005) did not find significant differences in Hb (haemoglobin) and PCV. Conversely, Amjed (2017) reported a significant increase in eosinophils, lymphocytes, and heterophils while basophils showed no significant increase.

Table 2: Haematological Indices of Broiler Chickens Fed Diets Containing Different Levels of Poultrystar®

Parameters	Level of Poultrystar® (g/100 kg)					SEM
	0	40	60	80	Oxytetracycline	
PCV (%)	16.960^{a}	11.900^{ab}	10.930^{ab}	14.360^{ab}	08.600^{b}	3.011
Hb (g/dL)	05.967^{a}	03.700^{ab}	04.033^{ab}	04.133^{ab}	02.733^{b}	1.188
RBC (x10^6/uL)	1.260^{a}	00.846^{ab}	00.420^{b}	00.626^{ab}	00.356^{b}	0.281
WBC (x10^3/uL)	40.80^{a}	23.070^{ab}	24.570^{ab}	41.430^{a}	19.000^{b}	9.308
Lymphocytes (%)	92.067^{a}	91.367^{a}	77.533^{b}	86.253^{a}	84.100^{a}	5.179
Monocytes (%)	04.733^{b}	05.400^{ab}	07.700^{a}	05.733^{ab}	06.833^{b}	1.332
Eosinophils (%)	01.600^{b}	01.967^{b}	04.400^{a}	02.067^{b}	03.033^{a}	1.123
Basophils (%)	0.2333^{b}	00.367^{ab}	00.333^{ab}	00.633^{a}	00.600^{ab}	0.110

^{ab}Means with different superscripts are statistically different. SEM: Standard Error of Means, PCV: Packed Cell Volume, Hb: Hemoglobin, RBC: Red Blood Cell, WBC: White Blood Cell

Nutrient Digestibility of Broiler Chickens Fed Diets Containing Different Levels of Poultrystar®

The results for nutrient digestibility of broiler chickens fed diets containing different levels of Poultrystar® were shown in Table 3. There were significant (P<0.05) differences for all the parameters except for ether extracts. Dry matter digestibility was significantly higher (74.17%) for birds fed 60g/100kg Poultrystar® compared to the control group (69.61%). It was, however, statistically (P>0.05) similar for birds fed 40g, 80g/100kg Poultrystar® and Oxytetracycline. Interestingly, crude protein digestibility follows a similar trend as with dry matter, with the 60g/100kg Poultrystar® fed group exhibiting the highest crude protein digestibility. Crude fibre digestibility was significantly (P<0.05) higher for birds fed Oxytetracycline (82.17%) and in those fed 60g Poultrystar® per 100kg diet (82.06%) compared to those fed 80g Poultrystar® per 100kg diet which was also statistically (P<0.05) higher than the birds fed control (77.47%) diet. It was also observed that birds fed 60g/100kg Poultrystar® had statistically (P<0.05) higher ash digestibility at 80.75% than birds in the control group (75.08%) and those fed Oxytetracycline. Birds fed 40g and those fed 80g had statistically (P>0.05) similar ash digestibility with those fed 60g Poultrystar® per 100kg diet. NFE digestibility followed a similar trend as dry matter and crude protein digestibility

There was an improvement in dry matter, crude protein, crude fibre, ether extract, ash and NFE digestibility by 6.9%, 3.8%, 5.9%, 2.5%, 7.6% and 10.8% respectively for birds fed 60g/100kg Poultrystar® compared to the control group. The significant differences observed in digestibility (table 3) were attributed to the synergistic effect of Poultrystar® leading to increased enzymatic activities. This is in line with the reports of Jin *et al.* (2000) who reported that *Lactobacillus* probiotics influenced digestive enzyme activity in the gastrointestinal tract (GIT) of poultry. Spore-forming bacteria produce extracellular enzymes including α-amylase, cellulase, proteases and metalloproteases (Lee *et al.*, 2010) which could increase nutrient digestion. Alam and Ferdaushi (2018) reported increased digestion and absorption when Poultrystar® was fed. Li *et al.* (2008), reported that the supplementation of broiler diets with probiotics enhanced the digestibility of dry matter (DM) by 12.4%. Poultrystar® inclusion boosts the effectiveness of digestive enzymes (Jin *et al.*, 2000), and produces essential amino acids and vitamins in the gastrointestinal tract. Furthermore, Fioramonti *et al.* (2003) reported probiotic bacteria's role in influencing the gastrointestinal tract's principal functions, such as digestion and absorption. In contrast, Biggs *et al.* (2007) reported a negative impact on digestibility. Apata (2008) reported no significant effect on the digestibility of crude protein or fat when a lower dose of probiotic was fed. However, at higher concentrations, specifically 6×10^6 CFU/g and 8×10^6 CFU/g, there was a substantial increase in the digestibility of protein and fat.

Table 3: Nutrient Digestibility of Broiler Chickens Fed Diets Containing Different Levels of Poultrystar®

Parameters (%)	Level of Poultrystar® (g/100 kg)					SEM
	0	40	60	80	Oxytetracycline	
Dry matter	69.61^{b}	70.99^{ab}	74.17^{a}	71.89^{ab}	71.37^{ab}	2.169
Crude protein	79.51^{b}	81.48^{ab}	82.49^{a}	81.71^{ab}	80.47^{ab}	1.341
Crude fiber	77.47^{c}	81.01^{ab}	82.06^{a}	80.79^{b}	82.17^{a}	0.910
Ether extract	89.15	90.13	91.33	90.09	90.08	2.318
Ash	75.08^{b}	77.36^{ab}	80.75^{a}	78.47^{ab}	75.27^{b}	1.962
Nitrogen free extract	60.91^{b}	62.67^{ab}	67.49^{a}	64.06^{ab}	64.09^{ab}	2.839

^{ab}Means with different superscripts are statistically different. S.E.M: Standard Error of Means

CONCLUSION

From the results obtained in this study, it was concluded that, adding Poultrystar® to the diet of broiler chickens at 60g/100kg enhances the digestibility of dry matter, crude protein, crude fibre, ash and NFE

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