Nig. J. Anim. Prod. 2022, 49(4): 13-19. https://doi.org/10.51791/njap.v49i4.3698 *Nigerian Journal of Animal Production*

Effect of commercially blended synbiotic product as a replacement for antibiotic growth promoters on growth performance and villi morphology of broiler chicks in dry hot season

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Abstract

Antibiotic growth promoters (AGPs) have been widely used in poultry diets for years. The use of AGPs has been either regulated or banned because of public concerns over possible antibiotic residual problems and the development of antibiotic resistant bacteria. Consequently, there has been search for potential alternatives to AGPs. Probiotics and prebiotics have been suggested as useful dietary means for compensating the loss in productive performance when AGPs are removed from poultry diets. The study aimed at evaluating the combined effect of dietary probiotics and prebiotics on bird growth performance as an alternative to antibiotic growth promoter. Six hundred day old chicks were used for this study and were intensively managed. The chicks were randomly assigned into five treatments in a complete randomized design and administered as 0g, 1g, 2g, 3g of Poultrystar® Sol with oxytetracycline as positive control. Growth parameters (total feed intake, weight gain and FCR) were studied. Collected data were subjected to one-way Analysis of variance and significant differences in the means were separated using Dunnet test at 95% probability. Result showed a significant ($p<0.05$) influence of Poultrystar® Sol on weight gain, feed intake, FCR and cost of total feed intake. The birds on 3g Poultrystar® Sol had better weight gain (1276.20g), FCR (0.74) and less cost of total feed intake (₦123.70) when compared with birds on 0% inclusion, oxytetracycline and birds on other levels of Poultrystar® Sol. No mortality was recorded. Result showed a significant ($p<0.05$) influence of Poultrystar® Sol on villi morphology section of ileum of broiler . There were significant ($P < 0.05$) differences in all parameters measured. Birds on diet containing 3g inclusion of Poultrystar® Sol had significantly ($P<0.05$) higher villi area (µm, 356210 μm^2), villi perimeter (851.19 µm), villi height (345.95 µm) villi width (181.39 µm) and crypt depth (130.52 µm) when compared with birds on diet containing 0 inclusion (116652 µm, 493.60 µm , 203.50 µm , 113.81 µm and 87.58, respectively) of Poultrystar® Sol, diet containing oxytetracycline (171659 μm^2, 780.81 µm , 309.33 µm, 157.87 µm and 92.47 µm, respectively) and birds on other treatments. It concluded that 3g/100kg inclusion of Poultrystar® Sol could be used to replace antibiotics in diets of broiler chicks to achieved better bird performance, reduced production cost, manage stress and produce healthier poultry products for human safe consumption.

Keywords: Poultrystar® Sol, synbiotic and Performance

Effet du produit synbiotique mélangé commercialement en remplacement des promoteurs de croissance antibiotiques sur les performances de croissance et la morphologie des villosités des pouletrs de chair en saison chaude sèche

Résumé

Les promoteurs de croissance antibiotiques (PCAs) sont largement utilisés dans l'alimentation des volailles depuis des années. L'utilisation des AGP a été soit réglementée, soit interdite en raison des inquiétudes du public concernant d'éventuels problèmes résiduels d'antibiotiques et le développement de bactéries résistantes aux antibiotiques. Par conséquent, il y a eu une recherche d'alternatives potentielles aux PCAs. Les probiotiques et les prébiotiques ont été suggérés comme moyens diététiques utiles pour compenser la perte de performances productives lorsque les PCAs sont retirés des régimes alimentaires des volailles. L'étude visait à évaluer l'effet combiné des probiotiques et des prébiotiques alimentaires sur les performances de croissance des oiseaux en tant qu'alternative aux antibiotiques promoteurs de croissance. Des poussins de 600 jours ont été utilisés pour cette étude et ont fait l'objet d'une gestion intensive. Les poussins ont été répartis au hasard en cinq traitements dans une conception randomisée complète et administrés sous forme de 0 g, 1 g, 2 g, 3 g de Poultrystar® Sol avec de l'oxytétracycline comme contrôle positif. Les paramètres de croissance (apport alimentaire total, gain de poids et FCR) ont été étudiés. Les données collectées ont été soumises à une analyse de variance unidirectionnelle et les différences significatives dans les moyennes ont été séparées à l'aide du test de Dunnet à 95 % de probabilité. Les résultats ont montré une influence significative ($p<0,05$) de Poultrystar® Sol sur le gain de poids, l'apport alimentaire, le FCR et le coût de l'apport alimentaire total. Les oiseaux sur 3 g de Poultrystar® Sol ont eu un meilleur gain de poids (1276,20 g), un FCR (0,74) et moins de coût de l'apport alimentaire total (₦123,70) par rapport aux oiseaux sur 0 % d'inclusion, oxytétracycline et les oiseaux sur d'autres niveaux de Poultrystar® Sol . Aucune mortalité n'a été enregistrée. Le résultat a montré une influence significative ($p<0,05$) de Poultrystar® Sol sur la section morphologique des villosités de l'iléon du poulet de chair. Il y avait des différences significatives ($P < 0,05$) dans tous les paramètres mesurés. Les oiseaux recevant un régime contenant 3 g d'inclusion de Poultrystar® Sol présentaient une surface de villosités (µm, 356210 µm2), un périmètre de villosités (851,19 µm), une hauteur de villosités (345,95 µm), une largeur de villosités (181,39 µm) et une profondeur de crypte significativement plus élevées ($P<0,05$). 130,52 µm) par rapport aux oiseaux recevant un régime contenant 0 inclusion (116652 µm, 493,60 µm , 203,50 µm , 113,81 µm et 87,58, respectivement) de Poultrystar® Sol, régime contenant de l'oxytétracycline (171659 µm2, 780,81 µm , 309,33 µm, 157,87 µm et 92,47 µm, respectivement) et les oiseaux sous d'autres traitements. Il a conclu que l'inclusion de 3 g/100 kg de Poultrystar® Sol pourrait être utilisée pour remplacer les antibiotiques dans l'alimentation des poussins de chair afin d'obtenir de meilleures performances des oiseaux, de réduire les coûts de production, de gérer le stress et de produire des produits de volaille plus sains pour une consommation humaine sans danger.

Mots-clés : Poultrystar® Sol, synbiotique et Performance

Introduction

Efficient feed conversion and high levels of production are the needs of the modern poultry industry, which to a certain extent could be achieved by the use of specific feed additives. (Agbai *et al.,* 2021). Growth performance is the general and direct indicator in poultry as it involves feed

utilization and overall effectiveness of poultry production (Ajuwon, 2015). With increased worldwide demand for animal products, intense pressure is being placed on livestock-rearing operations to enhance animal productivity while maintaining high levels of product quality and safety. Numerous advances in animal productivity have been made through the use of nutritional supplements and the incorporation of antimicrobial compounds into livestock feed, although undeniably effective in increasing animal productivity and reducing feed costs. (Castanon, 2007; Casewell *et al.*, 2003).

Antibiotic feed additives as growth promoters have long been supplemented to poultry feed to stabilize the intestinal microbial flora, improve the general performances and prevent some specific intestinal pathology (Hassan *et al*., 2010). However, the application of antibiotics to animal feed has reduced because of academic and public scrutiny and the health implication on the end users of the products. In fact, the European Union has passed legislation that prohibits the subtherapeutic application of antibiotics in animal agriculture, due to the emergence of microbes resistant to antibiotics which are used to treat human and animal infections, the European Commission (EC) decided to phase out, and ultimately on 1 January 2006, banned the marketing and use of antibiotics as growth promoters in feed. There have been a significantly increased number of studies focused on searching for alternatives to antibiotics with similar antimicrobial and growth-promoting effects without inducing bacterial resistance and potential side effects to animals.

PoultryStar® sol is a well-defined, multi-species synbiotic product that promotes a beneficial gut microflora through the combined action of carefully selected probiotic microorganism and prebiotic fructooligosaccharide. PoultryStar® sol is designed to improve gut health of poultry and to make day old chicks and birds of all ages more resistant to pathogens leading to improved performance parameters (Biomin, 2018). The combination of probiotics and prebiotics is called synbiotics. Synbiotics include both beneficial microorganisms and substrates, which may have synergetic effects on the intestinal tract of animals (Gibson *et al.,*1995).

Material and methods

Study Area: The study was carried out at the Poultry Unit of the Livestock section of Division of Agricultural College, Ahmadu Bello University, Zaria. Zaria is located within the Northern Guinea Savanna Zone on latitude 11^0 11' 06" N and longitude 7^0 38' 55" E, at an altitude of 706m above sea level. The maximum temperature ranges from 26-32^{0}C depending on the season while the mean relative humidity during the dry and wet season were 21 and 72%, respectively. (Meteorological Unit, Institute for Agricultural Research, Ahmadu Bello University Zaria, 2021).

Source of experimental birds: Day-old broiler chicks (Cobb 500) were purchased from Olam Hatcheries Limited, Dutse Village, Chikun Local Government, Kilometer 25 Kaduna-Abuja Expressway, Kaduna State, Nigeria

Laboratory analysis: Proximate analysis of the experimental diets was done at the Biochemical Laboratory, Department of Animal Science, Faculty of Agriculture, Ahmadu Bello University, Zaria according to methods described by A.O.A.C. (2005) as shown in table 1.

***Experimental design and management of birds*:** Six hundred day old broiler chicks were allocated to five dietary treatments withthree replicates of 40 birds each in a completely randomized design. The birds were housed in deep litter pens and

managed with all necessary routine management practices. Feed and water were provided *ad libitum* for the period of the experiment. Birds were cared for according to guidelines established by the Ahmadu Bello University Animal Care Committee.

Experimental diets

Five diets were formulated. The Poultrystar® Sol was added as non-inclusive part of the diets.

Diet 1: Control diet – without Poultrystar® Sol and oxytetracycline

Diet 2: Control diet + 1g of Poultrystar® Sol /100 Kg diet

Diet 3: Control diet + 2g of Poultrystar® Sol /100 Kg diet

Diet 4: Control diet + 3g of Biotronic® Top Forte /100 Kg diet

Diet 5: Control diet + Oxytetracycline at 8g/100Kg diet (as recommended by manufacturer).

Recommended dosage for Poultrystar® Sol 20g/tonne of feed.

***Growth study*:** Initial and final weights of birds were taken at the beginning and at the end of the study. Weight gain and feed intake were measured at the end of every seven days while FCR and cost of feed intake were computed after the study. There was no mortality recorded.

Villi morphology

Intestinal segment samples (approximately 2cm in length) of ileum were taken from slaughtered birds to ascertain villi morphometry parameters. The morphometry indices that were evaluated include villus height (from the tip of the villus to the crypt), crypt depth (from the base of the villi to the sub mucosa), and the villus height to crypt depth as described by Zhang *et al*. (2005). This was carried out at the Histology Laboratory of the Department of Anatomy, Ahmadu Bello University Zaria.

Statistical analysis: All data obtained from the five treatments were statistically analyzed using the General Linear Model Procedure of Statistical Analysis Systems (SAS, 2002). Significant differences between treatments means were separated using Dunnett's test in the SAS package.

Results and discussion

The growth performance of broiler chicks (0-4weeks) fed of Poultrystar® Sol, Synbiotic product (a probiotic strains and Prebiotic fructooligosaccharides (FOS)) a stress reducing agent and to replace antibiotics as growth promoter is presented in Table 2. The results showed that there were significant ($P < 0.05$) differences in final weight, weight gain, feed intake, FCR and cost of total feed intake. Birds on diet containing 3g inclusion of Poultrystar® Sol had significantly higher final weight (1318.67g), weight gain (1276.20g), better FCR (0.74) and least cost of production (₦115.65) when compared with birds on diet containing 0 inclusion (942.33g, 899.87g, 1.40 and ₦ 154.88 respectively) of Poultrystar® Sol, diet containing oxytetracycline (976.67g, 934.20g, 1.26 and ₦ 147.19 respectively) and birds on other treatments.

The Significant differences observed in final weight, weight gain, FCR and cost of total feed intake were as a result of the features of probiotic strains and Prebiotic fructooligosaccharides in Poultrystar® Sol exerting its synergistic effects by fast establishment of a beneficial gut microflora and inhibition of enteric pathogens which resulted to improved weight gain, improved feed conversion ratio and no mortality. Poultrystar® Sol enhance effectiveness utilization of nutrients thereby reducing amount of feed consumed and reduce cost of production. This agrees with the report of Awad *et al.,* 2009; Li *et al.,*2008; El- Banna *et al.,* 2010 and Falaki *et al.,* 2011. The authors observed that weight gain, feed conversion efficiency and the overall performance of broilers were improved in

synbiotic supplemented group. Contrary to this finding, Jung *et al.*,(2008) and Erdogan *et al.,* (2010) reported that the diet supplemented with synbiotic had no effect (P> 0.05) on weight gain, feed intake and feed conversion efficiency of broilers.

Table 1: Proximate composition of experimental diets

Parameters	Dry matter	Crude protein	Crude fiber	Ether extract	Ash	NFE	ME(Kcal/kg)
Composition	94.61	20.68	4.48	3.65	6.15	65.04	3331.29

ME(Kcal/kg) = Metabolizable energy. ME(Kcal/kg) = (35.0 x %CP) + (81.8 x EE) + (35.5 x NFE). Pauzenga,1985

Table 2: Growth performance of chicks fed diets containing different levels of Poultrystar® sol (0 – 4weeks)

	Levels of inclusions (g)					
Parameters	**0**	**1**	**2**	**3**	**oxytet**	**SEM**
Initial weight(g)	42.47	42.43	42.40	42.47	42.46	0.15
Final weight (g)	942.33^{c}	1001.00^{b}	1051.67^{b}	1318.67^{a}	976.67^{bc}	49.80
Weight gain (g)	899.87^{c}	958.57^{b}	1009.27^{b}	1276.20^{a}	934.20^{bc}	49.83
Feed intake(g)	1260.30^{a}	1082.70^{b}	1067.00^{b}	935.00^{c}	1177.30^{b}	107.51
FCR	1.40^{c}	1.15^{c}	1.07^{b}	0.74^{a}	1.26^{bc}	0.15
Cost/kg feed	122.90	123.20	123.40	123.70	125.00	-
Cost of total feed intake	154.88^{c}	133.34^{b}	131.69^{b}	115.65^{a}	147.19^{bc}	13.33

^{abc}=means within same row with different letter superscript are significantly different (P<0.05), Oxytet - Oxytetracycline, SEM - Standard error of means, g= gram, kg – kilogram

Villi morphology of broiler chicks fed diets containing different levels of Poultrystar® sol (0 – 4 weeks)

The result of the effect of diets containing graded levels of Poultrystar® Sol on villi morphology section of ileum of broiler is shown in Table 3. There were significant (P < 0.05) differences in all parameters measured. Birds on diet containing 3g inclusion of Poultrystar® Sol had significantly (P<0.05) higher villi area (µm, 356210 μm^2), villi perimeter (851.19 µm), villi height (345.95 µm) villi width (181.39 µm) and crypt depth (130.52 µm) when compared with birds on diet containing 0 inclusion (116652 µm, 493.60 µm, 203.50 µm , 113.81 µm and 87.58 respectively) of Poultrystar® Sol, diet containing oxytetracycline (171659 μm^2, 780.81 µm , 309.33 µm, 157.87 µm and 92.47 µm respectively) and birds on other treatments.

The Significant differences observed in villi area, villi perimeter, villi height, villi width and crypt depth in birds on 3g inclusion of Poultrystar® Sol may be as a result of synergic effect of Poultrystar® Sol enhancing intestinal bacteria performance, stimulating the growth of beneficial bacteria and improved immunity of chickens (that is, Poultrystar® Sol beneficially affects the host by improving the survival and implantation of live microbial dietary supplements in the gastrointestinal tract). The Significant effects observed were due Poultrystar® Sol used in activating the metabolism of one or a limited number of health-promoting bacteria or by selectively stimulating their growth, which improved the welfare of the bird or both. This agrees with the report of

Table 3: Villi morphometrics of chicks fed diets containing different levels of Poultrystar® sol (0 – 4weeks)

	Levels of Biotronic® Top Forte (g)					
Parameters	**0**	**1**	**2**	**3**	**Oxytet**	**SEM**
Villi Area (μm^2)	116652^{c}	155332^{bc}	277093^{b}	356210^{a}	171659^{b}	4899.68
Villi Perimeter (μm)	493.60^{e}	644.41^{c}	814.64^{b}	851.19^{a}	780.81^{c}	70.78
Villi Height (μm)	203.50^{c}	263.98^{b}	312.64^{b}	345.95^{a}	309.33^{b}	22.70
Villi Width (μm)	113.81^{d}	172.05^{b}	173.60^{b}	181.39^{a}	157.87^{c}	23.54
Crypt Depth (μm)	87.58^{e}	114.24^{c}	124.78^{b}	130.52^{a}	92.47^{d}	15.06

^{abcd} = means with different superscripts on the same row differ significantly (P<0.05), Oxytet: Oxytetracycline. SEM: Standard Error of Means

Bozkurt et al. (2014) and Kim et al. (2011) that **synbiotic** influences intestinal bacteria, stimulating the growth of beneficial bacteria. Also agrees with the report of Patterson and Burkholder (2003) that symbiotic modulate host defense system. The result from present study is not in agreement with the report of Biggs *et al.* (2007) who did not observe any significant growth performance in broiler chicks fed diets supplemented with symbiotic product at 4 g/kg. The authors also found depressed growth performance and a negative impact on amino acid digestibility as well as metabolizable energy when supplemented with higher level of inulin (8 g/kg).

Conclusion and recommendations:

Study showed that birds on 3g inclusion of Poultrystar® Sol had better final weight, weight gain, FCR, cost of total feed intake and better villi morphology. Farmers can use Poultrystar® Sol feed additives as replacement for antibiotic growth promoter and also as stress reducing agent in broiler chicks production.

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Date received: 19th February, 2022.
Date accepted: 21st June, 2022.