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Probiotic Supplemented diet improved the gut morphology of broiler chickens

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Target audience: Feed millers and poultry farmers.

Abstract

An experiment was conducted to evaluate the effect of baker's yeast (saccharomyces cerevisiae) inclusion as probiotic on gut morphology of broiler chickens in the northern guinea savannah. Two hundred and fifty-five day old broiler chicks were used for the study. The chickens were fed diets containing graded levels of saccharomyces cerevisiae (SC). There were five treatment groups for both starter and finisher phases. Each treatment group had three replicates with 17 birds per replicate and fifty-one birds per group in a completely randomized design (CRD). Treatments 1, 2, 3, 4 and 5 contained 0, 0.5, 1.0, 1.5 and 2.0% SC respectively.Data obtained from the experiment were subjected to the analysis of variance (ANOVA) using the general linear model procedure of (SAS, 2001). Significant differences among treatment means were compared using Dunnetts. The results obtained showed significant difference ($P<0.05$) in villi density, villi Area, villi perimeter, villi height and villi width. No significant ($P>0.05$) difference between treatment groups fed 0.5, 1.0 and 1.5% level of SC inclusion in terms of villi area. Villi perimeter was significantly higher (2347.2µm) in broiler chickens fed 2.0% SC. Broiler chickens fed 1.0 and 1.5% SC did not differ ($P>0.05$) significantly in terms of villi height; though chickens fed 1.0% SC had the highest (870.3µm) mean value while the least value (525.5µm) was obtained in the broiler chickens fed control diet. Villi width was higher (358.14µm) in chickens fed 2.0% SC compared to other treatment groups. It is concluded from the study that inclusion of SC in the diet of broilers improved the gut morphology which is an indication of healthy gut which is important for optimum performances of the birds.

Description of Problem

The gut is an important organ which mediates nutrient uptake and use by the animals [1]. To understand how healthy a gut is, a balance of gut ecosystem is of importance [2]. Diets and infectious disease agents seem to affect this balance, and subsequently affect the health status and production performance of the chicken [2]. With the ban and/or reduction of the use of antibiotic growth promoters (AGPs) in poultry production, other alternatives are needed to preserve the balance of gut micro biota in chicken. Fast growth rate and feed efficiency are important targets in poultry production. Some factors need to be taken into consideration to get optimum performance of birds such as genetic potential of the birds, quality of the diets, environmental condition and disease outbreaks [3]. Also gut health has recently been the subject of interest in poultry production. A well developed and healthy gut is important for optimum performances of the birds. When the gut function and health are impaired, digestion and absorption of nutrients are affected and thus the health and performance of birds will also

be affected. Therefore, the aim of this study is to determine the effect of baker's yeast (*Saccharomyces cerevisiae*) inclusion as probiotic on gut morphology of broiler chickens in the northern guinea savannah.

Materials and Methods

Experimental Site

The study was conducted at the National Agricultural Extension and Research Liaison Services, Skill Acquisition Farm, Ahmadu Bello University, Zaria, located within the Northern Guinea Savannah Zone of Nigeria at latitude 11^{o} 09' 06'' N and longitude 7^{o} 38' 55'' E, at an altitude of 706m above sea level [4]. The area falls within the Northern-Guinea Savannah Zone having an average annual rainfall of 1100mm, which starts from late April or early May to mid-October. The peak of rainy season is between June and September, followed by the harmattan period of cool and dry weather which last from November to January. This is then followed by hot – dry weather from February to April. The mean maximum temperature varies from 26^{o}C to 35^{o}C depending on the season, while the mean relative humidity during harmattan period and wet season are 21% and 72% respectively [5].

Source of Experimental Birds

Two hundred and fifty five commercial broiler chicks of Ross White strain were purchased from a reputable hatchery for these studies. The Baker's yeast was purchased in Samaru market in Zaria, Kaduna State, Nigeria.

Experimental Diets

Five experimental diets (Broiler starter and broiler finisher) were formulated to meet the nutrient requirement of broilers as shown in Tables 1 and 2. Diet 1 serves as the control while diets 2, 3, 4, and 5 contained 0.5, 1.0, 1.5 and 2.0% of commercial dry yeast respectively.

Table 1: Composition of Broiler Starter Diets Containing Varying Levels of *Saccharomyces Cerevisiae* (SC)

	Levels of inclusion of SC (%)				
Ingredients	**0.0**	**0.5**	**1.0**	**1.5**	**2.0**
Maize	50.66	50.63	50.60	50.55	50.52
Groundnut cake	25.31	24.81	24.31	23.82	23.32
Soya cake	12.59	12.59	12.59	12.59	12.59
Fish meal	3.00	3.00	3.00	3.00	3.00
Palm oil	3.69	3.72	3.75	3.79	3.82
Limestone	0.90	0.90	0.90	0.90	0.90
Bone meal	2.75	2.75	2.75	2.75	2.75
Common Salt	0.30	0.30	0.30	0.30	0.30
Premix**	0.30	0.30	0.30	0.30	0.30
Lysine	0.30	0.30	0.30	0.30	0.30
Methionine	0.20	0.20	0.20	0.20	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated Analysis					
ME (Kcal/kg)	3008	3008	3008	3008	3008
Crude protein (%)	23.31	23.31	23.31	23.31	23.31
Ether extract (%)	8.11	8.12	8.12	8.13	8.14
Crude fibre (%)	3.70	3.68	3.66	3.65	3.63
Calcium (%)	1.28	1.28	1.28	1.28	1.28
Lysine (%)	1.24	1.23	1.22	1.22	1.21
Methionine (%)	0.35	0.34	0.34	0.34	0.34
Available P (%)	0.57	0.57	0.58	0.58	0.59
Feed cost/kg(₦)	100.84	103.28	105.71	108.18	110.48

ME=Metabolizable Energy; **Biomix premix supplied per kg of diet: Vit. A, 10,000I.U; Vit.D_3, 2000 I.U; Vit E, 23 mg;Vit. K, 2mg: Vit.B_1,1.8;Vit. B_2, 5.5mg; Niacin, 27.5mg; Pantothenic acid, 7.5mg; Vit. B_{12}, 0.015mg: Folic acid, 0.75mg; Biotin, 0.06mg; Choline chloride, 300mg; Cobalt, 0.2mg; Copper, 3mg; Iodine, 1 mg; Iron, 20 mg; Manganese, 40 mg; Selenium, 0.2 mg; Zinc, 30mg; Antioxidant, 1.25mg; P=Phosphorus.

Table 2: Composition of Broiler Finisher Diets Containing Varying Levels of *Saccharomyces Cerevisiae* (SC)

	Levels of inclusion of SC (%)				
Ingredients	**0.0**	**0.5**	**1.0**	**1.5**	**2.0**
Maize	57.52	57.52	57.52	57.52	57.52
Groundnut cake	11.67	11.17	10.67	10.17	9.67
Soya cake	20.00	20.00	20.00	20.00	20.00
Fish meal	3.00	3.00	3.00	3.00	3.00
Palm oil	2.81	2.81	2.81	2.81	2.81
Limestone	1.10	1.10	1.10	1.10	1.10
Bone meal	2.80	2.80	2.80	2.80	2.80
Common Salt	0.30	0.30	0.30	0.30	0.30
Premix**	0.30	0.30	0.30	0.30	0.30
Lysine	0.30	0.30	0.30	0.30	0.30
Methionine	0.20	0.20	0.20	0.20	0.20
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated Analysis					
ME (Kcal/kg)	3045	3044	3042	3041	3039
Crude protein (%)	21.00	21.00	21.00	21.00	21.00
Ether extract (%)	7.21	7.18	7.16	7.13	7.11
Crude fibre (%)	3.66	3.65	3.63	3.62	3.60
Calcium (%)	1.35	1.35	1.35	1.35	1.35
Lysine (%)	1.25	1.24	1.23	1.22	1.21
Methionine (%)	0.35	0.35	0.35	0.35	0.35
Available P (%)	0.57	0.57	0.58	0.59	0.59
Feed cost/kg(₦)	94.51	96.86	99.21	101.56	103.91

ME=Metabolizable Energy; **Biomix premix supplied per kg of diet: Vit. A, 10,000I.U; Vit.D_3, 2000 I.U; Vit E, 23 mg;Vit. K, 2mg: Vit.B_1,1.8;Vit. B_2, 5.5mg; Niacin, 27.5mg; Pantothenic acid, 7.5mg; Vit. B_{12}, 0.015mg: Folic acid, 0.75mg; Biotin, 0.06mg; Choline chloride, 300mg; Cobalt, 0.2mg; Copper, 3mg; Iodine, 1 mg; Iron, 20 mg; Manganese, 40 mg; Selenium, 0.2 mg; Zinc, 30mg; Antioxidant, 1.25mg; P=Phosphorus.

Experimental Design and Management of Birds

Two hundred and fifty five (255), day old broiler chicks were allotted to five treatments (0.0, 0.5, 1.0, 1.5 and 2.0) consisting of 17 chicks per replicate and three replicates per treatment. T_1 was the basal diet (0.0% SC) while T_2, T_3, T_4 and T_5 had *Saccharomyces cerevisiae* included at 0.5, 1.0, 1.5 and 2.0% of the total diet. The design of the experiment was a completely randomized design (CRD). The birds were reared on deep litter system with feed and water provided *ad libitum* during the experimental period. All the diets were formulated to meet the nutrient requirements of the broiler chickens [6].Vaccines against Newcastle and Gumboro diseases were given following the vaccination schedule of Veterinary Teaching Hospital of Ahmadu Bello University, Zaria. Anti-stress was given to the birds after each vaccination.

Quantitative Assessment of Gut Morphology

Tissue samples of six birds per treatment were collected from the small intestine and

placed in 10% neutral buffered formalin for histomorphological analysis. Samples were embedded in paraffin wax, sectioned and stained with haematoxylin and eosin according to the procedures of [7].Using an image capture and analysis system (Image-Pro Plus version 4.5, 0.27), villi density, villi height, villi width, villi perimeter and area were measured. Villus height was measured from the basal to villus tip; perimeter was measured around the border where microvilli were located as decribed by [8].

Statistical Analysis

Data obtained from the experiment were subjected to the analysis of variance (ANOVA) using the general linear model procedure of [9]. Significant differences among treatment means were compared using Dunnetts.

Results

The Table 3 shows the results of the inclusion of SC in broiler diet on intestinal morphology and proliferation. The results showed that there was no significant (P>0.05) difference in villi density in all the treatment groups though, the broiler chickens in T_4 fed 1.5% SC had the highest (10.0) value. No significant (P>0.05) difference between treatment groups fed 0.5, 1.0 and 1.5% level of SC inclusion in terms of villi area. Villi perimeter was significantly (P<0.05) higher (2347.2µm) in treatment group fed 2.0 SC. Broiler chickens fed 1.0 and 1.5% SC did not differ (P>0.05) significantly in terms of villi height; though broiler chickens fed 1.0% SC had the highest (870.3µm) mean value while the least value (525.5µm) was observed in the chickens fed control diet. Villi width was higher (358.14µm) in chickens fed 2.0% SC compared to other treatment groups.

Table 3: Effect of inclusion of *Saccharomyces cerevisiae* in broilers diet on gut morphology

Parameters	Dietary Treatments					SEM
	Control T_1	T_2	T_3	T_4	T_5	
Villi Density	8.67^{a}	9.00^{a}	9.00^{a}	10.00^{a}	8.67^{a}	0.95
Villi Area (µm)	19783^{b}	68682^{a}	57802^{a}	66888^{a}	32741^{b}	9218.02
Villi Perimeter (µm)	1156.8^{b}	1487.9^{b}	1307.9^{b}	1834.7^{ab}	2347.2^{a}	263.35
Villi height (µm)	525.5^{b}	626.0^{b}	870.3^{a}	815.5^{a}	564.9^{b}	93.04
Villi Width (µm)	130.43^{b}	221.55^{b}	176.53^{b}	183.73^{b}	358.14^{a}	53.85

^{ab}: Means with different superscripts along same rows show significant differences (P<0.05)
SEM: Standard Error of Means

Discussion

The result revealed that increase in the villus height suggested an increased surface area capable of greater absorption of available nutrients [10]. Likewise, greater villus height may increase the activity of enzymes secreted from the tip of the villi resulting in improved digestibility [11]. Improved gut morphology is an indication of healthy gut which is important for optimum performances of the birds. [12] The authors reported an improved digestibility in birds supplemented with SC in their diet during the harmattan season. Furthermore, this result corroborated that of [13] who also reported a similar finding that villus height increased in duodenum and ileum of chicks when their diet was supplemented with *Lactobacillus* sp. Similarly, supplementation of multi-microbe probiotic product has been reported to cause increased villus height to crypt depth ratio in duodenum and ileum [14].

Conclusion and Applications

1. It is concluded that SC used as probiotic positively affect development of the gut in broiler chickens
2. Feed millers and poultry farmers can include probiotics (Bakers yeast) at 1% in poultry feed for improved development of gut and optimum performance of birds.

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