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Effect of Different Levels of Supplemental Yeast on Performance Indices and Serum Biochemistry of Broiler Chickens

Aluwong T[a,*], Raji M.A[b], Hassan B.F[c], Kawu M.U[a], Kobo P.I[a] and Ayo J.O[a]

[a]*Department of Veterinary Physiology, Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria, Nigeria*

[b]*Department of Microbiology, Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria, Nigeria*

[c]*College of Agriculture and Animal Health, Mando-Kaduna, Nigeria*

Abstract: The aim of the study was to investigate the effect of supplemental probiotic preparation on performance indices and serum biochemistry of broiler chickens. Two hundred day-old Marshall broiler chicks were randomly selected and distributed based on the level of supplementation into four groups of 50 chicks each (Control, C; $E_1$0.5%, $E_2$1.5% and $E_3$2.0%). Chicks were fed commercial broiler starter diet for the first 28 days of age followed by pelleted finisher diet from 29-42 days. Chickens fed 2.0% probiotic had a significantly higher body weight when compared with the control group. Activity of alanine aminotransferase differed significantly in the group E_1 and especially ($p<0.01$) in the group E_2. Alkaline phosphatase activity decreased significantly ($p<0.05$), when compared with that of the control group.. Blood glucose concentration was significantly different ($p<0.05$) in E_2 probiotic supplemented group when compared with control. Cholesterol concentration in broiler chickens decreased significantly ($p<0.01$) in E_1 experimental group.

Keywords: Body weight, Feed conversion ratio, Blood biochemistry, Broiler, Probiotic.

1. INTRODUCTION

Essentially, modern broiler industry tends to improve on the production level by employing appropriate genetic crossbreeding, adequate rearing conditions and good nutrition. One of the major challenges faced by poultry industry in the developing world including Nigeria is the issue of improving efficiency of production. In an attempt to address this very issue, series of efforts have been made by researchers. These involved the incorporation of antimicrobials and other natural products, such as yeasts to animal feeds [1]. Live yeast addition to animal feed has been known to improve the nutritive quality of feed and performance of animals [2, 3]. Non-antibiotic growth promoters, such as organic acids and probiotics are already well established in animal nutrition [4]. Probiotics are viable single or mixed cultures of microorganisms that when given to animals or humans, beneficially affect the host by improving the properties of the indigenous microflora [5, 6]. They have been used as an alternative to use of antibiotics in animals and humans, and their efficiency as such in animals has been widely discussed [7-9]. Probiotics aimed at stabilizing the microbial communities and the health-promoting effects have an important position in the medical health care of different age groups [10]. *Saccharomyces cerevisiae* (SC) yeast has biologically important proteins, B-complex vitamins, trace minerals and several unique 'plus factors'. Other identified beneficial factors include the enhancement of phosphorus availability [11-13] and utilization by animals [14-16], reduction in cases of disease infection [17] in addition to improvement of feed efficiency [18, 19]. However, there are still conflicting reports on the beneficial effect of yeast inclusion in poultry diets. Hayat *et al*., 1993 suggested that the beneficial effects of Saccharomyces dried yeast in feeds may be influenced by the birds' genome.

Agawane and Lonkar [20] reported that improvement in serum albumin concentration could be due to probiotic supplementation to broiler feed. In rats, *Lactobacillus plantarum* and *Bifidobacterium infantis* added to the feed caused decrease alanine aminotransferase (ALT) level [21], but addition of *Saccharomyces cerevisiae* caused significant increase of serum ALT and ALP [22]. Probiotics could contribute to the regulation of serum cholesterol concentrations by deconjugation of bile acids. Since the excretion of deconjugation of bile acids is enhanced and cholesterol is its precursor, more molecules are spent for the recovery of bile acids [23]. Also, Klaverand Van Der Meer [24] suggested that co-precipitation with bile acids might be of importance for decreasing of serum cholesterol concentrations.

Based on this background the main aim of the study was to investigate the effect of supplemental probiotic preparation on performance indices and serum biomarkers of broiler chicks. We hypothesized that different level of supplemental probiotic in poultry feeds could decrease performance indices of broiler chicks and decreased lipid profile of blood. We assume improvement in BW, FCR, FI and decrease mortality rate of broiler chicks supplemented with the probiotic. All the above changes may contribute to huge improvement of the general welfare, health status, and performance of broiler chicks.

*Address correspondence to this author at the Department of Veterinary Physiology, Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria, Nigeria; Tel: +234-8024-660-804;
E-mail: aluwong_tagang@yahoo.co.uk

Table 1. Dietary Composition of Starter and Finisher Feeds

Ingredient, (%)	Starter	Finisher
Crude protein	20	19
Fat	10	10
Crude fibre	9	10
Calcium	1.0	1.0
Available phosphorus	0.45	0.40
Metabolisable Energy (Kcal/Kg)	2800	2900

Table 2. Proximate Analysis of Starter, Finisher and Probiotic

Ingredient, (%)	Starter	Finisher	Probiotic
Dry matter	92.92	93.55	93.82
Crude protein	18.83	15.81	34.87
Crude fibre	7.42	9.92	9.13
Oil	6.08	5.29	8.56
Ash	5.40	8.33	8.03
NFE	62.27	60.65	39.41

2. MATERIALS AND METHODS

2.1. Experimental Design and Animal Management

The experiment was carried out on hybrid broiler Marshall (n=200). Two hundred day-old chicks were randomly selected and distributed into four groups of 50 day-old chicks each (Control, C; $E_{1,}$ 0.5%; $E_{2,}$ 1.5% and $E_{3,}$ 2.0% experimental groups). Birds were housed in an environmentally controlled poultry house with floor covered with wood shavings. The shavings were kept dry throughout the experimental period by replacing the spoiled litter as when due. The feeding lasted 42 days. Chicks were fed commercial broiler starter diet for the first 28 days of age and pelleted finisher diet from 29-42 days of age. Ingredients and nutrients composition of diets, proximate analysis of diets and probiotic are all shown in Table **1** and **2** respectively. Feed and water were provided *ad libitum*.

BW, FCR, FI and mortality were recorded on weekly basis for comparative evaluation and interaction effects of all treatment groups. For body weight measurement, birds were weighed individually at weekly intervals and the body weights were recorded to calculate body weight gains. FCR was calculated by the standard formula using total FI (g)/bird divided by total weight gain (g) for each period. FI was calculated as the difference between the amount of feed supplied to the birds and the amount of feed that remained at the end of each feeding period. To know the status of mortality, daily observations were made to record the occurrence of deaths in different experimental groups.The chicks were apparently healthy and their condition was judged to be good at the commencement of the experiment.

2.2. Blood Sampling and Analyses

After 42 days of feeding, blood was collected from 10 birds randomly selected and slaughtered from each group. Blood was collected through the brachial vein and drained into polythene tubes. Serum was collected by first allowing the blood to clot, followed by centrifugation at 5000 revolutions per minute. Serum enzymes (aspartate aminotransferase, AST; ALP), total proteins and cholesterol were determined using Ecoline kits and automatic analyzer Microlab 300 (Merck®, Germany), spectrophotometer Beckman Coulter DU 520 (Voight Distribution Inc., USA) and micro-processor-controlled analyser EasyLite (Medica, Bedford, USA) according to the manufacturers' instructions. Fasting blood glucose was determined from serum by glucose oxidase method [25]. Albumins content of chicken blood was assayed by spectrophotometer Beckman Coulter DU 520 using antioxidant RANDOX kits (RandoxLabs., Crumlin, UK) accordingto the manufacturers' instructions.

2.3. Statistical Analysis

Graph Pad Prism Software, version 4.03 for Windows (San Diego, California, USA) was used and data obtained were expressed as mean ± standard error of the mean (Mean ± S.E.M.). Data were analyzed using repeated measures ANOVA. Dunnett' post hoc test was used to compare all experimental groups with the control. Values of $p<0.05$ were considered significant.

3. RESULTS

3.1. Body Weight of Broiler Chickens

Results are shown in Table **3**. Body weights from week 4 in $E_3$2.0% probiotic supplemented group differed significantly ($p<0.01$) when compared with control. On the

Table 3. Effects of Dietary Yeast Probiotic Supplement on Body Weight of Broilers

Weeks	C	E_1	E_2	E_3
1	130.9±2.65	131.6±3.06	129.5±2.75	133.5±2.96
2	302.9±8.86	305.4±8.90	305.5±7.25	306.8±9.41
3	572.8±17.53	566.4±13.11	540.5±13.52	594.7±17.89
4	779.2±14.41	812.8±16.57	800.3±16.52	860.2±21.34*
5	1049.0±23.58	1162.0±31.99**	1121.0±30.87	1166.0± 31.67**
6	1342.0±47.17	1387.0±35.22	1376.0±40.32	1509.0±44.42**

**$p<0.05$ vs. control, *$p<0.01$ vs. control
The data are presented as Mean ± SEM, (n = 40)

Table 4. Weekly Feed Conversion Ratios of Broiler Chickens Supplemented with Probiotic

Week	C	E_1	E_2	E_3
1	1.14	1.51	1.47	1.37
2	1.45	1.44	1.46	1.41
3	1.31	1.33	1.29	1.23
4	1.24	1.24	1.24	1.19
5	1.16	1.21	1.14	1.26
6	1.21	1.56	1.19	1.18

5^{th} week, body weights differed significantly ($p<0.05$) in $E_1$0.5 and $E_3$2.0% probiotic supplemented groups, respectively when compared with the control group. Body weights of broiler chickens from week 1 to 3 did not differ ($p>0.05$) when compared with that of the control group. Overall, the body weight obtained in $E_3$2.0% probiotic supplementation at the 6^{th} week was higher ($p < 0.05$) than that of the control group (C).

3.2. Feed Conversion Ratio of Broiler Chickens

The results are shown in Table **4**. Weekly FCR of the broiler chickens for the entire duration of the experiment were determined. A significant improvement in FCR was recorded in E_2 and E_3 probiotic supplementation. But the general trend of our investigation seems to be inconsistent. FCR values for Marshall broiler chickens supplemented with 1.5 and 2.0% dietary probiotic ranged from 1.14 to 1.41.

3.3. Serum Enzymatic Profile of Broiler Chickens

Results are shown in Table **5**. Among the enzymatic profile of broiler chickens blood, there was variation in ALT and ALP activity in all the experimental groups supplemented with probiotic. Serum ALT and ALP levels decreased significantly ($p<0.05$) in all experimental groups when compared with control (C). There was no significant difference ($p>0.05$) in serum AST level in experimental groups when compared with control group.

3.4. Parameters of Glucose, Albumin, Total Proteins and Cholesterol of Broiler Chicken Blood

The results are shown in Table **6**. Blood glucose concentration was significantly different ($p<0.05$) in E_2 probiotic supplemented group when compared with control. Probiotic supplementation have no significant effect ($p>0.05$) on albumins. Total proteins in serum of broiler chickens were not affected by probiotic supplementation. But cholesterol concentration in broiler chickens decreased significantly ($p<0.01$) in E_1 experimental group, and tended to decrease in all probiotic supplemented groups.

4. DISCUSSION

The huge potential of good quality food in promoting and maintaining adequate health has set the tone of research in the area of food for health world-wide [26]. There are also a few sound data about the impact of probiotics on metabolic functions of the host [10]. Probiotics are mainly represented by mannanoligosaccharides and fructo-oligosaccharides present in the cell wall of yeasts, such as *Saccharomyces cerevisiae*. They exert their action by maintaining or re-establishing the conditions of eubiosis in the digestive tract, and thus, maintaining a normal microbial flora and balanced gastrointestinal tract [27]. Addition of probiotic to broiler feed resulted in significant improvement concerning hematobio chemical parameters [20].

4.1. Body Weight of Broiler Chickens

The result showed that probiotic supplementation had no effect on body weight of broiler chickens from the 1^{st} week to 3^{rd} week of life. This may be due to the time it took for the probiotic to re-establish the conditions of eubiosis in the digestive tract. However, from the 4^{th} to 6^{th} week, body weight differed significantly between control and experimental groups E_1 and E_3, but not in the second experimental group (E_2). Overall, the highest body weight gain was recorded in the experimental group with the highest probiotic concentration ($E_3$2.0%). This finding demonstrated that probiotic supplementation has more positive effect on body weight when administered in higher concentrations.

Table 5. Effect of Probiotic Supplementation on Activity of Serum Enzymes of Broiler Chickens

Activity of Enzymes	C	E_1	E_2	E_3
AST (IU/L)	233.1±10.86	248.6±17.00	251.8±24.23	234.8±8.24
ALT(IU/L)	86.40±1.64	76.00±3.50^{a}	75.00±2.92^{b}	79.90±1.38
ALP (KAU/L)	172.7±2.31	148.1±9.57^{d}	143.2±10.28^{c}	157.6±1.88

Mean ± S.E.M, (n = 10) ^{acd}p< 0.05 vs. control, ^{b}p<0.01 vs. control

Table 6. Effect of Probiotic on Glucose, Albumins, Total Proteins and Cholesterol Levels of Broiler Chickens

Parameters	C	E_1	E_2	E_3
Glucose, mmol/L	13.0±0.53	12.16±0.60	11.27±0.29**	11.79±0.48
Albumins, g/L	14.70±0.68	14.50±0.40	13.80±0.59	16.30±0.83
Total proteins, g/L	41.70±1.11	39.20±0.74	39.30±0.82	40.20±1.20
Cholesterol, mmol/L	2.68±0.15	2.04±0.09*	2.45±0.15	2.53±0.14

Mean±SEM, (n = 10) **p<0.05 vs. control, *p<0.01 vs. control

Santin *et al*., 2001 showed that cell walls of *Saccharomyces cerevisiae* improve nutrient absorption from the intestinal mucosa and suggested that this factor may be responsible for the improvement in performance of broilers supplemented with *Saccharomyces cerevisiae*.

Probiotics act by reducing the feed conversion, resulting in an increase of daily live weight gain [28, 29]. This is achieved through a natural, physiological way, improving digestion by balancing the resident gut microflora. Essentially, they help the animal to fulfil its genetic potential. The significant decrease in feed conversion ratio obtained in the present study (result not included in this article) agrees with the findings obtained in the field by [41, 44, 45] and [30] that probiotic supplementation improved performance of broiler chickens. According to [40], prebiotics and probiotics as growth promoters can be used as alternative non-antibiotic feed additives as they do not have side-effects on the consumers, but they improve growth indices of broiler chickens. Similar findings on the positive effect of probiotics on growth performances have been well documented by [42, 46, 31] and [50].

4.2. Feed Conversion Ratio of Broiler Chickens

The FCR of broiler chickens for the entire duration of the experiment were determined. A significant improvement in FCR was recorded in experimental groups E_2 and E_3 probiotic supplementation. However, the result showed an inconsistent trend. FCR values for Marshall Broiler chickens supplemented with 1.5 and 2.0% dietary *Saccharomyces cerevisiae* possessed the highest body weights, and ranged from 1.14 to1.18 percent. At 6^{th}wk of age there was significant changes ($p<0.05$) in the feed conversion ratio of broiler chickens in experiment E_2 and E_3 probiotic supplementation when compared with the control. This result is in agreement with the findings of [43] who reported that although a significant improvement in feed conversion ratio was observed in probiotic-supplemented broilers, the results were inconsistent. Probiotics act by reducing the feed conversion, thereby resulting in an increase of the daily live weight gain [28]. Improvement in FCR might be due to efficient ileal digestibility of nutrients [32, 33]. Bansal [29] reported significant and better weekly feed conversion efficiency on probiotic supplementation in the diet of commercial broiler chicks.

4.3. Serum Enzymatic Profile of Broiler Chickens

The decrease in activities of serum ALT and ALP of the broiler chickens were recorded in all the probiotic supplemented groups, when compared with the control. Also, serum ALP level decreased in all the experimental groups. The decrease in ALT activity obtained in the present study agrees with similar observations made in studies on rats in which addition of *Lactobacillus plantarum* and *Bifidobacterium infantis* to diets fed to rats decreased ALT activity [21]. In another study, Mannaa [22] showed that the addition of *Saccharomyces cerevisiae* caused significant increase in serum ALT and ALP activities. The differences in the enzymatic activity may be due to animal species and probiotic interventions. In this study, no significant differences ($p > 0.05$) between control group and probiotic supplemented groups were observed in the activity of AST, and similar results were observed in broiler chickens fed probiotic supplemented diet [34, 35]. Any abnormal increase in serum levels of AST, ALT and ALP may imply liver damage [36]; therefore, the relatively stable levels of AST may be associated with hepato-protective effects of the yeast probiotic.

4.4. Parameters of Glucose, Albumins, Total Proteins and Cholesterol of Broiler Chickens Blood

In our study, blood glucose concentration was significant in E_3 group but no significant differences ($p>0.05$) between control group and probiotic supplemented groups were observed in the content of total protein. This result agrees with the findings of [48] who reported no significant difference in the level of total proteins in a study with ducklings using a multi-strains probiotic. In the present study, cholesterol content tended to decrease in the probiotic supplemented groups ($p>0.05$). Reduction in circulating cholesterol with supplemental yeast agrees with the results of other researchers [37, 38], that the addition of innocuous microorganisms including yeast to diet of rabbit and broiler chickens decreased serum cholesterol, triglycerides and phospholipids. Also, blood cholesterol levels of layers fed yeast supplemented diets were lowered than the control [39]. Similar studies conducted by [47] and [49] found that cholesterol content was lowered with inclusion of yeast into broiler chicks'diets.

CONFLICT OF INTEREST

The authors confirm that this article content has no conflicts of interest.

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