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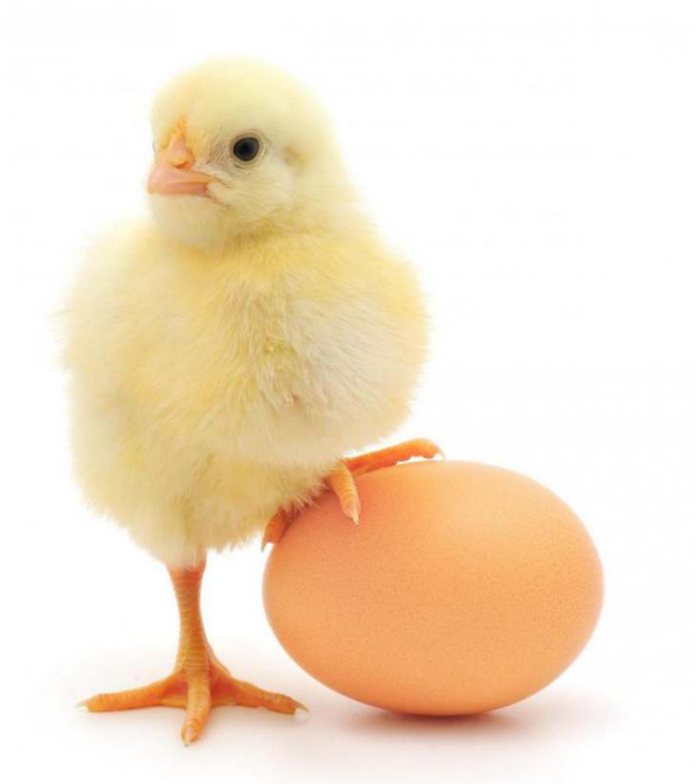

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Feed Efficiency and Blood Hematology of Broiler Chicks Given a Diet Supplemented with Yeast Culture

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Abstract: A study was conducted to evaluate the effect of supplemental yeast culture (Diamond V XP Yeast Culture; YC) in broiler diets on growth performance and hematological parameters. One-day-old Ross 308 broiler chicks (n = 240) were randomly assigned to 1 of 4 dietary treatments based on corn and soybean meal containing 0, 1, 1.25 (recommended level) and 1.5 g/kg of YC in the diet over 42 days. Each treatment group had 60 birds divided into 4 replicates. All birds were kept under the same managerial, environmental and hygienic conditions except for different dietary levels of yeast. Feed consumption, weight gain and feed conversion were measured on 3 week-interval basis. At 42 days of age three birds were chosen randomly from each replicate for determination of hematological parameters. The results of this study indicate that dietary supplemental YC at 1.25 g/kg (recommended level of the manufactory) improved growth performance. However, this improvement was not statistically differed. The chicks fed supplemented diets with YC in the rate of 1.5 g/kg had significantly ($p<0.05$) lower White Blood Cell (WBC) counts compared to control one. However, no significant differences were found among treatment groups for HGB, RBC, HCT, MCV and MCH. Generally, broiler chicks fed with yeast shows highly significant decrease ($p<0.0005$) in thrombocyte count compared to the control group. In conclusion, the addition of yeast culture in broilers' diet improved body weight gain and feed efficiency and decreased H:L ratio, especially in recommended level (1.25 g YC/kg diet).

Key words: Yeast, growth, feed efficiency, hematological parameters, broilers

INTRODUCTION

For a long time, yeast products have been successfully included in feed as natural growth promoters for animals and poultry. Many types of yeast have been fed to animals either in the form of yeast fermented mash produced on farm, yeast by-products from breweries or distilleries, or commercial yeast products (Kemal *et al*., 2001; Saied *et al*., 2011). *Saccharomyces cerevisiae* also known "baker's yeast" is one of the most widely commercialized species and one of the effective adsorbents which is rich in crud protein 40-45% and its biological values is high and also rich in vitamin B complex, biotin, niacin, pantathonic acid and thiamin (Reed and Nagodawithana, 1999). Whole yeast products or yeast cell wall components have been used to improve growth and affect the physiology, morphology and microbiology of the intestinal tract of both turkey (Bradley *et al*., 1994; Hooge, 2004b; Sims *et al*., 2004; Zdunczyk *et al*., 2004; 2005; Huff *et al*., 2007; Rosen, 2007b; Solis De Los Santos *et al*., 2007; Huff *et al*., 2010) and broiler chicks (Hooge, 2004a; Zhang *et al*., 2005; Huff *et al*., 2006; Rosen, 2007a; Yang *et al*., 2008a,b; Morales-Lopez *et al*., 2009). The reduction of antibiotics in poultry feed is critical for human health due to the contaminations of meat products with antibiotics residues (Engberg *et al*., 2000; Apajalahti *et al*., 2004). Many researchers referred an advantage of culture yeast that are fed to animals are responsible for production of vitamins of B complex and digestive enzyme and for stimulation of intestinal mucosa immunity and increasing protection against toxins produced by pathogenic microorganisms (Sarker *et al*., 1996; Martinez *et al*., 2004; Silversides *et al*., 2006). Some studies have confirmed the effects of yeast culture could be an alternative to antibiotic-based drugs in feed in broiler chicks (Hooge *et al*., 2003; Stanley *et al*., 2004). It has been reported (Bonomi and Vassia, 1978; Ignacio, 1995; Onifade *et al*., 1999) that feeding yeast to chicks improves body weight gain and feed:gain ratio. On the other hand, Madriqal *et al*. (1993) failed to observe a positive effect of feeding yeast on body weight of broiler chicks. Kanat and Calialar (1996) reported that active dry yeast effectively increases BW gains without affecting feed/gain ratio in broiler chicks. In contrast, supplementation of yeast to broiler diets improves feed/gain ratio but not growth rates (Valdivie, 1975; Onifade *et al*., 1999). The aim of this study was to determine the effects of adding different levels of yeast culture to diet on body weight gain, feed efficiency and hematological indices of broiler chicks.

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MATERIALS AND METHODS

Experimental design and husbandry of birds: A total of 240 one-day-old broiler chicks (Ross 308) were purchased from a commercial supplier. The chicks were randomly assigned to four dietary treatments with similar average initial weight of 60 birds each. Each treatment was allotted to 4 caged replicates (each having 15 chicks). The dietary treatments consisted of the basal diet supplemented with increasing level of YC; 0 (control), 1, 1.25 (recommended level) and 1.5 g/kg in the diet over 42 d. The birds were fed a corn-soybean meal starter diets containing 21.5% crude protein and 3000 Kcal ME/Kg diet until 21 d of age followed by a finishing diet containing 19.0% crude protein and 3200 Kcal ME/Kg diet from day 21 to day 42. Respective amounts of yeast were first mixed with small amounts (100 g) of the basal diets, then with a larger amount of the diet until the total amount of the respective diets were homogeneously mixed. All birds were kept under the same managerial, environmental and hygienic conditions except for different dietary levels of yeast. Birds were provided with continuous light. Feed and fresh water were available for *ad libitum* consumption throughout the 42 d of the experimentation. Upon arrival, the temperature inside the house has been adjusted to 32^{o}C at the first day and was then reduced by 2.5^{o}C each week. The mean value of daily temperature inside the house throughout the whole experimental period was 25±1^{o}C.

Growth performance measurements: Body weight in gram was determined at 0, 21 and 42 days of age. Feed consumption, weight gain and feed conversion were measured on 3 week-interval basis. Feed conversion (kilograms feed intake per kilograms BW gain) was calculated for each replicate within each treatment. Feed intake and feed conversion was adjusted for mortalities when appropriate.

Blood collection and hematological measurements: At 42 days of age three birds were chosen randomly from each replicate for bleeding. Blood was collected from wing vein into anticoagulant EDTA treated tubes for determination of hematological parameters. The following hematological parameters were assessed by using Automatic Fully Digital Hematology Analyzer, BC-3000 Plus, Shenzhen Mindray, Bio-Medical Electronics Co., LTD.

- Total Red Blood Cell (RBC)
- Total White Blood Cell (WBC)
- Hemoglobin (HGB)
- Hematocrit (HCT)
- Mean Corpuscular Volume (MCV)
- Mean Corpuscular Hemoglobin (MCH)
- Thrombocyte (T)
- Lymphocytes (L)
- Heterophils (H)
- Lymphocytes: Heterophils ratio (H: L)

Statistical analysis: Data were subjected to a one-way ANOVA using JMP Ver. 8.0.1 (SAS Institute, 2009) with dietary treatment as a fixed effect. All results are presented as mean and the pooled SEM. The significance of difference among the groups was assessed using Duncan's new multiple range test. Significance was set as $p<0.05$.

RESULTS AND DISCUSSION

The effects of yeast inclusion on body weight gain, feed intake and Feed Conversion Ratio (FCR) are showed in Table 1. Yeast level didn't significantly affect body weight gain, feed intake and FCR during the first three weeks of age. Body weight gain increased by the addition of yeast. But there was not statistically different between groups over the 42-day experimental period. However, lowest body weight gain was recorded for the control treatment. Our results are in harmony with the findings of Saied *et al.* (2011). They stated that birds supplemented with YC consumed more and grew faster and the better gain weight and Caracas weight than broilers given feed without YC. Overall feed conversion ratio of the different treatments was 1.73, 1.83, 1.50 and 1.61 for 0, 1, 1.25 and 1.5 g/kg supplementation, respectively. It could be noticed that chicks received recommended level of yeast had the better feed conversion ratio compared to the other supplemented groups. In terms of feed intake, the present results revealed that chicks fed a diet containing the lowest level of yeast consumed more quantity of feed than the other groups. The greater performance of birds fed the recommended level of YC (1.25 g/kg) compared with greatest level (1.5 g/kg) may partly be attributed to reduced energy partitioning toward tissue turnover. The last observation is sustained by Santin *et al.* (2001) and Zhang *et al.* (2005), who reported greater villus height and improved performance in birds with supplementation of whole yeast or yeast cell wall. Cell wall components of YC (β-glucans and α-mannans) may provide a protective function to mucosa by preventing pathogens from binding to villi and allowing fewer antigens to be in contact with the villi. Likewise, greater villus height increases the activities of enzymes secreted from the tips of the villi (Hampson, 1986), resulting in improved digestibility. Taller villi indicate more mature epithelia and enhanced absorptive function due to increased absorptive area of the villus. Also, Bhatt *et al.* (1995); Kemal *et al.* (2003) reported improvements in feed conversion ratio when antibiotic and baker yeast was added to the diets. On the contrary, some experiments reported that feed conversion ratio was not affected by YC used in the diets (Kumprechtova *et al.*, 2000; Ghasemi *et al.*, 2006; Saied *et al.*, 2011).

Table 1: Effect of yeast supplementation on body weight gain and feed efficiency of broiler chicks

	Yeast supplementation (g/kg diet)					
Item	0	1 g/kg	1.25 g/kg	1.5 g/kg	P	SEM
0-3 wk						
BW gain (g/bird)	655.48	687.60	682.48	680.17	0.49	7.68
Feed intake (g/bird)	1003.95	1014.35	1036.43	1022.29	0.85	12.43
FCR	1.54	1.48	1.52	1.50	0.65	0.02
3-6 wk						
BW gain (g/bird)	1464.40	1526.30	1781.10	1706.50	0.06	84.51
Feed intake (g/bird)	2652.70	3020.50	2641.80	2823.60	0.29	74.96
FCR	1.81	1.98	1.49	1.66	0.45	0.07
0-6 wk						
BW gain (g/bird)	2119.80	2213.90	2460.90	2386.70	0.07	91.63
Feed intake (g/bird)	3667.50	4053.80	3680.20	3845.90	0.36	80.84
FCR	1.73	1.83	1.50	1.61	0.57	0.06

Table 2: Blood hematology parameters as affected by different yeast levels

	Yeast supplementation (g/kg diet)					
Parameter	0	1 g/kg	1.25 g/kg	1.5 g/kg	P	SEM
WBC ($10^3/\mu L$)	19.77^a	19.28^a	18.73^{ab}	16.73^b	0.04	0.41
HGB (g/dL)	12.72	13.05	12.47	11.33	0.17	0.29
RBC ($10^6/\mu L$)	2.51	2.63	2.48	2.23	0.10	0.06
HCT (%)	32.01	33.54	31.90	28.93	0.18	0.76
MCV (fl)	128.01	127.95	128.90	129.16	0.79	0.51
MCH (pg)	50.82	49.68	50.31	50.38	0.77	0.37
T ($10^3/\mu L$)	12.00^a	8.00^b	8.58^b	7.92^b	0.0005	0.43

^{ab}Means within a row within titer with no common superscript differ significantly

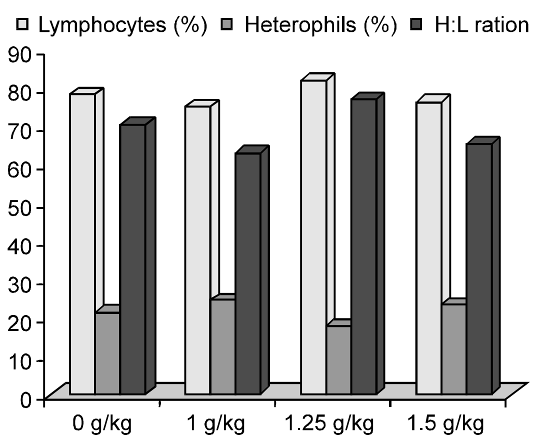

Fig. 1: Effect of yeast supplementation on lymphocytes, heterophils and H:L ratio

Blood hematological parameters serve as indicators of the physiological state of birds (Castagliulo *et al*., 1996; Sarker *et al*., 1996; Chowdhury *et al*., 2005). Whoever, hematological indices of broiler chicks fed a diet supplemented with YC are shown in Table 2. While, the concentration of lymphocytes, heterophils and H:L ratio are illustrated in Fig. 1. The current results revealed that the chicks fed supplemented diets with YC in the rate of 1.5 g/kg had significantly (p<0.05) lower White Blood Cell (WBC) counts compared to control one. Also, it could be concluded that the yeast inclusion decreased WBC as level increase. The last result enhances the hypothesis that yeast inclusion may be improve immunity through WBCs reduction. Changes in blood cell profile in broiler chicks as affected by yeast supplementation have been reported (Saied *et al*., 2011). They stated that total WBC and lymphocytes counts were significantly (p<0.05) reduced, but did not effects on the hematocrit and hemoglobin concentrations when compared with the birds of control group. Paryad and Mahmoudi (2008) reported that both 1.5 and 2% *S. cerevisiae* yeast significantly (p<0.05) increased WBC and decreased heterophils to lymphocytes ratio of chicks. The inclusion of YC didn't affected the variables of H:L ratio. However, chicks received a diet supplemented with 1.25 g/kg exhibited the lowest ratio compared to the other supplemented groups. However, no significant differences were found among treatment groups for HGB, RBC, HCT, MCV and MCH. Generally, broiler chicks fed with yeast shows highly significant decrease (p<0.0005) in thrombocyte count compared to the control group. In conclusion, the inclusion of yeast culture in broilers' diet greatly enhances feed efficiency and improves H:L ratio.

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