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ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorijps@gmail.com

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Effect of Dietary Supplement Yeast Culture on Production Performance and Hematological Parameters in Broiler Chicks

J.M. Saied, Q.H. Al-Jabary and K.M. Thalij
College of Agriculture, Tikrit University, Tikrit, Iraq

Abstract: Twenty-one-day-old commercial broilers chicks (Ross) were used in completely randomized design to evaluate the efficacy of *Saccharomyces cerevisiae* (SC), grown at 3% Wheat Bran (WB) used solid state fermentation process to produce Yeast Culture (YC), on growth performance and hematological parameters. The YC production test revealed that the fermentation of WB significantly ($p<0.05$) increased the crude protein and decreased the crude fiber percentage. At 42 d of age birds supplemented with YC consumed more and grew faster and the better gain weight and Caracas weight than broilers given feed without YC. However, no effects observed in decreasing feed conversion ratio. Measurements of the birds blood parameters should that inclusion YC in the diet significantly increased the total protein, albumin, glucose and uric acid while decreased cholesterol and triglyceride concentration. Furthermore, the 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. Also there was not significantly effecting on enzymes activity in blood serum of birds received YC. Overall, the maximum responses an achieved when the birds fed with T4 and T5, compared with the other treatments.

Key words: Yeast culture, hematological parameters, broiler chicks

INTRODUCTION

In Iraq an average of 3.0 million tons of wheat was crushed per year and resulted in an annual production of approximately 0.45 million tons of Wheat Bran (WB) (Cromwell *et al*., 1993). Traditionally, WB has been fed mainly to ruminants because of its high level of fiber. Although cereal grain and oil seed by products are extensively used as ingredients in commercial feed formulations for poultry. However, WB is a good source of phosphors containing 0.72% (Natt and Herrick, 1952) and the bioavailability of phosphors is higher than that in typical of most plant ingredients (Castagliulo *et al*., 1996; Ghasemi *et al*., 2006). For many years poultry industry has been looking for improvement of production indexes and broiler growth promoters as additives (bacteria, yeast and molds) in rations. It would be beneficial to identify feed additive that could improve the use of WB. One potential feed additive is using fermentation with yeast isolate *Saccharomyces cerevisiae* (Abaza *et al*., 2008).

Many types of yeast have been fed to animals for more than a hundred years, 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). *Saccharomyces cerevisiae* also know "bakers 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). A new approach almost all broilers are given probiotic growth promotors as additive in feeds to their effects to improve growth and influence certain disease states (Jin *et al*., 2000; Stern *et al*., 2001; Lee *et al*., 2003; Zinedine *et al*., 2005) and within antibiotics, have been particularly considered by international health institute, such as Food and Drug Administration (FDA). There is currently a world trend to reduce the use of antibiotics in animal food due to the contaminations of meat products with antibiotics residues (Engberg *et al*., 2000; Apajalahti *et al*., 2004).

Some others reported advantage of SC 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). The aim of this study was to determine the effects of adding Sucrose or $(NH_4)_2SO_4$ to the wheat bran as substrate in solid state fermentation process to produce yeast culture from *Saccharomyces cerevisiae* and investigate the efficacy on growth performance and hematological parameters after feeding to broiler chicks.

MATERIALS AND METHODS

A total of 225 1-d-old broilers (Ross) chicks of sexes was randomly divided into 5 groups at 45 birds and placed in a broiler house with wood shaving litter.

Corresponding Author: J.M. Saied, College of Agriculture, Tikrit University, Tikrit, Iraq

Wheat Bran (WB) was included in starter diets and Yeast Culture (YC) was included in finisher diets in place at WB at 22-42 d of age. There were three replications per treatment. Treatments were arranged using a randomized block design. Starter and finisher diets were formulated to meet (Sarker *et al*., 1996) (Table 1). After 21 d of feeding, the starter diet was switched to the finisher diet which was fed for an additional 21 days. The following treatments were administered *ad libitum* in the ration: T1 finisher diet included 10% WB control. T2) finisher diet included 10% YC (WB + SC + 0.5% $(NH_4)_2SO_4$. T3) finisher diet included 10% YC (WB + SC + 1% $(NH_4)_2SO_4$. T4) finisher diet included 10% YC (WB + SC + 1% sucrose). T5) finisher diet included 10% YC (WB + SC + 2% sucrose). Chicks weights, BW gain, feed consumption were recorded weekly and feed efficiency was calculated. At 42 days of age, 4 birds were randomly selected from each pen; five milliliters of blood were collected (via wing bleed) without anticoagulant to obtain serum. Tubes were kept in ice and protected from light until plasma was separated by centrifugation.

Another 5 ml sample aliquots were collected with EDTA from the same broilers for hematological parameters determination. Total leukocytes ($10^3/mm^3$) was determined in a Neubaure chamber, through Natt-Herrick staining solution (Natt and Herrick, 1952). Differential leukocyte counts was made on slides stained according to the Rosenfeld technique (Jain, 1986) and observed in an optical microscope (1000 x magnification). Hemoglobin level (g/100 ml) was measured by the cyanmethemoglobin method and hematocrit (percentage) was determined using a microhematocrit capillary (Jain, 1986). The following parameters were determined: enzymes (AST Aspartate Amino Transferase; GOT Glutamic Oxaloacetic Transferase; GGT Gamma Glutamyl Transferase and ALP Alkaline Phosphatase) total protein, albumin, uric acid, triglycerides and cholesterol using (Kits, Biolabo, SA, 02160, Mazaiy, France, Fabricant). Birds were then slaughter and carcass, weight, dressing percentage and liver, pancreas, small intestine were collected and weighed.

Data were analyzed by the ANOVA analysis, using the general linear model of the Statically Analysis System (SAS, 2001). Significant treatment differences were evaluated using Duncan's multiple-range test (Duncan, 1955). All statements of significance are based on the 0.05 level of probability.

RESULTS AND DISCUSSION

The yeast culture production test revealed that the fermentation of WB was significantly increased the crude protein and decreased crude fiber in treatment groups compared with control groups (Table 2). Previous works (Cromwell *et al*., 1993; Shurson, 2003; Martinez *et al*., 2004) on the effected the viability yeast all had increased the nutrients due to fermentation by used *Sacchromyces cerevisiae*.

Table 1: Percentage composition and calculated nutritional levels for the basal diet

Ingredients	Starter (%)	Finisher (%)
Yellow corn	20.00	55.00
Wheat	33.40	3.00
Wheat bran	10.00	10.00
Soybean meal (44%P)	20.00	20.00
Meat meal (45%P)	10.00	8.00
Vegetable oil	5.00	5.40
Limestone	1.00	1.00
Salt	0.30	0.30
Vitamin mix[1]	0.15	0.15
Trace mineral mix[2]	0.15	0.15
Total	100.00	100.00
Calculated levels		
Metabiological energy (kcal/kg)	2898.00	3112.00
Crude protein (%)	20.47	17.36

[1]Concentration per kg: Vitamin A 10.000.000 IU; vitamin D_3 2.000.000 IU; vitamin E 30.000 IU; vitamin K_3 3.0 g; vitamin B_1 2.0 g; vitamin B_2 6.0 g; vitamin B_6 4.0 g; vitamin B_{12} 15 mg; nicotinic acid 50.0 g; selenium 2.5 g

[2]Concentration per kg: Mn 72 g; Cu 10 g; Zn 100 g; Fe 100 g; I 2 g; Co 0.2 g. Avoparcin 10 mg/kg in ration. Nicarbazin 40 mg/kg and maduramicine 3.75 mg/kg in ration. Lasalocid Sodium 90 mg/kg in ration. The experimental treatments were included as starch replacements - 0, 0.25, 0.5, 1.0 and 2.0% of the organic acids in rations

Table 2: Chemical composition of yeast culture YC after *Saccharomyces cerevisiae* SC was grown on wheat bran

Trt.	DM	CP	EE	CF	Ash	Fiber
[1]T1	*90.05^c	15.80^d	4.01^a	10.59^a	4.97^a	54.68^a
T2	90.61^a	17.47^c	3.75^b	10.15^b	5.00^a	54.24^b
T3	90.31^b	17.70^c	3.72^b	9.91^b	4.98^a	54.00^b
T4	89.71^d	18.05^b	3.44^c	9.57^c	4.99^a	53.66^c
T5	89.38^e	18.35^a	3.43^c	9.27^d	4.97^a	53.36^d

$^{a-e}$Means with a column with no common superscript differ significantly at probability range 0.05.

[1]T1 Control; T2 Basal diet + YC [0.5% $(NH_4)_2SO_4$]. T3 Basal diet + YC [1% $(NH_4)_2SO_4$]. T4 Basal diet + YC 1% Sucrose. T5 Basal diet + YC 2% Sucrose.

*Means represent 3 pens of 15 birds per treatment. Each value is mean of 12 observation. Trt. = Treatments

Data presented in Table 2 show the effect of SC on GW, FI, GFC of broilers receiving YC (SC + 1% sucrose) entire period (22-42 day of age) were significantly increased ($p<0.05$) and higher than those in other treatments. However, numerically higher GW was observed in YC included groups (T3 and T5) than groups (T1 and T2). This was in agreement with the results obtained by Durst *et al*., 1995; Spring and Privulescu, 1998; Ghasemi *et al*., 2006.

On the contrary, Al-Thunky, observed a significant increase in WG in started phase, but no significant difference was observed among the treatments in WG in finisher phase. The cumulative feed intake revealed a significant difference ($p<0.05$) between treatment groups. Treatment 4 consumed more feed than other groups and among treatment groups T2 and T3 consumed lower amount at feed. This finding favorably to compare with those earlier reports at (Yadav *et al*., 1994).

Table 3: Growth performance for broilers feed yeast culture YC (22-72) days of age

Dietary treatments	Initial weight	Final weight	Gain weight	Carcass weight	Feed intake	Dressing percentage	Feed: Gain
	---------- (g) ----------					(%)	(g/kg)
[1]T1	*425[a]	1900[c]	1478[c]	1340[c]	2700[bc]	70.78[a]	1.83[a]
T2	445[a]	1925[bc]	1485[b]	1385[a]	2686[bc]	70.02[a]	1.81[a]
T3	427[a]	1935[ab]	1493[b]	1392[a]	2674[c]	70.50[a]	1.79[a]
T4	429[a]	1950[a]	1530[a]	1408[a]	2762[a]	70.53[a]	1.81[a]
T5	417[a]	1952[a]	1493[b]	1383[a]	2715[b]	70.55[a]	1.82[a]

[a-c]Means with a column with no common superscript differ significantly at probability range 0.05.
[1]T1 Control; T2 Basal diet + YC [0.5% $(NH_4)_2SO_4$]. T3 Basal diet + YC [1% $(NH_4)_2SO_4$]. T4 Basal diet + YC 1% Sucrose. T5 Basal diet + YC 2% Sucrose.
*Means represent 3 pens of 15 birds per treatment. Each value is mean of 12 observation

Table 4: Effect of dietary YC on some blood parameters in broilers chicks

Treatments	PCV (%)	Hb (g/l)	WBC $10^3/mm^3$	Heterophills	Monocytes	Lymphocytes	Esinophillus	Basophillus	H/L
[1]T1	*30.33[a]	9.38[a]	25.27[a]	6.37[a]	1.57[a]	15.53[a]	0.26[a]	1.55[b]	0.41[b]
T2	29.63[b]	8.65[b]	24.16[b]	6.22[a]	1.71[a]	14.78[b]	0.26[a]	1.35[c]	0.42[b]
T3	29.67[b]	8.73[b]	24.27[b]	6.29[a]	1.71[a]	15.00[b]	0.21[a]	1.35[c]	0.67[a]
T4	28.50[c]	8.51[b]	23.98[b]	5.95[b]	1.61[a]	14.72[b]	0.27[a]	1.23[c]	0.41[b]
T5	29.83[b]	8.95[ab]	24.14[b]	5.42[c]	1.72[a]	15.05[b]	0.27[a]	1.72[a]	0.36[b]

[a-c]Means with a column with no common superscript differ significantly at probability range 0.05.
[1]T1 Control; T2 Basal diet + YC [0.5% $(NH_4)_2SO_4$]. T3 Basal diet + YC [1% ($NH_4)_2SO_4$]. T4 Basal diet + YC 1% Sucrose. T5 Basal diet + YC 2% Sucrose.
*Means represent 3 pens of 15 birds per treatment. Each value is mean of 12 observations

Table 5: Effect of dietary YC on blood biochemical parameters in broilers chicks

Treatments	Total protein (g/100 ml)	Albumin	Glucose	Cholesterol	Triglycerides	Uric acid
		----------	----------	(mg/100 ml)	----------	----------
[1]T1	*3.55[c]	1.60[c]	268[c]	173[a]	103[a]	4.23[b]
T2	4.93[b]	1.87[b]	281[b]	157[b]	83[b]	6.10[a]
T3	4.98[b]	1.85[b]	285[b]	156[b]	86[b]	5.93[a]
T4	5.35[a]	2.20[a]	293[b]	157[b]	86[b]	5.90[a]
T5	5.44[a]	2.23[a]	306[a]	150[c]	78[c]	5.89[a]

[a-c]Means with a column with no common superscript differ significantly at probability range 0.05.
[1]T1 Control; T2 Basal diet + YC [0.5% $(NH_4)_2SO_4$]. T3 Basal diet + YC [1% ($NH_4)_2SO_4$]. T4 Basal diet + YC 1% Sucrose. T5 Basal diet + YC 2% Sucrose.
*Means represent 3 pens of 15 birds per treatment. Each value is mean of 12 observations

Dietary YC didn't induce any significant differences' from the control group with respect to feed to BW ratio from 22-42 d of age. Kumprechtova *et al.* (2000); Ghasemi *et al.* (2006) reported that feed conversion ratio was not affected by YC used in the diets.

On the contrary Bhatt *et al.* (1995); Kemal *et al.* (2003) reported improvements in feed conversion ratio when antibiotic and baker yeast was added to the diets. However, the positive basal diet with supplemental YC in our study yielded an increase in carcass weight equal to or numerically higher than those obtained from control groups. Thus, our results suggest that YC had no direct effect on dressing percentage, which agrees with the studies by Yadav *et al.* (1994); Durst *et al.* (1995); Ghasemi *et al.* (2006). The concentration of white blood cell and lymphocytes were low compared with control group when broiler feed YC form 22-24 d of age (Table 4). The concentration of heterophills, basophiles, eosinophills, basophiles and hetrophills to lymphocytes ratio were not affected by dietary treatments, but the inclusion of YC didn't affected monocytes counts. The hematocrit and hemoglobin concentration were not affected by the inclusion of YC in the diet.

Blood hematological parameters serve as indicators of the physiological state of birds (Chowdhury *et al.*, 2005). Hematocrit values in the current study were in the normal range for broiler (Ibrahim *et al.*, 2002). Analysis of variance of data on serum total protein, albumin and glucose level revealed a significant difference ($p<0.05$) between treatment groups (Table 5).

The serum biochemical parameters in all treatment groups were higher when compared with the control group however; the mean serum cholesterol and triglycerides of these groups were significantly lower. But the uric acid concentration revealed no significant difference among treatment groups resulted due inclusion of yeast culture. This finding was consistent with Line *et al.* (1997) who indicated the beneficial effects of YC when supplemented in diet, which was increased levels of serum protein and albumin thereby enhancing the levels of circulating immunoglobulin.

A comparison of the analyzed enzyme activity levels of AST, GOT, GGT and ALP revealed no significantly ($p<0.05$) in all treatment group due to dietary inclusion of YC (Table 6).

Table 6: Effect of dietary YC on blood serum enzymes activity in broilers chicks

Trt.	AST	GOT	GGT	ALP
	---------- (IU/mol) ----------			
[1]T1	*49.50	155.85	112.17	37.23
T2	49.90	156.95	112.80	37.63
T3	50.35	157.32	113.63	38.48
T4	52.92	155.92	114.88	37.86
T5	52.43	156.03	112.93	39.08

[1]T1 Control; T2 Basal diet + YC [0.5% $(NH_4)_2SO_4$]. T3 Basal diet + YC (1% $(NH_4)_2SO_4$). T4 Basal diet + YC 1% Sucrose. T5 Basal diet + YC 2% Sucrose.

*Means represent 3 pens of 15 birds per treatment. Each value is mean of 12 observations

AST: Aspartate Amino Transferase; GOT: Glutamic Oxaloacetic Transferase; GGT: Gamma Glutamyl Transferase; ALP: Alkaline Phosphatase. Trt. = Treatments

However, no significant difference were found between treatment T2, T3 and T4 for serum AST, GOT, GGT and ALP levels in all groups. Also Stanley *et al*., (1993) reported that addition of *Saccharomyces cerevisiae* at 0.1% to the diet resulted as increased activities of laying hens. Similarly Castagliulo *et al*., 1996; Sarker *et al*., 1996 reported that blood hematological parameters serve as indicators of the physical state of the birds. In the present study the enzyme activity levels in birds supplemented with YC diets suggests a great degree of positive indicators of physical state of the birds which led to improve their production performance.

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