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EFFECT OF PROBIOTICS ON GROWTH PERFORMANCE, NUTRIENT DIGESTIBILITY AND CARCASS CHARACTERISTICS IN BROILERS

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ABSTRACT

An experiment was conducted to investigate the comparative efficacy of two probiotics of different origins (yeast and bacterial based) on the growth performance, immune response, carcass characteristics and nutrient digestibility of broilers. One hundred and twenty day old chicks were purchased from local hatchery and were randomly divided into 4 groups and each group had 3 replicates of 10 chicks. Four (A, B, C and D) iso-caloric and iso-nitrogenous (ME 2850 kcal/ kg and CP 20%) broiler starter and finisher (ME 2880 kcal/ kg and CP 18%) diets were formulated containing yeast (*Saccharomyces Cerevisiae*), toyocerine (*Bacillus cereus toyoi*) and mixture of both @ 0.2 % except group A which was control. Birds were raised for first week on commercial diet. Broiler starter and finisher diets were fed from 8-28 and 29-42 days, respectively. A significant ($P<0.05$) effect was observed on overall performance of the birds fed diet containing probiotics (yeast and bacteria). Growth performance, immune response, carcass characteristics and nutrient digestibility were significantly ($P<0.05$) higher in birds fed diet (B) containing yeast (followed by those fed diet (C) containing toyocerine and those fed diet (D) containing both yeast and toyocerine.

Keywords: Yeast (*Saccharomyces Cerevisae*), Toyocerine® (*Bacillus cereus toyoi*), growth performance, nutrient digestibility, carcass characteristics, immune response, broilers

INTRODUCTION

Poultry scientists have used many techniques like supplementation of feed additives, natural or synthetic origin in a compound feed to improve weight gain, feed efficiency and to decrease mortality rate in broilers to meet protein requirements of rapidly increasing population. These additives include antibiotics, prebiotics, probiotics, enzymes and coccidiostats (Saegusa *et al.,* 2004). Poultry diets usually contain antibiotic growth promoters to enhance performance of birds. Estimated cost of antibiotic growth promoters in poultry diets in Pakistan ranged from 2-3 rupees/kg of feed (Bhatti, 2011). The addition of antibiotics is not cost effective and also has an issue of bacterial resistance that's why European Union Commission banned the incorporation of antibiotics in animal feed (EUC, 2005). As an alternative to antibiotic growth promoters, probiotics can be used for competitive exclusion of bacterial pathogens (Karaoglu and Durdag, 2005). Dietary supplementations of probiotics prevent the spread of pathogens and improve growth performance, immune response in poultry birds by modulating native microflora (Bezkorovainy, 2001). Probiotics are those viable microbes (bacteria and fungi) which have beneficial effect on the host animal (Ghadban, 2002). Baker's yeast (*Saccharomyces cerevisiae*) is extensively used in livestock as feed additive. It is rich source of crude protein (40-45%) and also contains number of water soluble vitamins (biotin, niacin and pantothenic acid) which increases the nutritive quality of the feed (Walker *et al.,* 2002). Several digestive enzymes are also excreted by the yeast that help the gastrointestinal tract to boost the nutrient digestibility, growth rate and feed conversion ratio (Nawaz *et al.,* 2008). From bacterial origin, Lactobacillus and Bifidobacteria have the potential to modulate the composition of microbial communities in the gut. In the gut, bacterial probiotic forms a physical obstruction on the binding sites of intestinal mucosa by their own attachment causes blockage of pathogenic bacteria (Lorenzoni, 2012). Probiotic containing Lactobacillus species provide resistance to the host against disease causing agents like E.coli, Salmonella, Campylobacter and *Eimeriaacervulina* (Dalloul *et al.,* 2003). It was, therefore, intended to initiate a comparative study by using probiotics of both origins; yeast (*Saccharomyces cerevisiae*) and bacteria (*Bacillus cereus toyoi*) in broilers.

The main objective of present study was to compare the effect of probiotics on growth performance, immune response, carcass characteristics and nutrient digestibility in broilers.

MATERIALS AND METHODS

Experimental birds: Day-old broiler chicks (n=120) were purchased from a local hatchery. Chicks were weighed on first day and checked for their physical health. Trial was conducted in open house but the

managerial practices were kept control throughout the experiment period. Chicks were offered with a sugar solution (250 g sugar/liter water) to provide energy and to overcome the stress of transportation. Afterwards, chicks were put in the brooding area. The brooding temperature was maintained at 90°F during 1st week and it was then gradually lowered by 5 °F every week till it reached 75°F. Commercial starter diet was fed to chicks for first week. On day 8, all birds were weighed individually and were randomly divided into four experimental groups (A, B, C and D) having 30 chicks in each group which were further divided into three replicates (10 chicks/ replicate). Birds were vaccinated against Newcastle disease on day 5 and 28. Vaccination against Infectious Bursal disease was repeated on day 15 and 22 of experiment.

Experimental diets: Two diets;starter and finisher were prepared having CP 20 %, 18 % and ME 2850, 2950 kcal/kg, respectively (Table 1). The birds were fed starter diet from 8-28 and finisher diet from 29-42 days. Birds of group A were fed diet without any supplementation (control group), whereas birds of group B, C and D were fed starter and finisher diets containing 0.2% yeast (*Saccharomyces cerevisiae*), toyocerine (*Bacillus cereus toyoi*) and blend of both yeast and Toyocerine (0.1% + 0.1%), respectively.

Data Recording: During the trial weekly feed intake, weekly body weight were recorded and feed conversion ratio (FCR) of the birds was calculated. Blood samples (2 birds/ replicate) were collected at 28th and 32nd day of age for the determination of antibody titer against Infectious bursal disease and Newcastle disease, respectively. At the end of the experiment, 2 birds from each replicate were randomly selected and slaughtered to determine dressing percentage, breast and thigh meat yield and giblet organs weight. The data collected was utilized to calculate dressing percentage and organ weights (g organ weight/100 g body weight).

Digestibility trial: At day 40, a digestibility trial was conducted. Five chicks/ replicate were randomly selected and used for digestibility trial. Nutrient digestibility was determined by adding an external marker (Celite®, acid insoluble ash) @ 1% in diets of birds (Scott and Boldaji, 1997). Fecal samples were collected at 41st and 42nd days of age which were subjected to proximate analysis for determination of crude protein, crude fat and crude fiber digestibility of diets fed to experimental birds.

Statistical Analysis: The data collected were analyzed using Analysis of Variance Technique under Completely Randomized Design and differences in means were compared by using Least Significant Difference (Steel *et al.,* 1997) test.

RESULTS AND DISCUSSION

Feed intake: Results showed improved feed intake due to the addition of yeast, Toyocerine® and mixture of both (yeast + Toyocerine®) @ 0.2 % of feed compared to the control group (Table 2). The highest feed intake was observed in birds fed diet supplemented with yeast followed by those fed diet supplemented with Toyocerine® and birds fed diet supplemented with mixture of both yeast + Toyocerine®. Results of the present study supported the findings of Paryad and Mahmoudi (2008) who reported increased feed intake in broilers fed diet supplemented with different levels of *Saccharomyces cerevisiae*. Results were also in accordance with those of Shareef *et al.* (2009) who used 1.0, 1.5 and 2.0% *Saccharomyces cerevisiae* in broiler diet and found a significant increase in feed intake.

Weight gain: Statistical analysis showed a significant increase in weight gain of broilers fed diets containing yeast, Toyocerine® and mixture of both (yeast + Toyocerine®). Birds fed diet containing yeast (*Saccharomyces cerevisea*) @ 0.2% gained higher weight gain followed by those fed Toyocerine® and mixture of both (*Saccharomyces cerevisea*+ Toyocerine®). Whereas, the lowest weight gain was observed in the birds of control group (Table 2). These results confirmed the previous findings of Zhang *et al*. (2005); Angel *et al*. (2005); Santin *et al.* (2003) who reported that dietary inclusion of probiotics in the diets of broilers showed improved body weight gain. Therefore improvement in body weight gain of the birds in this study may be attributed to better digestibility of crude protein, which may have contributed in better growth of the birds.

Feed conversion ratio: The FCR showed improvement in broilers fed diets containing yeast, Toyocerine® and mixture of both (*Saccharomyces cerevisiae* + Toyocerine®) compared to birds fed diets without probiotic supplementation (Table 2). The most efficient FCR was observed in birds of group B fed diet containing yeast, followed by those of group C fed diet containing Toyocerine® and group D fed diet containing mixture of both *Saccharomyces cerevisiae* + Toyocerine®. These results are in agreement with the findings of Ramesh *et al.* (2000) when they fed *Lactobacillus acidophilus* based probiotic to broiler chicks and observed that chicks fed probiotic cultures showed better FCR than those control chicks. Paryad and Mahmoudi (2008) observed better FCR due to dietary inclusion of yeast @ 1.5%/kg of diet. Better FCR of the birds using the yeast culture may be attributed to the digestion of crude protein, which enhanced growth of the birds resulting in better efficiency of feed utilization.

Carcass characteristics

Dressing percentage: Results showed that the significantly (P<0.05) higher dressing percentage was found for birds fed diet supplemented with yeast @ 0.2% followed by those fed diet supplemented with both (yeast 0.1% + Toyocerine® 0.1%) and those fed diet supplemented with Toyocerine® @ 0.2%. Whereas, the birds fed control diet showed the minimum dressing percentage (Table 3). These findings are compatible with those observed by Adejumo *et al.* (2004) who observed better dressing percentage in broilers by using dried yeast.The higher dressing percentage in birds fed diet containing yeast (*Saccharomyces cerevisiae*) may be due to higher body weight gain in the birds of this group compared to other treatment groups.

Breast meat yield: Results showed that the breast meat yield in broilers fed diet supplemented with yeast (*Saccharomyces cerevisiae*), Toyocerine® and mixture of both (*Saccharomyces cerevisiae* + Toyocerine®) showed a significant increase. Highest breast meat yield was observed in birds fed diet containing yeast (*Saccharomyces cerevisiae*) than other treatment groups. These findings are compatible with those observed by Mutassim (2013) who reported that supplementation of yeast increased breast meat yield in broilers.

Thigh meat yield: Table 3 showed that highest thigh meat yield was observed in birds fed diet containing yeast (*Saccharomyces cerevisiae*) than other treatment groups. These results are in line with findings of Zhang *et al.* (2005); Fathi *et al.* (2012) and Manal (2012).

Relative weight of giblet organs: Data regarding relative weight of giblet organs (liver, heart, and gizzard) of broilers fed diet containing yeast (*Saccharomyces cerevisiae*), Toyocerine® and mixture of both (*Saccharomyces cerevisiae* + Toyocerine®) showed a non-significant difference between the groups.

Immune response

New castle disease: Statistical analysis of the data revealed significantly higher antibody titer against ND in birds offered diet supplemented with yeast (*Saccharomyces cerevisiae*) followed by those fed diet supplemented with Toyocerine® and those fed diet supplemented with yeast + Toyocerine®. The higher level of antibody titer against ND in birds treated with probiotics (yeast and bacteria) may be due to their anti-microbial effect which might have reduced the pathogenic load and lowered immune stress and thus helped in boosting immunity (Cheng *et al.*, 2004; Chambers *et al*., 1997). Another possible reason of increased level of antibody titer against ND might be due to increased activity of neutrophils in blood after vaccination, which could play a major role in body immunity production (Guo *et al*., 2003). Dietary yeast culture increases lysozyme content of serum and increased serum concentration of lysozyme is responsible for breakdown of polysaccharide walls of many types of bacteria and thus provide protection against infection (Gao *et al.*, 2009).

Infectious bursal disease: Results showed that antibody titers against Infectious Bursal disease in broilers was significantly (P<0.05) higher in the birds fed diet supplemented with yeast (*Saccharomyces cerevisiae*) followed by those fed diet supplemented with Toyocerine® and those fed diet supplemented with yeast + Toyocerine®. The higher level of antibody titer against IBD in birds of group B offered feed supplemented with yeast may be due to better immunomodulatory effect of *saccharomyces cerevisae* against IBD virus in vaccinated birds (Kabir *et al.*, 2004). These findings are similar with Cross (2002) who observed that probiotics could increase resistance against microbial pathogens by stimulating protective immune response in birds.

Nutrient digestibility

Crude protein: Statistical analysis of the data regarding crude protein showed significantly higher crude protein digestibility of the diet supplemented with yeast (*Saccharomyces cerevisiae*) fed to broilers followed by those supplemented with Toyocerine and those supplemented with mixture of both (*Saccharomyces cerevisiae* + Toyocerine®). Higher crude protein digestibility might be due to reduction in pathogenic load in gastrointestinal tract and intestinal thickness which is helpful in digestion and efficient absorption of nutrients (Safamehr *et al*., 2013). Afsharmanesh *et al.* (2010) reported that ileal digesta of broiler chickens given yeast in both wet and dry diets could also improve utilization of nutrients as acidification can reduce the emptying rate of the stomach and improve the digestion process.

Crude fat: Results showed that the crude fat showed significantly higher crude fat digestibility of the diet supplemented with yeast (*Saccharomyces cerevisiae*) fed to broilers followed by those supplemented with Toyocerine and those supplemented with mixture of both (*Saccharomyces cerevisiae* + Toyocerine®). Results of the present study are in agreement with the findings of Mikulski*et al*. (2012) who observed increase in the digestibility of crude fat in birds fed diet supplemented with yeast (*Saccharomyces cerevisae*).

Crude fiber: Statistical analysis of the data regarding crude fiber digestibility showed non-significant results of diets supplemented with yeast (*Saccharomyces cerevisiae*), Toyocerine® and mmixture of both (*Saccharomyces cerevisiae* + Toyocerine®).

Table 1. Percent ingredient and nutrient composition of broiler diets containing yeast, Toyocerine® and mixture of both (yeast + toyocerine).

Ingredients	Starter diets				Finisher diets			
	A	B	C	D	A	B	C	D
Maize	38.00	38.00	38.00	38.00	45.50	45.50	45.50	45.50
Rice bran	6.00	6.00	6.00	6.00	6.50	6.50	6.50	6.50
Sorghum	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
Ricepolishing	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Corn gluten (60%)	5.00	5.00	5.00	5.00	4.70	4.70	4.70	4.70
Soybean meal	17.00	17.00	17.00	17.00	12.15	12.15	12.15	12.15
Fish meal	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50
Limestone	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80
DCP	0.90	0.90	0.90	0.90	0.50	0.50	0.50	0.50
Molasses	5.00	4.80	4.80	4.80	5.00	4.80	4.80	4.80
L-Lysine HCl	0.15	0.15	0.15	0.15	0.47	0.47	0.47	0.47
Methionine	0.10	0.10	0.10	0.10	0.20	0.20	0.20	0.20
NaCl	0.45	0.45	0.45	0.45	0.08	0.08	0.08	0.08
Vit. Min. Premix	0.90	0.90	0.90	0.90	0.60	0.60	0.60	0.60
Saccharomyces cerevisiae	-	0.20	-	-	-	0.20	-	-
Toyocerine®	-	-	0.20	-	-	-	0.20	-
Saccharomyces cerevisiae +Toyocerine®	-	-	-	0.10 + 0.10	-	-	-	0.10+0.10
Total	100	100	100	100	100	100	100	100
Crude protein(%)	20	20	20	20	18	18	18	18
Metabolizable energy (kcal/kg)	2850	2850	2850	2850	2950	2950	2950	2950
Crude fiber(%)	4.15	4.15	4.15	4.15	3.98	3.98	3.98	3.98
Ether extract (%)	3.58	3.58	3.58	3.58	3.81	3.81	3.81	3.81
Lysine (%)	1.03	1.03	1.03	1.03	0.9	0.9	0.9	0.9
Methionine(%)	0.46	0.46	0.46	0.46	0.42	0.42	0.42	0.42
Ca (%)	0.99	0.99	0.99	0.99	0.89	0.89	0.89	0.89
Ava.P(%)	0.54	0.54	0.54	0.54	0.45	0.45	0.45	0.45
CP : Calorie ratio	1 : 143	1 : 143	1 : 143	1 : 143	1 : 164	1 : 164	1 : 164	1 : 164

Table 2. Growth performance and nutrient digestibility of broilers fed diets supplemented with yeast, toyocerine® and mixture of both yeast and toyocerin (8-42 days).

Diets	Feed intake (g)			Weight gain (g)			Feed conversion ratio			Nutrient digestibility		
	8-28	29-42	8-42	8-28	29-42	8-42	8-28	29-42	8-42	CP %	EE %	CF %
A	1989^{b}	2188^{b}	4177^{b}	1118^{c}	1061^{c}	2179^{c}	1.79^{a}	2.06^{a}	1.92^{a}	72.38^{b}	85.20^{b}	13.00^{b}
B	2020^{a}	2244^{a}	4264^{a}	1250^{a}	1173^{a}	2423^{a}	1.62^{b}	1.92^{b}	1.76^{b}	75.08^{a}	87.56^{a}	17.80^{a}
C	2009^{a}	2214^{ab}	4223^{ab}	1226^{a}	1109^{b}	2335^{ab}	1.64^{b}	2.00^{a}	1.81^{ab}	73.49^{ab}	86.90^{a}	14.76^{b}
D	1998^{b}	2190^{b}	4188^{b}	1155^{b}	1060^{c}	2215^{bc}	1.73^{b}	2.07^{a}	1.89^{a}	74.48^{a}	87.34^{a}	15.20^{a}
SEM	8.98	15.99	13.04	21.91	16.85	34.13	0.033	0.03	0.02	2.17	1.45	0.98

Table 3. Carcass characteristics and immunity of broilers fed diet containing yeast, Toyocerine® and mixture of both (yeast + Toyocerine®).

Diets	Carcass Parameters							Immune response	
	Dressing (%)	Breast meat (%)	Thigh meat (%)	Abdominal fat (%)	Relative organs weight (g/100g BW)			ND (gmt)*	IBD (gmt)
					Liver	Heart	Gizzard		
A	65.08^{b}	20.25^{b}	20.20^{b}	2.63^{a}	2.39^{b}	0.40^{a}	1.44^{b}	106.65^{b}	45.00^{b}
B	66.54^{a}	21.07^{a}	22.17^{a}	1.93^{b}	2.97^{a}	0.38^{ab}	1.61^{a}	234.70^{a}	106.64^{a}
C	65.08^{b}	20.91^{a}	19.34^{ab}	2.00^{b}	2.83^{a}	0.37^{ab}	1.50^{a}	160.00^{ab}	85.33^{ab}
D	65.27^{b}	20.60^{ab}	20.37^{b}	2.60^{a}	2.42^{b}	0.39^{a}	1.44^{b}	211.33^{b}	96.00^{a}
SEM	0.76	0.40	0.46	0.13	0.01	0.02	0.03	17.19	8.99

Conclusion: Supplementation of probiotics (yeast and bacterial based) in broiler diets proved to be the most beneficial because the results showed improvement in feed intake, weight gain, feed conversion ratio, carcass parameters and nutrient digestibility which ultimately lead to economical broiler farming. Therefore, it is concluded that the use of probiotics in broiler diet may be more effective to achieve maximum profit from broiler production.

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