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Effect of Feeding Probiotic on Performance of Broiler Ducks Fed Different Protein Levels

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ABSTRACT

The present study was performed to investigate the effect of feeding *Saccharomyces cerevisiae* (probiotic) with different protein levels on duck performance, carcass traits and blood parameters. A total number of 40 two weeks old Molar ducklings randomly distributed into 4 equal groups.The first group was fed on control diet (16% CP) without any feed additives, while groups 2, 3 and 4 (T2, T3 and T4) were fed on basal diets containing 16, 14 and 12% CP respectively and supplemented with probiotic. Additives was probiotic, thepax (*Saccharomyces cerevisiae*), at 0.1% of the grower-finisher diet. The results showed that, birds fed on 16% protein diet supplemented with probiotic recorded significantly the best live body weight, body weight gain, feed intake and feed conversion compared with other treatments. There were no significant differences in hot carcass percentage, eviscerated percentage, dressing percentage and relative percentage of internal organs (gizzard, heart, liver and spleen), total protein and triglycerides, between different experimental groups. While there were significant ($P<0.05$) differences in serum albumin, globulin, cholesterol and uric acid between control group and other treatments. The relative economic feed efficiency was the highest in birds fed 16%protein diets supplemented with *Saccharomyces cerevisiae* compared with other treated groups. It could be concluded that, dietary inclusion of 0.1% S.cerevisiae in 16% protein diet improved body weight, weight gain, feed intake and feed conversion ratio and carcass traits.

Introduction

Beneficial effects of dietary additives such as probiotics, prebiotics and organic acids, on the energy and protein utilization of poultry have been reported (Angel *et al*., 2005; Pirgozliev *et al*., 2008; Yang *et al*., 2008). It has also been suggested that, feed additives may be more efficient when low nutrient diets are fed. Generally, low density diets are more profitable and resulted in less environmental pollution problems. In recent years, the high price of protein sources as well as environmental concerns related to high nitrogen excretion have resulted in increasing interest for using low protein diets in poultry production (Torres-Rodriguez *et al*., 2005).

Probiotic has been defined as viable microorganisms, which after sufficient oral intake, lead to beneficial effects for the host by modifying the intestinal microbiota (Simon, 2005). Positive effects of probiotics on animals can result either from a direct nutritional effect of the probiotic, or a health effect, with probiotics acting as bioregulators of intestinal microflora and reinforcing the host's natural defenses. There have been numerous studies in human and animals on the ability of probiotics to change the types and numbers of gut microflora (Endo *et al*., 1999). Exactly how dietary microbial products function in the digestive system is not known, but some suggested mechanisms as they provide nutrients, aid in digestion and inhibit harm-

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ful bacteria (Owings *et al*., 1990). Moreover, *Saccharomyces cerevisiae* could act as bioregulator of the intestinal microflora and reinforcing the host natural defenses, through the sanitary effect by increasing the colonization resistance and stimulation of the immune response. The present study was carried out to investigate the effect of adding probiotic (*Saccharomyces cerevisiae*) for duckling fed different protein levels on duck performance, carcass traits and some blood biochemical parameters.

Materials and methods

Birds, housing and feeding

A total number of 40 two weeks old Molar ducklings were weighed (286±3.60) and randomly distributed into 4 equal groups, each of 10. Ducks were reared under similar environmental and managerial conditions during the period from 2-10 weeks of age.

The first group was fed a diet free from probiotic and considered as control. The other three groups were fed on diets with different protein levels (16, 14 and 12%) supplemented with probiotic at level of 0.1%.

The duckings in the four groups were fed adlibitum on the respective diets in pellet form and given free access to fresh and clean water.

Measurements

Performance characteristics including body weight, body weight gain, feed intake and feed conversion ratio were calculated. The proximate analysis of the experimental feeds was performed using procedures detailed by the Association of Official Analytical Chemistry (AOAC, 1990).

Carcass Traits

At the end of the experiment, three birds from each group were randomly taken, individually weighed and slaughtered by severing the carotid artery and jugular veins. After four minutes of bleeding, each bird was dipped in a water bath for two minutes and feathers were removed by hand. After the removal of head, carcasses were manually eviscerated to determine some carcass traits including dressing % (eviscerated carcass without head, neck and legs) and giblets % (gizzard, liver, spleen and heart). The organ weight was expressed as relative weight proportionate to preslaughter live body weight.

Table 1. Composition and energy value of the experimental diets

Item	Treatments			
	T1	T2	T3	T4
Physical composition (%)				
Yellow corn, ground	51.30	51.20	58.21	62.65
Soybean meal	18.30	18.30	12.38	6.35
Wheat bran	20.00	20.00	20.00	22.00
Sunflower oil	7.15	7.15	5.94	5.51
*Saccharomyces cerevisiae**	---	0.10	0.10	0.10
Sodium phosphate dibasic	1.30	1.30	1.35	1.35
Limestone, ground	1.35	1.35	1.40	1.40
Common salt	0.30	0.30	0.30	0.30
Methionine	---	---	0.02	0.04
Premix**	0.30	0.30	0.30	0.30
Calculated chemical composition (%)				
Dry matter	87.35	87.27	86.88	86.71
Crude protein	16.01	16.00	14.00	12.00
Ether extract	10.21	10.21	9.16	8.87
Crude fiber	4.48	4.48	4.24	4.16
Nitrogen-free extract	53.40	53.34	56.39	58.70
Ash	3.25	3.24	3.09	2.98
Calcium	0.60	0.60	0.60	0.60
Phosphorus, available	0.30	0.30	0.30	0.30
Lysine	0.97	0.97	0.83	0.71
Methionine	0.31	0.31	0.30	0.30
Calculated energy value:				
ME (kcal/kg diet)	3002	2998	2997	3000

**Saccharomyces cerevisiae*: is a probiotic

**Each 3 kg contains : Vit. A, 1200000 IU ; Vit. D3, 300000 IU ; Vit. E, 700 mg ; Vit. k3, 500 mg ;Vit. B1, 500 mg ; Vit. B2, 200 mg ; Vit. B6, 600 mg ; Vit. B12, 3 mg ; Vit. C, 450 mg; Niacin, 3000 mg; Methionine, 3000 mg; Pantothenicacid, 670 mg ; Folicacid 300 mg; Biotin, 6 mg; Choline chloride, 10000 mg; Magnesiumsulphate, 3000 mg; Copper sulphate, 3000 mg; Ironsulphate, 10000 mg; Zinc sulphate, 1800 mg; Cobalt sulphate, 300 mg.

Serum samples and biochemistry

At the end of the experiment, three randomly selected birds from each group were slaughtered after fasting overnight. Blood samples were collected from the selected birds of each treatment, allotted to clot at ambient temperature, centrifuged for 15 minutes at 3000 rpm and serum from each sample was extracted. The serum samples were kept at -20^{0}C until further analysis. Serum samples were assayed for estimation of total protein and its fractions (albumin and globulins), triglycerides, cholesterol and uric acid by spectrophotometer using commercial test kits (Spectrum, Cairo, Egypt).

Total feed cost, total production cost, price of body weight, net revenue and economic feed efficiency were calculated.

Statistical analysis

All data were analyzed using one way analysis of variances (ANOVA) followed by LSD test using SPSS 11.0 statistical software (SPSS, Inc, Chicago, IL,2001), www.spss.com.

Results

The obtained results (Tables 2 and 3) indicated that, inclusion of 0.1% *Saccharomyces cerevisiae* to16% protein diet (T2) had no effect on body weight until the fourth week of feeding and began to increase significantly (P<0.05) from the fifth week until the end of experiment compared with the control group (T1).On the contrary, results also indicated that, inclusion of 0.1% *S. cerevisiae* to 14% protein diet had no significant effect on body weight and weight gain during the whole experiment in comparison with the control. On the other hand, the results cleared that, the addition of 0.1% *S. cerevisiae* for 12% protein diet had no significant effect on body weight until the fifth week of the experiment. However, the supplementation of 12% protein diet with *S. cerevisiae* significantly decrease the body weight at 6, 7and 8 weeks of experiment. As a comparison between the *S. cerevisiae* groups (T2, T3 and T4). The obtained data (Table 4) also showed a decrease in total weight gain between birds fed 12% and 14% protein diet and those fed on control one.

Table 2. Body weight development (g/bird) of ducklings during the experiment

Exp. period (week)	Treatments			
	Control group	*Saccharomyces cerevisiae* groups		
	T1	T2	T3	T4
0*	294±17.59^{a}	280±12.78^{a}	287±12.51^{a}	290±12.52^{a}
1	589±38.79^{a}	588±19.06^{a}	576±34.39^{a}	541±30.46^{a}
2	984±48.54^{a}	994±28.64^{a}	985±57.41^{a}	926±48.48^{a}
3	1341±53.25^{a}	1443±35.61^{a}	1371±75.70^{a}	1297±83.26^{a}
4	1751±49.39^{ab}	1946±51.54^{a}	1801±76.22^{ab}	1683±93.78^{b}
5	2106±91.52^{b}	2411±53.03^{a}	2186±83.29^{ab}	2046±97.10^{b}
6	2593±89.30^{b}	2919±47.41^{a}	2616±91.93^{b}	2291±98.74^{c}
7	2878±51.49^{b}	3215±52.25^{a}	2901±86.89^{b}	2517±97.57^{c}
8	3078±81.65^{b}	3441±62.22^{a}	3063±86.57^{b}	2668±95.48^{c}

* 0= 2 weeks of age
Means within the same row with different superscripts are significantly different (P < 0.05).
T1 : the control diet 16% protein ; T2 : 16% protein ; T3: 14% protein ; T4 : 12% protein.

Table 3. Weight gain (g/bird) of ducklings during the experiment

Exp. Period (week	Treatments			
	Control group	*Saccharomyces cerevisiae* groups		
	T1	T2	T3	T4
1	295±23.20^{ab}	308±7.01^{a}	289±22.67^{ab}	251±20.50^{b}
2	395±15.20^{a}	406±10.80^{a}	409±24.54^{a}	385±19.09^{a}
3	357±14.77^{b}	449±19.19^{a}	386±19.43^{ab}	371±35.89^{ab}
4	411±11.14^{b}	503±24.57^{a}	431±19.75^{b}	386±18.11^{b}
5	354±49.55^{b}	465±18.69^{a}	384±20.33^{ab}	363±19.95^{b}
6	487±24.59^{a}	508±14.21^{a}	430±26.52^{a}	245±23.84^{b}
7	285±50.40^{a}	296±35.63^{a}	285±26.21^{a}	226±42.74^{a}
8	200±40.74^{a}	226±37.42^{a}	162±21.59^{a}	152±29.25^{a}
Total	2783.60	3161.00	2776.00	2378.80

Means within the same row with different superscripts are significantly different (P < 0.05).

Concerning the feed intake of birds during the experiment (Table 4) results showed that, the total feed intake of ducklings fed 16% protein diet supplemented with 0.1% *S. cerevisiae* is slightly higher than the control by 341g/bird during the whole experiment, while the feed intake of birds fed 14% and 12% protein diet was decreased by 108g and 741g/bird respectively.

Table 4. Feed intake (g/bird) of ducklings during the experiment

Exp. period (week)	Treatments			
	Control group	*Saccharomyces cerevisiae* groups		
	T1	T2	T3	T4
1	654.46	606.17	760.59	669.64
2	999.35	1035.81	1100.21	1109.95
3	1159.60	1148.42	1071.97	1172.99
4	1388.50	1555.51	1434.56	1327.15
5	1389.25	1709.73	1326.18	1501.16
6	2108.71	1905.49	2009.03	1282.81
7	1417.44	1421.76	1470.08	1433.83
8	1105.78	1180.61	942.26	984.44
Total	10223.10	10563.48	10114.89	9481.98

From the obtained results it was cleared that, inclusion of 0.1% *S. cerevisiae* improved the feed conversion ratio compared with the control one who has the same level of protein by 0.33, while duckling fed 14% protein diet supplemented with *S. cerevisiae* has nearly the same feed conversion ratio. Conversely, inclusion of 0.1% *S. cerevisiae* to 12% protein diet lowered the feed conversion ratio by 0.32 (Table 5).

Table 5. Feed conversion ratio of ducklings during the experiment.

Exp. period (week)	Treatments			
	Control group	*Saccharomyces cerevisiae* groups		
	T1	T2	T3	T4
1	2.22	1.97	2.63	2.67
2	2.53	2.55	2.69	2.88
3	3.25	2.56	2.78	3.16
4	3.38	3.09	3.33	3.44
5	3.92	3.68	3.45	4.14
6	4.33	3.75	4.67	5.23
7	4.97	4.80	5.16	6.35
8	5.54	5.22	5.82	6.48
Average	3.67	3.34	3.64	3.99

The obtained results (Table 6) showed that, addition of *S. cerevisiae* to 16% protein diet increased but not significantly, The weights of preslaughter, hot carcass,eviscerated carcass and dressing than other groups.

Table 6. Carcass trait parameters of ducklings in the experiment.

Parameters	Treatments			
	Control group	*Saccharomyces cerevisiae* groups		
	T1	T2	T3	T4
Pre-slaughter weight (g)	3133±88.19^{ab}	3477±91.46^{a}	2910±49.33^{b}	2677±240^{b}
Hot carcass weight (g)	2578±90.42^{ab}	2923±223^{a}	2425±49.13^{ab}	2219±203^{b}
Hot carcass weight (%)	82.25±0.64^{a}	83.90±4.85^{a}	83.34±0.36^{a}	82.90±0.76^{a}
Eviscerated carcass wt (g)	2248±65.94^{ab}	2613±114^{a}	2099±50.34^{b}	1941±135^{b}
Eviscerated carcass (%)	71.74±0.53^{a}	75.11±1.99^{a}	72.11±1.03^{a}	72.85±2.35^{a}
Dressing weight (g)	2409±76.18^{ab}	2780±120^{a}	2250±61.79^{b}	2074±175^{b}
Dressing weight (%)	76.88±0.61^{a}	79.86±2.07^{a}	77.28±1.18^{a}	77.83±2.53^{a}
Liver (%)	1.59±0.05^{a}	1.62±0.04^{a}	1.65±0.02^{a}	1.65±0.10^{a}
Heart (%)	0.83±0.07^{a}	0.77±0.01^{a}	0.83±0.02^{a}	0.76±0.02^{a}
Gizzard (%)	2.72±0.08^{a}	2.39±0.07^{a}	2.69±0.32^{a}	2.57±0.15^{a}
Spleen (%)	0.08±0.01^{a}	0.07±0.01^{a}	0.06±0.00^{a}	0.07±0.00^{a}

Means within the same row with different superscripts are significantly different (P < 0.05).

Supplementation of probiotic showed no significant difference in the concentration of serum total protein and triglycerides among all the treatment groups (Table 7).Adding probiotic increased significantly (P<0.05) globulin and significantly decrease the A/G ratio content of blood serum. The obtained results revealed that, probiotic supplementation recorded significantly (P<0.05) lower values of serum albumin, uric acid and cholesterol compared with those fed control one.

Table 7. Blood parameters of ducklings during the experiment.

Item	Treatments			
	Control group	*Saccharomyces cerevisiae* groups		
	T1	T2	T3	T4
Total protein (g/dl)	3.38±0.24^{a}	3.83±0.39^{a}	3.75±0.11^{a}	3.63±0.18^{a}
Albumin (g/dl)	1.85±0.06^{a}	1.45±0.05^{c}	1.38±0.01^{c}	1.68±0.07^{b}
Globulin (g/dl)	1.53±0.19^{b}	2.38±0.34^{a}	2.37±0.10^{a}	1.95±0.11^{ab}
Alb/Glob ratio	1.24±0.12^{a}	0.63±0.07^{c}	0.58±0.02^{c}	0.86±0.02^{b}
Triglycerides (mg/dl)	26.27±5.77^{a}	30.35±4.35^{a}	31.71±1.41^{a}	35.05±5.35^{a}
Cholesterol (mg/dl)	323.98±1.14^{a}	182.50±21.35^{c}	236.19±12.02^{b}	214.48±7.84^{c}
Uric acid (mg/dl)	3.06±0.29^{a}	1.89±0.17^{b}	1.99±0.47^{b}	1.63±0.14^{b}

Means within the same row with different superscripts are significantly different (P < 0.05).

Table 8. Economical evaluation of the different experimental diets.

Parameters	Treatments			
	Control group	*Saccharomyces cerevisiae* groups		
	T1	T2	T3	T4
Average feed intake (kg/bird)	10.223	10.563	10.115	9.482
Price/kg feed (L.E)	3.18	3.29	3.11	2.95
Total feed cost (L.E)	32.51	34.75	31.46	27.97
Total production cost (L.E)	54.51	56.75	53.46	49.97
Body weight (kg/bird)	3.077	3.441	3.063	2.669
Price/kg body weight (L.E)	25	25	25	25
Total revenue (L.E)	76.93	86.03	76.58	66.73
Net revenue (L.E)	22.42	29.27	23.12	16.75
Economic feed efficiency (%)	41.12	51.58	43.24	33.53
Relative economic feed efficiency	100	125.4	105.2	81.52

The production cost of birds in different dietary treatments is shown in Table 8. The total feed cost was highest (34.75 L.E) in treatment 2 and lowest (27.97 L.E) in treatment 4, while the total feed cost of the control diet was 32.51 L.E. The results also showed that, the net revenue was the highest in treatment 2 (29.27 L.E), followed by treatment 3 (23.12 L.E) and treatment 4 (16.75 L.E), respectively. The highest total net profit (revenue) was observed in dietary treatment 2 and the lowest total net profit was observed in treatment 4 as compare to treatment 1 (control group).The relative economic feed efficiency was the highest in treatment 2 and the lowest in treatment 4. The results cleared that, the addition of 0.1% S.cerevisiae to 16% protein diet highly increased the relative economic feed efficiency by about 25%, and supplementation of 14% protein diet with 0.1% S.cerevisiae increased the relative economical feed efficiency by about 5%.

Discussion

The positive effect of inclusion of *S. cerevisiae* to 16 and14% protein diets on body weight and total gain might be attributed to the fact that it is a naturally rich source of proteins, minerals and B-complex vitamins. It is well known that, yeast culture and its cell wall extract containing 1,3-1,6 D-glucan and Manna oligosaccharide are the important natural growth promoters for modern livestock and poultry production (Van Leeuwen *et al*., 2005).The present results are in agreement with those of Zhang *et al*.(2005); Shareef and Al-Dabbagh (2009) who reported that, supplementationof feed with *Saccharomyces cerevisiae* improved broiler body weight and gain. Similar results were found by Wang and Zhou (2007); Weis *et al*. (2010), who reported that, addition of probiotic to ducklings diet significantly improved body weight and body weight gain compared with control group. El-Nagmy *et al*. (2004); Kermanshahi *et al*. (2011); Sritiawthai *et al*. (2013) recorded that body weight and body weight gain significantly (P<0.05) decreased by decreasing dietary protein level. In contrast, Chumpawadee *et al*.(2008); Awad *et al*. (2009); Ehsani *et al*. (2011) reported that, dietary supplementation of probiotic did not affect body weight of broilers. Kamraa *et al*. (2008); Laudadio *et al*. (2012) found that, insignificant reduction in body weight and body weight gain due to decrease in dietary protein level.

The decrease in feed intake of birds fed 14 or 12% protein diet supplemented with *S. cerevisiae* may be attributed to the low level of protein and not to the probiotic. These results agreed with that found by Wang *et al*. (2010);Sritiawthai *et al*. (2013) who reported a significant reduction in feed intake due to decrease in dietary protein level. On the contrary, Kamraa *et al*. (2008); Kermanshahi *et al*. (2011) recorded that, feed intake did not differ significantly between the groups receiving diets with different levels of crude protein.

Regarding the effect of crude protein levels on FCR the results are in harmony with those obtained by Abd El-Hady and Abd El-Ghany (2003); Kamraa *et al*. (2008), who showed that, feed conversion ratio was not significantly affected by different protein levels. Djouvinov *et al*. (2005); Talebi *et al*. (2008) reported that, addition of probiotic to broiler chicken diets improved feed conversion ratio significantly. Improvement in feed efficiency of broiler chickens fed probiotics is thought to be induced by the total effects of probiotic action including the maintenance of beneficial microbial population (Fuller, 1989), improving feed intake and digestion (Nahanshon *et al*., 1993), and altering bacterial metabolism (Jin *et al*., 1997).

The increase or decrease in parameters of carcass traits for birds fed 16, 14and 12% protein diets supplemented with S.cerevisiaeand those fed the unsupplemented diet was attributed to the increase or decrease in preslaughter weights of ducklings.

The results of this study are in agreement with previous researches(Chumpawadee *et al*., 2008; Shareef and Al-Dabbagh, 2009; Ashayerizadeh *et al*. (2011) who reported that, probiotic had no significant (P>0.05) positive effect on carcass traits of broilers and ducks. However, Kumar *et al*. (2003) found significant differences in the average value of internal organs as a percentage of body weight between birds that were fed probiotic and those not fed.

Our results are in agreement with the earlier findings of (Djouvinov *et al*., 2005; Alkhalf *et al*., 2010), who recorded that, probiotic did not significantly affect serum levels of total protein and triglycerides. Joy and Samuel (1997) recorded that, adding probiotics to broiler diets significantly (P<0.05) decreased serum cholesterol. However, Panda *et al*. (2006) stated that, concentration of serum protein significantly increased due to probiotic supplementation. Shareef and Al-Dabbagh (2009); Alkhalf *et al*.(2010) stated that, probiotic did not affect serum uric acid . Djouvinov *et al*. (2005) reported that, serum cholesterol was not significantly affected by feeding probiotic preparation to mule ducklings. A very interesting and a healthy to the consumer, reduction in the level of serum cholesterol. The beneficial effect of *S. cerevisiae* probiotic supplementation has been shown to reduce the cholesterol concentration in egg yolk as reported by (Abdulrahim *et al*., 1996) and in serum of chicken (Mohan *et al*., 1996). Several studies has shown that, probiotic exhibited lipid lowering properties which might be related to the interference of probiotic bacteria with cholesterol absorption in the gut by de-conjugating bile salts or directly assimilating cholesterol (Mohan *et al*., 1996; Liong and shah, 2005).

The difference in total feed cost in different protein diets supplemented with *Saccharomyces cerevisiae* referred to the difference in protein level which reflected on the total feed cost. Addition of 0.1 *S. cerevisiae* to 14% protein or more increased the utilization of diets by Molar broiler ducks. On contrast, addition of 0.1 *S. cerevisiae* to 12% protein diet (T4) did not able to improve the net profit of ducks.

Conclusion

Probiotic supplementation to 16% protein diet had positive effect on growth performance and carcass traits parameters of molar ducks

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