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The Effect of Yeast (*Saccharomyces cerevisiae*) Culture Versus Flavomycin Supplementation on Laying Hen Diets and Their Comparative Influence on the Late Stage Production Performnce

Research Article

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ABSTRACT

The effect of yeast culture (*Saccharomyces cerevisiae*) supplementation on laying hen diets was tested against flavomycin supplementation during 12 weeks, using 112 Brown Bovans laying hens, 52 week-old, divided into 7 equal groups fed on a basal diet containing 18.8% crude protein and 2810 kcal/kg ME (metabolizable energy) feed. Three groups were supplemented with 3 different levels of commercial yeast culture (1, 2 and 3 kg/ton) and 3 groups were supplemented with 3 different levels of flavomycin (50, 75 and 100 mg/ton). ncreased levels of yeast culture supplementation significantly decreased hen-day egg production ($P<0.05$). Flavomycin supplementation showed the same result with the exception of the group that received 75 mg/ton which showed significant ($P<0.05$) increase in hen-day egg production. Egg mass was significantly increased ($P<0.05$) for the group receiving 75 mg flavomycin and significantly decreased in the group receiving 3 kg yeast culture. Both yeast culture and flavomycin supplementation significantly lowered ($P<0.05$) feed intake as mg/hen/day. Feed conversion was improved significantly ($P<0.05$) by the addition of 2 kg yeast culture and 75 mg flavomycin per ton feed. The addition of 50 mg flavomycin improved yolk percentage significantly ($P<0.05$). The blood constituents showed no significant differences among treatments for TP, AL and GL ($P>0.05$) AST, ALT and Glu values showed an increasing trend, with the highest significant values ($P<0.05$) of AST and Glu for the supplementation level of 100 mg flavomycin. Higher level of flavomycin (100 mg/ton) had adverse effects on blood plasma biochemical profile, but had no significant effects on egg production ($P>0.05$).

KEY WORDS egg production, flavomycin, laying hens, yeast culture.

INTRODUCTION

The overall goal of the layer industry is to achieve the best performance, feed utilization and bird's health. Growth promoting antibiotics have been used numerously to offer these benefits. In 1997, the European Union and other organizations started the first ban for using the first group of sub therapeutic levels of a group of antibiotics followed by banning another group in 1999. The last antimicrobials group was banned in January 2006. These bans are forcing feed manufactures and nutritionists to seek other ways to maintain production and animal health. Mixed with the extraordinary array to seek to replace antibiotics, there is *Saccharomyces cerevisiae* yeast culture, which has been authorized among other microorganisms as new additives for feedstuffs according to European Economic Community (EEC) directive 70/524.

Dawson (1993) reviewed the current and future role of *Saccharomyces cerevisiae* yeast culture in animal production and listed its potential effects on growth rate, feed conversion and egg production due to its rich content of enzymes, vitamins and other nutrients. Onifade and Babatunde (1996) used high fiber diet supplemented with dried yeast containing *Saccharomyces cerevisiae* to feed broiler chicks from 7 up to 35 days old. They indicated significant ($P<0.05$) improvement in body weight gain, feed conversion efficiency and apparent retention coefficients of dry matter, crude protein, ether extract, crude fiber and detergent fiber.

In contrast to these findings, Guevara *et al.* (1978) reported decreased growth rate and feed utilization in broiler chicks as the dietary including live yeast culture increased. However, Mohamed *et al.* (2008) reported a significant improvement in feed conversion of broiler chicks feed diets supplemented with Mannan oligosaccharide which is derived from yeast cells. They postulated that this compound might be used as an alternative to growth promoting antibiotics in broiler diets.

The laying hen's response to yeast culture is inconsistent. Soliman (2002) compared the effect of different levels of yeast culture supplementation and bacitracin on the performance of laying hens using two energy levels. He reported improved values of feed conversion and digestion coefficients with the exception of EE, which decreased significantly; There was no effect on egg production and internal as well as external egg quality. Other studies described the improved feed efficiency by yeast culture dietary supplementation (Liu *et al*. 2002; Tangendjaja and Yoon, 2002).

Yalcin *et al*. (2008) reported that yeast culture did not significantly affect a feed intake, hen-day egg production, feed efficiency, interior as well as exterior egg quality characteristics, serum levels of total protein and other blood parameters. A significant increase ($P<0.05$) was reported for serum uric acid and egg weight ($P<0.01$) by increasing yeast culture level of supplementation.

Dizaji and Pirmohammadi (2009) used a dietary supplementation of 300 g/ton feed *Saccharomyces cerevisiae* in laying hen diets and reported no improvement in egg production and egg weight during 10 weeks of experimental period; however, feed conversion was significantly improved.

As far as we know, flavomycin is one of subtherapeutic antibiotic which is not yet banned. A few reports concerning the influence of yeast culture compared to flavomycin in laying hen diets are available. Therefore, the objective of this study is to investigate the effects of yeast culture (*saccharomyces cerevisiae*) supplementation versus flavomycin on the productive performance and blood biochemistry of laying hens at the late stage of production.

MATERIALS AND METHODS

Experimental design and treatments

A total of 112 Brown Bovans 52 weeks old laying hens, were used in this study. Hens were housed individually in egg production cages under the same environmental conditions during summer season at ambient temperature ranging from 30 to 36 ^{o}C, with a light regimen of 16L:8D. Hens were randomly distributed into 7 equal groups of 16 hen per each. The first group served as control and was fed a basal diet shown in Table 1.

Birds were fed 1, 2 and3 kg/ton commercial yeast culture for groups T2, T3 andT4, respictively.

The yeast culture was a formed product composed of *S.cerevisiae* grown on a medium of sugar cane molasses and dried to preserve the fermenting activity of the yeast. The other three groups, T_5, T_6 and T_7, were fed the basal diet supplemented with 50, 75 and 100 mg/ton flavomycin, respectively. The diet was formulated to meet the nutrient requirements of laying hens of the Management Guide of Brown Bovans. Feed in mash form and water were provided ***ad-libitum*** during the entire 12 weeks of experimental period.

Nutritive composition of the diet was determined according to AOAC (2000). Metabolizable energy content of the diet was estimated using energy values of NRC (1994). Feed consumption was recorded daily through the experimental period and calculated as mg/hen per day. Eggs were collected daily and egg production was expressed on a hen-day basis. All the eggs laid during the last 2 consecutive days of every week were collected and weighed individually to determine average egg weight. Feed conversion was calculated as kg feed/kg egg mass (egg number×average egg weight).

To determine the egg traits, the laid eggs of 5 hens from each treatment were collected at the last week of the experimental period; individual eggs were weighed, shape index and yolk index were determined according to Romanoff and Romanoff (1949).

Shell thickness was measured to the nearest 0.01 mm at the equator using a micrometer. Haugh unit was measured according to Haugh (1938). The egg yolk visual colour score was determined using 15 matching bands of Roche improved yolk colour fan. The height of thick albumin and egg yolk were measured with a tripod micrometer and related to egg weight as percentage.

At the end of the experimental period, three hens from each group were randomly selected and slaughtered according to Islamic religion conditions by a knife. Blood samples were collected in heparinized tubes and plasma was immediately separated and stored at 20 ^{o}C for determining total protein, albumin, glucose, aminotransferases (ALT and AST) and creatinine using spectrophotometer and commercial kits.

Statistical analysis was performed using analysis of variance according to SAS (1990) and Duncan's Multiple Range test (Duncan, 1955) at 5% level of probability.

Table 1 The composition and chemical analysis of the control diets

Ingredient (%)	Control
Yellow corn	63.00
Soybean meal (44%CP)	18.00
Corn gluten meal (60%CP)	8.00
Limestone (Ca CO3)	7.50
Bone meal	2.50
Vit & Mineral Premix*	0.30
Salt (NaCl)	0.40
L-Lysine	0.15
DL-Methionine	0.15
Total	100.00
Calculated analysis	
Crude protein (%)	18.08
Metabolizable energy (Kcal/ kg diet)	28.10
Available P (%)	0.43
Calcium (%)	3.67
Lysine (%)	0.73
DL-Methionine (%)	0.35

* Each one kg of Vit. and Min. Mixture contains: Vit. A 7500000 IU, Vit. D_3 1650000 IV, Vit. E 33000 mg, Vit. K_3 2500mg, Vit. B_1 1250mg Vit. B_2 4950mg, Vit. B_6 3300mg, Nicotinic acid 20000mg, pantothenic acid 9000 mg, Vit. B_{12} 10mg, Biotin 80mg, folic acid 400 mg, choline chloride 600g, Iron 40 g, Mangancese 50g copper 4g, Iodine 0.4g, Zinc 30g, selenium 0.24 and Ca Co3 was used as a carrier.

RESULTS AND DISCUSSION

1-Productive performance

Effects of supplemental graded levels of yeast culture (*Saccharomyces cerevisiae*) and subtherapeutic levels of flavomycin on the performance of laying hens at the late stage of production period are shown in Table 2.

Egg production showed no significant differences when adding 1 or 2 kg/ton yeast culture. Increasing the supplemental level up to 3 kg decreased egg production significantly (P<0.05) compared with control. As for the flavomycin supplementation, the supplemental level of 75 mg/ton showed a significant increase in egg production. Egg weight increased significantly only in T_3 which received 2 kg yeast culture per ton feed, while other groups showed no significant differences. Egg mass showed a numerical increase in both T_2 and T_3 but a significant decrease (P<0.05) was observed when yeast culture level increased to 3 kg/ton feed (T_4). A significant (P<0.05) increase in egg mass occurred with the group which received 75 mg/ton flavomycin which may be the result of egg production increase.

The feed intake was significantly decreased for all the treatments as compared with control group. The feed conversion efficiency was significantly improved in 2 kg/ton yeast culture and 75 g/ton flavamycin supplemented groups (T_3 and T_6), while not significantly influenced in the other groups. Mahdawi *et al.* (2005) reported no improvement in laying hen performance during 12 weeks of experimentation (28-39 weeks old) using a bioplus (*Bacillus subtilis*) supplementation at levels up to 2 kg/ton. Yalcin *et al.* (2008) reported no significant differences in egg production among groups fed on either soybean or sunflower diets supplemented with yeast culture. In agreement with the findings of this study Dizaji and Pirmohammdi (2009) concluded that the dietary application of Biosaf a commercial product of *Saccharomyces cerevisiae* at levels up to 300 g/ton in laying hens diets from 46 to 55 weeks old did not substantially affect egg performance.

However, other studies reported an improved egg production (P<0.05) by yeast culture supplementation (Abou El-Ella *et al.* 1996; Liu *et al.* 2002). Liu *et al.* (2002) reported that yeast culture at the level of 0.2% increased egg weight; similarly in the present study supplementation with 2 kg/ton feed (0.2%) resulted in a significant increase (P<0.05) in egg weight and consequently increased egg mass. Other studies (Day *et al.* 1987; Nursoy *et al.* 2004) have found no effect of yeast culture supplementation on egg weight.

The noticeable improvement in feed intake and feed conversion efficiency values in this study are supported with the findings of several investigators (Liu *et al.* 2000; Tangendjaja and Yoon, 2002; Abou El–Ella *et al.* 1996).

It has been hypothesized that improvement in feed efficiency in laying hens may be partially attributed to the establishment of an intestinal bacterial population that favored improved nutrient retention.

2-Egg quality

The interior and exterior egg parameters as shown in Table 3 revealed that the supplementation of graded levels of yeast culture or flavomycin did not affect albumin percentage, yolk index, yolk colour and shell thickness. The results of this study agree with the findings of Brake (1991), Aboul El-Ella (1996) and Nursoy *et al.* (2004).

Supplementation level of 75 and 100 mg flavomycin (T_6 and T_7) significantly decreased shell percentage as compared with the control group (T_1). The values of yolk perce-

Table 2 Effect of yeast culture and flavomycin supplementation on performance of laying hens

Traits	Control	Yeast			Flavomycin		
	T_1	T_2	T_3	T_4	T_5	T_6	T_7
Egg production (%)	78.72±1.25^{b}	78.63±2.36^{b}	76.07±1.53^{bc}	72.77±1.13^{c}	75.3±0.97^{bc}	83.34±0.89^{a}	75.13±1.37^{bc}
Egg weight (g)	66.48±0.65^{b}	66.58±1.04^{b}	70.66±0.68^{a}	66.01±0.34^{b}	66.65±0.16^{b}	66.51±0.49^{b}	67.28±0.86^{b}
Egg mass (g)	4397±108.4^{bc}	4416±124.1^{abc}	4515±92.32^{ab}	4097±77.07^{d}	4217±49.02^{cd}	4656±60.99^{a}	4277±110.8^{bcd}
Feed intake (g)	131.0±0.57^{a}	126.2±0.38^{bc}	125.3±0.56^{c}	126.9±0.37^{b}	125.1±0.54^{c}	127.2±0.34^{b}	125.1±0.76^{c}
Feed conversion (kg feed/kg egg)	2.51±0.07^{ab}	2.41±0.06^{bcd}	2.35±0.04^{cd}	2.61±0.05^{a}	2.50±0.04^{abc}	2.4±0.03^{d}	2.48±0.09^{abc}

*The means within the same row that have at least one common letter, do not have significant difference (P>0.05).

Table 3 Effect of dietary treatments on egg quality

Traits	Control	Experimental groups					
		Yeast			Flavomycin		
	T1	T2	T3	T4	T5	T6	T7
Egg weight (g)	68.60±2.16	67.00±1.52	68.80±1.53	68.00±1.58	64.20±1.16	65.80±2.03	67.00±2.02
Yolk %	26.77±1.08^{c}	28.20±1.03^{abc}	28.08±0.41^{abc}	27.65±0.31^{abc}	29.67±1.18^{a}	28.25±0.54^{abc}	29.25±0.43^{ab}
Albumin (%)	60.41±1.55	60.44±1.15	59.71±0.61	60.61±0.72	58.49±1.05	61.07±0.52	60.22±0.73
Shell (%)	12.82±0.55^{a}	11.36±0.42^{abc}	12.22±0.30^{ab}	11.74±0.68^{abc}	11.83±0.55^{abc}	10.68±0.33^{bc}	10.53±0.87^{c}
Shape index	76.08±1.85^{a}	73.82±1.03^{abc}	72.81±0.91^{abc}	71.15±1.93^{c}	72.42±2.06^{abc}	75.70±0.71^{ab}	75.04±0.69^{abc}
Yolk index	43.94±0.34	43.41±0.39	43.82±0.70	43.96±0.54	43.52±0.36	44.08±0.44	43.56±0.71
Haugh unit	74.98±0.42	74.58±0.61	74.53±0.69	74.48±0.69	74.63±0.47	74.48±0.64	75.30±0.58
Yolk colour	8.00±0.32^{ab}	7.40±0.4^{ab}	7.80±0.49^{ab}	7.60±0.51^{ab}	7.60±0.24^{ab}	7.00±0.32^{b}	8.20±0.37^{a}
Shell thickness	34.00±0.55	33.60±1.47	33.40±0.51	33.00±1.70	33.00±0.71	31.00±1.14	31.80±0.49

*The means with in the same row that have at least one common letter, do not have significant difference (P>0.05).

Table 4 Effect of dietary treatments on blood constituents

Traits	Control	Experimental groups					
		Yeast			Flavomycin		
	T_1	T_2	T_3	T_4	T_5	T_6	T_7
TP	6.10±0.26	6.03±0.15	5.90±0.06	6.07±0.18	6.13±0.12	6.07±0.24	6.00±0.12
AL	2.70±0.12	2.83±0.09	2.87±0.09	2.93±0.09	2.83±0.15	2.87±0.18	3.02±0.04
GL	3.40±0.38	3.20±0.01	3.03±0.07	3.13±0.12	3.30±0.06	3.23±0.09	2.98±0.11
A/G	0.81±0.14^{b}	0.89±0.03^{ab}	0.95±0.05^{ab}	0.94±0.03^{ab}	0.86±0.06^{ab}	0.87±0.06^{ab}	1.07±0.04^{a}
AST	168.3±4.41^{b}	171.7±4.41^{b}	176.7±17.64^{b}	180.00±10.41^{ab}	183.3±6.01^{ab}	185.0±5.77^{ab}	206.7±8.82^{a}
ALT	27.33±1.45	29.33±2.96	29.00±1.00	28.00±0.58	30.0±1.15	29.67±1.20	32.67±3.71
Glucose	191.76±6.01^{b}	190.00±5.77^{b}	176.7±12.02^{b}	193.00±6.51^{b}	193.33±8.82^{b}	193.33±3.33^{b}	218.33±6.01^{a}
Creatinine	0.36±0.009	0.36±0.02	0.37±0.04	0.37±0.01	0.37±0.01	0.38±0.01	0.38±0.006

*The means within the same row that have at least one common letter, do not have significant difference (P>0.05).

TP: total protein; AL: albumin; GL: globulin; A/G: albumin/globulin; AST: aspartat amino transferase; ALT: alanin amino transferase;.

ntage increased significantly (P<0.05) by flavomycin supplementation. The shape index value decreased significantly (P<0.05) for the group received 3 kg/ton feed yeast culture. Similar results were obtained by Yalcin *et al*. (2008).

3-Some blood plasma constituents

Any effect of yeast culture or flavomycin supplementation on blood constituents (Table 4) was not seen for total protein, albumin, globulin and creatinine, indicating that protein metabolism and kidney functions were not affected by the supplementation treatments. Yalcin *et al*. (2008) studied the effects of yeast culture supplementation on laying hen diets containing soybean or sunflower meal and showed that neither AST nor ALT were affected. However, the plasma glucose level showed a significant (P<0.05) increase for the treatment T_7 that received 100 mg flavomycin per ton feed. The increase of plasma glucose could be attributed to its lower utilization and/or stressful conditions due to higher dose of flavomycin.

To sum up, the results of this particular study showed that yeast culture, at the level of 2 kg, significantly decreased feed intake, improved feed conversion and increased egg weight. The improvement in egg production was only achieved when flavomycin supplementation level was 75 mg/ton; neither less nor more. Generally, the egg parameters were not affected by yeast culture contrary to flavomycin supplementation. Liver functions and metabolism as indicated by blood plasma metabolites were negatively affected by flavomycin and they were significant at the highest level (100 gm/ton), while yeast culture supplementation showed normal values.

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