Effect of Yeast as Feed Supplement on Behavioural and Productive Performance of Broiler Chickens

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Abstract: This study was conducted to evaluate the effects of new patent probiotic inactivated *Saccharomyces cerevisiae Var. ellipsoideus* (Thepax®) and other commercial yeast *"Saccharomyces cerevisiae*" either live or dry feed additives, on behavioral and productive performance of broiler chickens. A total of 496 day-old Cobb chicks were used and divided into 4 groups, 2 replicates for each. Chicks in group one were fed on commercial basal diet as a control group©, the chicks in other three groups were fed on the same diet enriched with 0.5 gm Live yeast / kg diet for group two (T1), 1 gm. dry yeast /kg diet for group three (T2) and 1 gm inactivated yeast /kg diet for group four (T3) (this dose of inactivated yeast was 0.5 g/ kg in grower diet). During 5 weeks experimental period, behavioral measurements as frequency and duration of feeding and drinking behavior; comfort behavior including wing and leg stretch, preening, ground scratch, body shaking and resting behaviour were observed and recorded. Broiler performance including weekly feed intake, weekly body weight gain, final feed intake, final body weight, feed conversion ratio, dressing weight, dressing percentage, mortality rate, and European efficiency index were calculated. Significant differences were observed between different yeast types in ingestive behavior, comfort behaviour, feed intake, final body weight, food conversion ratio, dressing weight, dressing percentage, mortality rate, and European performance index. It can be concluded that the inactivated yeast probiotic can be included in broiler diets for their beneficial effect and to improve their behavioral and productive performance.

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Key words: Behavior, Broiler, inactivated yeast, Probiotics, Performance, Thepax®

1. Introduction

Probiotics firstly defined as non-digestible food ingredients that beneficially affect the host by selectively stimulating the growth and or activity of bacteria in the colon **(Gibson and Roberfroid, 1995).** The mode of action of probiotics in poultry includes: (i) maintaining normal intestinal microflora to improve the health and wellbeing of the host (ii) altering metabolism by increasing digestive enzyme activity and decreasing ammonia production (iii) improving feed intake and digestion iv) stimulating the immune system **(Apata, 2008),** and (iv) adversely compete with pathogens for nutrients **(Biggs et al., 2007).**The probiotic microorganisms used in animal nutrition are mainly bacterial strains belonging to different genera, e.g. *Lactobacillus, Enterococcus*, *Pediococcus* and *Bacillus spp.* Other probiotics are microscopic fungi, including *Saccharomyces* cerevisiae yeasts. **Paryad and Mahmoudi (2008).** A few years ago active live yeast, has been documented as probiotic feed additive for poultry due to its improvement effect on performance characteristics. In Egypt, few studies have been conducted to investigate the effect of feeding yeast on performance of Broilers; so the objective of this study was to evaluate the effect of live yeast (1 x 10^7 cfu/gm), dry yeast "Yeastmax®" (1 x 10^5 cfu/gm) (from *unipharma company, Egypt*) and the patent new inactivated *Saccharomyces cerevisiae Var. ellipsoideus Doxal strain's* "Thepax®", (1 x 10^{10} Cfu/ gm) (from Doxal company, Italy and Elyoser medicine trading company, Egypt) on behaviour patterns and productive performance of broiler chickens.

2. Materials and Methods

2.1. Birds and Housing

A total of 496 one day-old Cobb chicks were used in this study. All chicks were housed in a broiler house, Faculty of Veterinary Medicine, Cairo University, Egypt. On arrival, chicks were randomly housed in experimental pens (2 m x 2.10 m x 3 m) with stocking density 15/ m^2. Continuous lighting was provided throughout the experiment; the ambient temperature during brooding was 35°C at one day old and gradually decreased to 25°C on day 21 and then kept constant. Feed and water were provided ad libitum via trough feeders and bell drinker. The birds were vaccinated against Newcastle disease and infectious bronchitis on day 6 of age and against Gumboro on day 12 of age.

2.2. Experimental design

The study was conducted on one control group and 3 treatment groups, 2 replicates for each. The replicate was 62 chicks (each treatment consists of 124 chicks). All diets used were in mash form and formulated to meet the nutrient requirement of the

broiler chickens during a five weeks experimental period according to recommendations of the national research council **(NRC 1994).** Table1 presents the treatment of the groups with yeast as feed additives, and table 2 indicates the composition and nutritive value of the basal diet.

Table 1: The experimental groups treated with yeast as feed additives

Groups	Treatment
Group one (control)	Chicks fed on Basal diet without any additives
Group two (T1)	Chicks fed on Basal diet enriched with 0.5 g/kg live yeast(*Saccharomyces cerevisiae* 1 x 10^7 cfu/gm yeast) **Hosseini (2011)**
Group three (T2)	Chicks fed on Basal diet enriched with 1 g/kg dry yeast (Yeastmax, *Saccharomyces cerevisiae* 1 x 10^5 cfu/gm) Unipharma *company*
Group four (T3)	Chicks fed on Basal diet enriched with inactivated yeast (Thepax®, *Saccharomyces cerevisiae* 1 x 10^{10} cfu/gm) in a dose of: -1 gm/ kg in starter diet and 0.5 g/kg in grower diet (Doxal Company , Italy and Elyoser medicine trading company, Egypt)

Table 2. Composition and nutritive value of starter, and grower diet used

	Components	Starter(Kg/100 kg)	Grower (Kg/100 kg)
Ingredients use in the diet	Yellow Corn	60.28	64.3
	Soya bean meal (47%)	34.25	29.28
	Safflower oil	1.51	2.49
	Na bicarbonate	0.18	0.07
	Sodium chloride	0.33	0.33
	DL-Methionine	0.16	0.15
	Lysine	0.18	0.21
	Di calcium phosphate	1.49	1.52
	Lime stone	1.33	1.34
	Premix	0.3	0.3
Total		100	100
Chemical analysis of diet	Metabolisable Energy (Kcal/kg)	2988	3083
	Crude Protein (%)	21	19
	Crude Fat (%)	4.83	5.79
	Fiber (%)	3.7	3.42
	Calcium (%)	0.9	0.9
	Phosphorus (total) (%)	0.73	0.7
	P. Available (%)	0.40	0.4

2.3. Measurements

2.3.1. Behavioral measurements,

The following behavioral parameters were observed and measured throughout the experiment; ingestive behaviour (feeding frequency, feeding duration, drinking frequency and drinking duration); comfort behaviour (wing and leg stretch, preening , ground scratch, Body shaking and resting behaviour **(Duncan, 1998).** All behavioral measurements were conducted according to **Altmann (1974)** through two methods; Daily focal samplings, for six birds per group were identified using special dyes, each bird observed 10 min/ session, two sessions/ day and three days/week; and Scan sampling were applied 2 times /day, 10 minutes / for each; so the total scan observation period was 20 minutes for each group/day.

2.3.2. Productive Performance:

Chicks were randomly weighed at the beginning of experiment, every week and at the end of experiment and also, the offered and remained feed was weighed weekly to calculate, initial body weight, weekly live body weight gain, final body weight, weekly feed intake, total feed intake, Food Conversion Ratio (FCR), and European efficiency index that calculated according to the equation below. Also dressing weight, dressing percentage and Mortality rate were calculated (Mahmood, et al., 2009).

$$\text{European efficiency Index} \quad \frac{A \times B \times 100}{C \times D}$$

A= Average bird final body weight
B= viability percentage (= 100- Mortality percentage)
C= Number of rearing days
D= Food conversion ratio
Results of European efficiency index = > 300 excellent flock 280-300 very good flock 270-280 Good flock 260-270 Fair flock < 260 weak flock

2.4. Statistical Analysis

The data were subjected to statistical analysis using SPSS program (statistical Package for Social Science) for windows 17 (SPSS 17.1 2005), **Dytham (2003).** Descriptive statistics were used for the analysis of the data result as follow, means, and stander error. The analytical tests which used to compare between the different groups where T test, One way ANOVA , Post Hoc Tests, and Kruskal-Wallis Test. Statistical significant level was at $P \leq 0.05$.

3. Results

The results of the study were tabulated in tables 3, 4, 5 and illustrated in figures 1 and 2

Table 3. Effect of the Yeast types on frequency (no/time) of the different behaviour patterns

Behaviour patterns		Contorl	Live yeast T1	Dry yeast T2	Thepax T3
Ingestive behaviour	Feeding Beh.	5.95a	5.53a	7.00b	5.7a
	Drinking	7.47a	5.37b	4.82b	6.53a
Comfort behaviour	wing and Leg stretch	6.47a	5.65b	5.45b	6.95a
	Preening (P)	6.95a	6.17a	5.62a	5.45b
	Ground scratching (GS)	6.36a	5.4b	5.75b	6.67a
	Body shaking (BS)	6.55a	5.47a	5.45b	6.65a
	Resting Beh.(RB)	7.08a	5.63b	4.69b	6.79a

a, and b means in the same raw highly statistical significant difference at $p \leq 0.05$

Table 4. Effect of the Yeast types on the duration "time spent/ Sec." of different behaviour patterns

Behaviour patterns		Contorl	Live yeast T1	Dry yeast T2	Thepax T3
Ingestive behaviour	Feeding Beh.	56.9a	58.9a	73.3b	53.6a
	Drinking	76.8a	54.2b	47.6b	63.3a
Comfort behaviour	wing and Leg stretch	67.6a	55.9b	52.2b	67.3a
	Preening	65.2 a	63 a	57.6 a	53b
	Ground scratching	62.6a	56.2b	59b	67.3a
	Body shaking	61.6a	53b	52b	65.2a
	Resting Beh.	61a	55b	51b	64a

a, and b means in the same raw highly statistical significant difference at $p \leq 0.05$

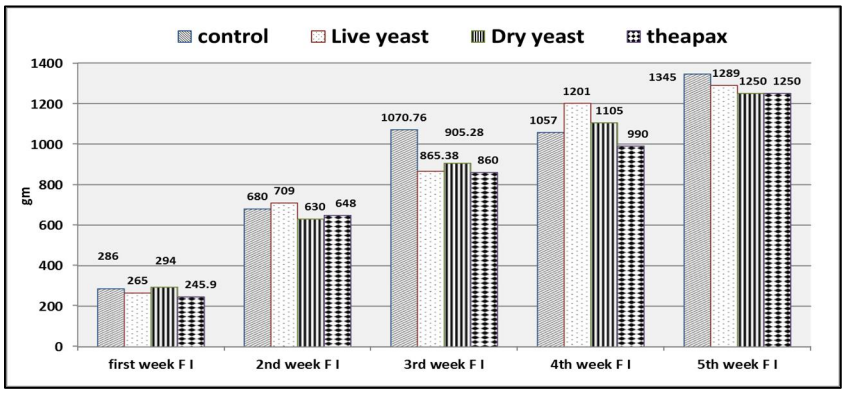

Figure 1. Weekly Feed Intake for broiler chicks fed on live, Dry and inactivated yeast *"Thepax®* enriched diet*"*.

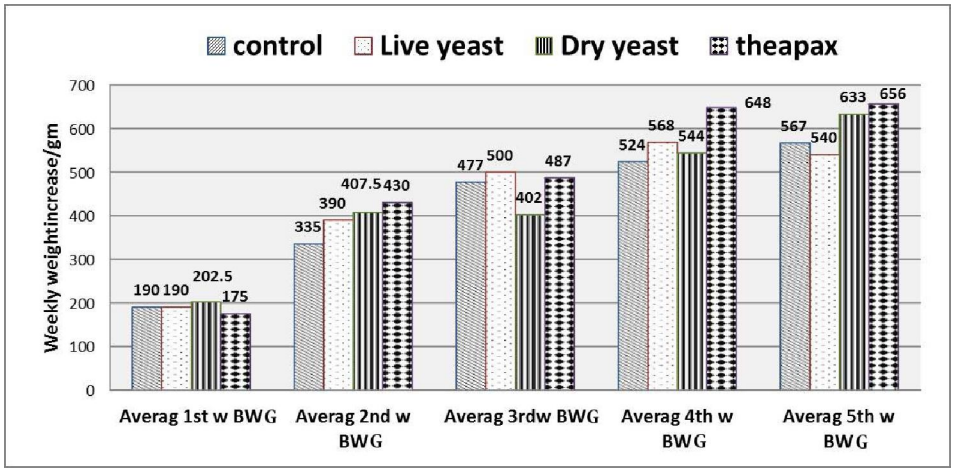

Figure 2. Weekly body weight gain for broiler fed live, Dry and inactivated yeast *"Thepax®* "enriched diet.

Table 5. Broiler performance fed on live yeast, Dry yeast and inactivated yeast *"Thepax®* enriched diet.

Parameters	Group "Mean+SE"			
	Contorl	Live yeast	Dry yeast	Thepax
Initial body weight "gm"	45	45	45	45
Final body weight "kg"	2.093 ± 0.033 [a]	2.188 ± 0.043 [a]	2.189 ± 0.035 [a]	2.396 ± 0.043 [b]
Total body weight gain "kg"	2.048 ± 0.027 [a]	2.143 ± 0.036[a]	2.144 ± 0.032 [a]	2.351 ± 0.038 [b]
Total feed intake "kg"	4.438 ± 0.054 [a]	4.329 ± 0.062 [b]	4.184 ± 0.058 [b]	4.073 ± 0.052 [b]
Food conversion ratio	2.17 [b]	2.02 [b]	1.95 [b]	1.73 [a]
Post slaughter weight "kg"	1.517 ± 0.027a	1.649 ± 0.024 [b]	1.681 ± 0.028 [b]	1.950 ± 0.027 [b]
Dressing percentage	72.5 [a]	75.4 [b]	76.8 [b]	81.4 [b]
Mortality rate	11.5 ± 0.09 [a]	2.7 ± 0.025 [b]	1.8 ± 0.018 [b]	0.9 ± 0.03 [b]
European Efficiency Index	270	288	359	502

a,b means within a column were significantly different at P<0.05

4. Discussion

4.1. Behavior Measurements

As shown in table (3) and (4), the results indicated that feeding behaviour (frequency and duration) was affected by the addition of yeast to the diet. This may related to the direct effect of probiotic by stimulating appetite of the host **(Nahashon et al., 1992 and 1993).** The birds in dry yeast group showed a significant higher feeding frequency and duration which may attributed to the vitamin mixture in the dry yeast "YEASTMAX", these vitamins have appetizing effect while in the control group, T1 group and T3 group there were no significance differences in feeding frequency and duration. Drinking behaviour (frequency and duration), was much higher in control group, followed by group T3 "Thepax", while the lower drinking frequency and duration recorded in T1 and T3 groups respectively without any significance difference between them.

The comfort behaviour patterns recorded were wing/ Leg stretch, Preening, body scratching, Body shacking and resting behaviour, as indicated in table 2 and 3, there were significance differences in different comfort behaviour, as T3 group showing higher wing/leg stretching, Body shaking and body scratching behaviors (frequency and duration); followed by control group, while the lower wing/leg stretching frequency and duration recorded in T1 and T2 groups, while the control group showing higher frequency and duration Preening behaviour. While control group showing higher Preening behaviour (frequency and duration) followed by T1 and lower preening behaviour was recorded in T3. Resting Behaviour, according to table 2 and 3, there was statistical significance difference, the higher resting behaviour recorded in control group, followed by T3 group. These results may related to the chemical analysis of inactivated yeast "Thepax ®", dry matter contain ß glucan 18 % stimulating broiler immune system **(Zhang etal., 2005; Flickinger and Fahey, 2002),** which minimize the effect of stress and reflect on the comfort behaviour.

4.2. Performance measurements

4.2.1. Weekly Feed Intake "WFI" and weekly body weight gain

The results illustrated in figure 1 and 2 showed that, T3 "Thepax group" recorded the lowest feed intake within the first week followed by group T1 while the highest feed intake was recorded in control group. At the same time, average weekly body weight increase was higher in group T2 compared to both Control and T1 groups. These results related to the fact that the effect of probiotics depend on the activation and maintaining the normal flora according to **Apata (2008);** as the chicks at one day old have a sterile gastro intestinal tract and the normal flora begin to grow within two weeks according to **Kabir (2009).** So the effect of Thepax, dry yeast and live yeast to stimulate the growth and multiplication of normal flora began to be obvious from the 2nd week, so during the age 8-15 days the weekly feed intake began to increase in group T2 followed by group T3, control group and group T1 these increase reflect on the weekly body weight gain in group T3, T2, T1 and finally control group. These findings agree with **Hadj Ayed et al. (2010)** who found an increase in the relative body weights of chicks receiving a diet supplemented with yeast probiotic. **Haj Ayed et al. (2004)** found an improvement in broilers growth performances when the feed supplemented with a *Saccharomyces cerevisiae*.

In the third week the feed intake in control group was the highest , and achieve lowest weekly body weight gain, it is obvious that live yeast is the best in these period followed by inactivated yeast" THEPAX", this agree with **Kanat and Calialar (1996)** who reported that dry yeast effectively increases body weight gains without affecting

feed/gain ratio. During the fourth and fifth weeks of age, T3 group achieved the lowest weekly feed intake but gained the highest weekly body weight, this related to the fact that the inactivated yeast began to be highly effective after third weeks of age, it is may be explained by the content of the Thepax® "inactivated yeast" the cell wall contain 18 % Mannan oligosaccharide which responsible for the increase intestinal villus development and consequently stimulating broiler performance. Furthermore, the inactivated yeast constitutes a considerable source in nutrients especially the B complex vitamins, amino acids and enzymes which serve to improve chickens health, according to **Zhang et, al., (2005)**; and **Flickinger and Fahey, (2002).** The good result of inactivated Saccharomyces cerevisiae Var. ellipsoideus Doxal strain's "Thepax®" may related to that THEPAX cells are treated by Chitinase, an enzyme which is able to reduce, dramatically, their chitin content from 10 % to 2.7 % according to **Yiannikouris, et al (2004),** so the inactivated yeast cell become more digestible to the gut microflora reflect on their growth and number which stimulate appetite **(Nahashon et al., 1992 and 1993);** improve intestinal microbial balance **(Fuller 1989**); synthesize vitamins **(Coates and Fuller, 1977);** produce the digestive enzyme **(Gilliland and Kim 1984); (Saarela et al., 2000);** utilize indigestible carbohydrate and stimulate lactic acid production **(Bailey, 1987).**

4.2.2. Final performance Measurements

As shown in table 5 there was a highly statistical significance difference, T3 group achieve the higher the final body weight followed by T1 and T2 groups which nearly the same while control group given the lowest final body weight. T3 recorded total the lowest feed intake through the experimental while control group give the highest feed intake and this reflect on the food conversion rate for T3 and control groups (1.7 and 2.12, respectively) These results agree with **Hadj Ayed et al. (2010)** who found an increase in the mean body weights of chicks receiving a diet supplemented with yeast probiotic, also It has been reported by **Ignacio, (1995); and Onifade et al., (1998)** who reported that, feeding yeast to chicks improves body weight gain and feed/gain ratio. Also it was observed that there was a significance difference in dressing yield, T3 group achieve the higher post slaughter weight and dressing percentage followed by T2 group, this result agrees with **Paryad and Mahmoudi (2008)** who found that, supplementation of feed with inactivated Saccharomyces cerevisiae, reduces abdominal fat and also related to the fact recorded by **Ayed and Ghaoui (2011)** which stated that the presence of lipase enzyme in Thepax® that may improve the digestion of lipids and limit their accumulation in the abdomen.

The mortality rate was much higher in control group 11.5 ± 0.09, followed by T1 group 2.7 ±0.025 then T2 group 1.8 ±0.018 and finally T3 group 0.9 ±0.003, it was clear that the groups supplied by Saccharomyces cerevisiae showed low mortality rate than control group and this may related to the effect of saccharomyces cerevisiae on stimulating the immune system **(Toms and Powrie, 2001)**, reducing intestinal pH and release bacteriocins (**Rolfe, 2000**), compete with other pathogenic microbes for adhesive sites in intestine**(Dunham *et al.,* 1993),** this reflect on the birds immunity and resistance to diseases, as recorded by **(Newman, 1994);** and **(Spring et al., 2000**). Also it may be due to the percentage of ß glucan contents in inactivated Saccharomyces cerevisiae Thepax® about 18.2% which consequently stimulating broiler immune system **(Zhang et, al., 2005),** and **(Flickinger and Fahey, 2002).**

European Efficiency Index was affected by different additives, the T3 group achieves EEI 502 "excellent" these related to the high final body weight and low mortality rate, followed by T2 EEI 359 "excellent" then T1 288 "very good" and finally C group give EEI 270 "good" these related to the high mortality percentage in the control group than the other groups.

Supplementation of broiler feed with yeast has a positive effect on their performance, and behaviour; so it can be concluded that, the inactivated yeast probiotic "Thepax" can be included in broiler diets for their beneficial effect and improvement of behavioral and productive performance of broilers.

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