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PROBIOTIC EFFECTS OF *Saccharomycese cerevisiae* ON HEN- DAY EGG PRODUCTION AND EGG QUALITY

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ABSTRACT

The current study investigated the influence of probiotic (Saccharomyces cerevisiae) on hen-day egg performance and egg quality of pullets (Dominion breed). At the point of lay, 100 pullets were randomly selected and divided into 4 groups (A-D) of 25 birds each. Each group was subdivided into 5 replicates of 5 birds. Diets for groups A to C were supplemented with probiotic at varied levels of 0.6 g/kg, 0.8 g/kg and 1.0 g/kg of feed, respectively. Group D diet contained no probiotic (control). The feed for all the groups were isocaloric and isonitrogenous. Eggs were collected three times daily. The numbers of eggs collected from each group were recorded daily. Each month, 10 eggs were randomly collected from each group and their length and width were measured. The ten eggs from each group were weighed and broken and the shell thickness was determined. The experiment revealed that all the probiotic supplemented groups recorded significantly ($p<0.05$) higher hen-day egg production than the control. During the first year in lay, group C had the highest mean hen-day egg performance (85.00 ± 10.00%) followed by groups B (70.00 ± 9.30%) and A (68.00 ± 9.20%) while group D (control) had the least (65.00 ± 5.00%). There was no significant difference ($p>0.05$) between the supplemented groups and the control in the external egg quality. Based on the results of this experiment, Group C (1.0 g/kg level of supplementation) was recommended for optimum production of table eggs.

Keywords: Pullets, Feed, Probiotic, Egg production, Egg quality

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INTRODUCTION

Food and Agricultural Organization of the United Nations recommended that deficit in animal protein supply and consumption in developing countries could be ameliorated by increased poultry, pork and rabbit production [1]. It has also been suggested that supply of poultry products in poorer countries can be rapidly expanded to meet their animal protein needs [2]. This is technically possible because poultry are able to adapt to most areas of the world, have low capital requirement, rapid generation time and a high rate of productivity.

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The major products from poultry production are egg and meat. Besides its excellent nutritive value, chicken egg possesses several health promoting, immunostimulating and therapeutic properties which makes it a versatile product. According to Narahari [3], eggs have a role to play at every age and stage of life. During pregnancy, high quality proteins, vitamins and minerals, omega-3 fatty oils from eggs are essential for both maternal and foetal health. Egg choline is needed for proper development of a child's brain while older people need it to activate their memory. Egg's leutin and zeaxanthin are essential to prevent macular degeneration in adults [3].

There is more to eggs than just a good nutrition. They also contain constituents that help in the treatment of a wide range of human health problems from wounds and rashes to cancer and cardiovascular diseases [3]. Eggs will induce and increase satiety (i.e reduce hunger). This will improve compliance with weight loss diet and enhance the benefits of a weight loss regimen. Despite being the protein food with the highest biological value, eggs still cost lower than most other animal protein sources. For instance in Nigeria, the cost of 100 gm of eggs is lower (₦40) than the same weight of beef (₦60) or chicken (₦70).

The number of eggs per hen per day (hen-day egg production) and egg quality are the major criteria for assessing the productive performance of a laying flock [4]. Krueger *et al.* [5] reported the results of feeding a *Lactobacillus* complex to young Leghorn hens at a concentration of 2.27 kg/ton. They monitored three groups of hens each of treated and control pens housing 26 young females and 2 males for 140 days and reported that the treatment improved egg production and feed efficiency by 3.03 and 7.41% respectively. Crawford [6] tested a mixed lactobacillus preparation at 340 g/ton in 101,615 commercial hens and reported an increase in egg production from 69.5% in control hens to 72.17% in treated birds. The author also noted that the amount of feed required to produce a dozen eggs was reduced from 1.75kg to 1.69 kg. In another study carried out in three different sites (Florida, South Dakota and Arizona), Miles *et al.* [7] fed a mixed lactobacillus at 0.0125, 0.0375 and 0.0625% inclusion levels estimated at a minimum of $4x10^6$ organisms per gram. The treated and untreated feeds were given to seven groups of ten layers from 24 weeks of age for 280 days and reported an increase in egg production in Florida with production levels of 72.77, 72.57 and 70.88% in treated birds compared with 70.89% for the control. Similar results were obtained at Arizona. The absence of an increase at the highest level was attributed to excessive numbers of organisms; suggesting that probiotics are not dose dependent but threshold dependent.

In further studies, direct fed microbials in diets of single comb white Leghorn pullets was reported to improve the nutrient retention and increase productive performance [8] while supplementing microbial culture in barley-based diets fed to laying hens significantly increased their hen- day egg production [9]. Yoruk *et al.* [10] reported that supplementation of layers' diet with humate and probiotic resulted in increase in egg production and a decrease in mortality but did not have any effect on egg quality.

It has also been reported that dietary probiotic (*Pediococcus acidilactici*) supplementation in Hy-line Brown laying hens significantly ($p<0.05$) increased egg weight, egg shell thickness, egg shell relative weight, egg specific gravity and improved feed efficiency ratio per kilogram of eggs but significantly ($p<0.05$) decreased the number of broken eggs. There is paucity of data on the efficacy of probiotic supplementations on the performance of layers in our environment. This study was designed to evaluate the effect of the probiotic, *Saccharomycese cerevisiae* on hen-day egg performance, external egg quality and determine the appropriate level of inclusion of the probiotic in the pullet's diet for maximum egg production.

MATERIALS AND METHODS

Source of Birds and their Management

A total of 110 day-old pullet chicks (Dominion breed) were procured from a hatchery at Ibadan, Nigeria. They were brooded together for 5 weeks during which they were given chick mash *ad libitum*. At the 5^{th}

week, they were given 50 g/bird/day of feed which was increased gradually at the rate of 10 g/week to 100 g/bird/day by the 10th week of age. They were thereafter maintained on 100 g/bird/day until the 16th week. During this period, all routine vaccinations were administered as recommended by the Nigerian Veterinary Research Institute, Vom, Nigeria. The experimental birds were house at the Teaching and Research Farm of the Faculty of Veterinary Medicine, University of Nigeria, Nsukka, Nigeria.

Probiotic Yeast

The probiotic yeast, *Saccharomyces cerevisiae* used in the study was procured from B. F. P., Dock Road, Felixstowe, United Kingdom.

Experimental Design

At the point of lay, 100 pullets were randomly selected and divided into 4 groups (A - D) of 25 birds each. Diets for groups A to C were supplemented with probiotic at varied levels of 0.6 g/kg, 0.8 g/kg and 1.0 g/kg of feed, respectively while that of group D contained no probiotic (control). The feed for all the groups were isocaloric and isonitrogenous. They were placed on 120 gm of feed/hen/day until their peak of egg production when their feed was increased to 140 g/bird/day. Water was given *ad libitum.* Eggs were collected three times daily (morning 08 hours; afternoon 12 hrs. and evening 16 hrs.). All the eggs from each group were weighed and recorded daily.

Determination of External Egg Quality

Egg Weight and Shell Weight

Each month, 10 eggs were randomly selected from each experimental group and weighed using electronic weighing balance (Sartorius, China). The eggs were broken and shells weighed with the same balance. This was repeated ten times.

Shell thickness

The thicknesses of the shells were measured at three points namely; the middle and the two ends of the egg using Ames paper thickness gauge and values were recorded in millimetres [11].

Egg Length and Width

The length and width of the 10 eggs from each group were measured using a Vernier Caliper [12].

Data Analysis

Results of the hen-day egg production were analyzed using Repeat Measure ANOVA while the egg and egg shell weights, shell thickness, egg length and width were analyzed with One-way ANOVA. Group means were compared using new Duncan's multiple range tests. Level of significance was accepted at $p<0.05$. All the analyses were performed with SPSS windows 15.0.

RESULTS

Pullet year (1st year) egg production is presented in Table 1, while the hen year (2nd year) egg production is shown in Table 2. The external egg qualities during the 1st and 2nd years are presented in Table 3.

On the average, all the probiotic supplemented groups recorded significantly ($p<0.05$) higher egg production than the control (Table 1). In the pullet year, mean hen-day egg production was highest in group C (85.24 ± 10%) followed by groups B and A (70.38 ± 9.3% and 68.36 ± 9.2% respectively). Group D (control) was the least (65.04 ± 5.0%). However, by the second year in lay, group A had the highest mean hen-day production (58.00 ± 0.18%) followed by groups B (57.00 ± 0.05%) and C (55. 00 ± 0.43%) with the control having the least (50.00 ± 0.30%) in the hen year (Table 2).

Table 1. Mean monthly hen-day egg performance (%) by layers fed diets supplemented with varied levels of Probiotic (1st year in lay).

Months	Group A (0.6 g/kg probiotic)	Group B (0.8 g/kg probiotic)	Group C (1.0 g/kg probiotic)	Group D (Control No probiotic)
November	16.06 ± 1.16^{ab}	20.20 ± 1.17^{b}	36.00 ± 2.89^{c}	10.12 ± 1.74^{a}
December	44.96 ± 1.51^{a}	58.00 ± 1.73^{b}	73.31 ± 4.63^{c}	40.30 ± 1.19^{a}
January	68.09 ± 1.73^{a}	70.05 ± 2.89^{a}	87.05 ± 4.04^{b}	66.13 ± 1.74^{a}
February	85.30 ± 2.90^{ab}	88.94 ± 2.31^{bc}	96.11 ± 1.16^{c}	80.32 ± 2.33^{a}
March	92.04 ± 1.16^{a}	94.17 ± 1.17^{a}	95.31 ± 1.87^{a}	89.17 ± 2.89^{a}
April	90.28 ± 1.75^{b}	83.20 ± 1.74^{a}	96.16 ± 1.74^{c}	89.44 ± 1.44^{b}
May	80.12 ± 2.89^{a}	82.27 ± 1.19^{a}	96.17 ± 0.60^{b}	80.13 ± 1.74^{a}
June	77.09 ± 1.15^{a}	80.06 ± 0.58^{a}	95.20 ± 1.74^{b}	76.07 ± 2.31^{a}
July	75.03 ± 1.14^{a}	$80.01 \pm .58^{b}$	94.27 ± 2.33^{c}	74.04 ± 1.16^{a}
August	68.14 ± 1.74^{a}	70.20 ± 2.89^{a}	90.04 ± 2.89^{b}	67.35 ± 2.34^{a}
September	63.17 ± 1.17^{b}	60.24 ± 1.75^{b}	90.20 ± 1.17^{c}	55.27 ± 1.75^{a}
October	60.08 ± 2.31^{b}	57.17 ± 1.17^{ab}	73.08 ± 1.73^{c}	52.15 ± 1.16^{a}

[a,b,c,d]Figures in the same row with different superscripts are significantly different ($p<0.05$).

Table 2. Mean monthly hen-day egg performance (%) by layers fed diets supplemented with varied levels of Probiotic (2nd year in lay).

Months	Group A (0.6 g/kg probiotic)	Group B (0.8 g/kg probiotic)	Group C (1.0 g/kg probiotic)	Group D (Control No probiotic)
November	52.12 ± 1.16^{b}	49.22 ± 2.32^{ab}	50.15 ± 1.74^{ab}	45.12 ± 1.74^{a}
December	48.03 ± 4.62^{a}	50.15 ± 2.89^{a}	46.27 ± 2.32^{a}	40.20 ± 1.17^{a}
January	56.14 ± 3.47^{b}	52.02 ± 1.15^{ab}	47.50 ± 2.36^{ab}	43.19 ± 4.05^{a}
February	60.02 ± 2.89^{b}	57.17 ± 2.32^{ab}	55.08 ± 2.89^{ab}	50.17 ± 2.89^{a}
March	63.07 ± 1.73^{b}	60.01 ± 2.89^{ab}	60.16 ± 1.74^{ab}	54.28 ± 1.76^{a}
April	65.25 ± 2.90^{a}	63.27 ± 1.75^{a}	64.02 ± 2.31^{a}	58.81 ± 2.32^{a}
May	65.17 ± 2.89^{b}	64.03 ± 2.31^{ab}	63.23 ± 1.75^{ab}	57.25 ± 1.75^{a}
June	65.03 ± 1.16^{b}	63.08 ± 1.16^{b}	61.25 ± 0.63^{ab}	56.10 ± 2.89^{a}
July	64.28 ± 2.33^{b}	61.15 ± 2.89^{ab}	60.31 ± 1.20^{ab}	54.29 ± 2.33^{a}
August	62.11 ± 1.16^{b}	58.00 ± 1.73^{ab}	56.11 ± 3.47^{ab}	51.15 ± 1.74^{a}
September	48.25 ± 2.90^{ab}	56.13 ± 2.31^{b}	50.17 ± 2.89^{ab}	45.83 ± 2.32^{a}
October	45.27 ± 2.89^{a}	47.28 ± 4.05^{a}	46.17 ± 1.74^{a}	43.17 ± 1.17^{a}

[a,b,c,d]Figures in the same row with different superscripts are significantly different ($p<0.05$).

There was no significant difference ($p>0.05$) between the supplemented groups and the control in the external egg qualities namely; egg weight, egg length, egg width, shell weight and shell weight (Table 3).

However, egg weight, egg length, egg width and shell weight were higher in all groups during the hen year than the pullet year (Table 3).

Table 3. The external egg qualities of eggs produced by layers fed diets supplemented with varied levels of probiotic.

Groups/ Parameters	Group A (0.6 g/kg probiotic)	Group B (0.8 g/kg probiotic)	Group C (1.0 g/kg probiotic)	Group D (Control No probiotic)
Pullet Year				
Egg Wt. (g)	62.50 ± 1.25	62.47 ± 0.66	62.38 ± 0.46	62.40 ± 0.71
Egg Length (mm)	85.10 ± 0.55	85.18 ± 0.43	85.09 ± 0.13	85.11 ± 0.49
Egg Width (mm)	74.51 ± 0.47	74.82 ± 0.35	74.36 ± 0.46	74.42 ± 0.53
Shell Wt. (g)	6.88 ± 0.14	6.94 ± 0.19	6.35 ± 0.08	6.84 ± 0.12
Shell Thickness (mm)	0.39 ± 0.02	0.43 ± 0.07	0.42 ± 0.05	0.41 ± 0.03
Hen year				
Egg Wt. (g)	67.96 ± 0.75	68.07 ± 0.14	67.95 ± 0.32	68.03 ± 0.53
Egg Length (mm)	88.13 ± 0.24	88.09 ± 0.66	88.11 ± 0.17	88.15 ± 0.33
Egg Width (mm)	77.01 ± 0.42	77.22 ± 0.50	77.03 ± 0.41	77.08 ± 0.14
Shell Wt. (g)	8.25 ± 0.16	8.66 ± 0.07	8.12 ± 0.22	8.45 ± 0.16
Shell Thickness (mm)	0.40 ± 0.67	0.42 ± 0.11	0.41 ± 0.46	0.41 ± 0.25

DISCUSSION

The results showed that *S. cerevisiae* increased the efficiency of feed utilization which led to more eggs being produced by the supplemented groups without any significant difference in the external egg qualities. These results agree with earlier studies [13,14,15,16,17] that reported increased efficiency of feed utilization following probiotic supplementation of the diets of poultry. The improved efficiency of feed utilization could be due to the activities of the digestive enzymes [18,19]. It is also possible that when the probiotic organisms clinically die in the gastrointestinal tract, they were absorbed as microbial protein [20]. The present findings are further supported by previous reports [21,22,23] that probiotics supplementation improved productive performance in poultry.

In an earlier study, Koop- hoolihan [24] observed that probiotics synthesized nutrients especially vitamins and also increased the bioavailability of nutrients which probably could be some of the ways through which probiotics increased productive performance.

The study also revealed that during the second year in lay, egg numbers decreased but egg weight and size increased. This result is in agreement with earlier findings of Oluyemi and Roberts [4] who stated that during the hen year, egg numbers decreased by about 20% but egg size increased.
The shift in high mean hen-day egg performance from group C in the first year in lay to group A during the second year could be due to follicular depletion.

In conclusion, the findings of this study suggest that the probiotic yeast may have contributed to the increased egg production but had limited or no effect on egg quality. The results also suggested that supplementation of layer diet with the probiotic yeast, *Saccharomyces cerevisiae* at 1.0 g/kg of feed produced optimal effect in egg production.

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