# EFFECT OF DIFFERENT LEVELS OF SELENIUM-ENRICHED SACCHROMYCES CEREVISIAE ON THE PRODUCTION PERFORMANCE, EGG QUALITY, LIPID PROFILE, ANTIOXIDANT STATUS, AND INTESTINAL MICROBIAL STRUCTURE OF LAYING HENS UNDER HOT CONDITIONS

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## SUMMARY

This study aimed to investigate the effects of different levels of selenium-enriched Saccharomyces cerevisiae (S. cerevisiae) on the production performance, egg quality, lipid profile, antioxidant status, and intestinal health of laying hens under hot environmental conditions. A total of 200 healthy 23-wk-age Brown Lohmann layers were randomly divided into 4 treatments, each in 5 replicates as follows: the first group (Se-ES0) fed the basal diet without supplementation (control), the second group fed the basal diet supplemented with 0.25 g selenium-enriched S. cerevisiae (Se-ES1), the third group fed the basal diet supplemented with 0.5 g selenium-enriched S. cerevisiae (Se-ES2), the fourth group fed the basal diet supplemented with 1.0 g selenium-enriched S. cerevisiae (Se-ES3). After 8 weeks, the results showed a deterioration in the productive performance and egg quality of laying hens fed on a diet without additives under heat stress conditions ($P < 0.05$). Compared with the control group, the feed conversion ratio (FCR) improved ($P < 0.05$), and the egg production%, albumen weight, albumen height, and Haugh unit in the Se-ES2 and Se-ES3 groups increased significantly ($P < 0.05$). Furthermore, the antioxidant capacity in the Se-ES3 group was enhanced than that in the other groups ($P < 0.05$) decreased MDA and increased SOD levels. Additionally, the lipid profile improved in the Se-ES3 group ($P < 0.05$) by decreased cholesterol and increased HDL levels. Moreover, supplementation with Se-ES modified the microbial content, as the Lactobacillus count increased, and the E. coli and Coliform count decreased. It can be concluded, that adding selenium-enriched S. cerevisiae improved the egg production%, FCR, and Haugh unit and enhanced microbial community, lipid profile, and antioxidant status of heat-stressed laying hens.

***Keywords:*** *Selenium-enriched Saccharomyces cerevisiae, laying hens, performance, lipid profile, antioxidant status, microbial count.*

## INTRODUCTION

Environmental stresses, the most influential of which is heat stress during the summer months, represent a major challenge to the laying industry in Egypt. Heat stress is one of the major obstacles to expansion in the poultry industry, as heat stress causes many negative effects on feed intake, decreased egg quality, increased mortality rate, and other important features that govern the economic success of the poultry industry (Abdel-Moneim *et al.,* 2021).Therefore, the issue of environmental stress has become an important point in the world, especially in animal husbandry, to find solutions to mitigate the harmful effects on productive performance and chick health(Wang *et al.*, 2022). Heat stress results from a negative balance between the amount of heat energy produced by the bird and the net amount of energy flowing from the chick's body to its surrounding environment. Therefore, stress is a biological response of the birds to the stimulus that negatively impacts their normal physiological equilibrium and welfare (Saleh *et al.,* 2020). Many previous studies have confirmed that exposure to heat stress leads to a deterioration in the performance of laying hens through decreased body weight, egg production, and egg weight, in addition to deteriorating eggshell quality by inducing a series of radical changes that lead to an increase in reactive oxygen species (ROS), which leads to a deterioration in production performance (Saleh *et al.,* 2020; Abdel-Moneim *et al.,* 2021). Feed additives, including probiotics, organic acids, oils, etc., play an important role in reducing the negative effects of heat stress (Abdel-Moneim *et al.,* 2022; Elbaz *et al.,* 2023a).

Probiotics are defined as "active bacterial preparations (microorganisms) that confer health benefits on the host" (Halder *et al.,* 2024). It contains a wide range of beneficial microbes, including Lactobacillus, Bifidobacterium, and yeast (Saccharomyces), with numerous health benefits, including promoting growth, maintaining gut flora, and other properties (Koiyama *et al.*, 2018). Adding probiotics to laying hens' diets has been shown to improve production performance parameters of hens including feed conversion ratio, egg quality, egg production, animal welfare, and disease resistance (Yalçın *et al.*, 2010). Moreover, many previous studies have supported the role of probiotics in regulating immunity, maintaining gut health and metabolic balance, and ultimately regulating bird behavior and performance (Koiyama *et al.,* 2018; Zhang *et al.,* 2020).

Selenium (Se) is an essential element for maintaining animal performance and health, as it has antioxidant properties and protects the animal from the effects of free radicals that occur during exposure to stress (Kieliszek and Błażejak, 2016), which protects cells from damage and maintains the function of cell membranes. In addition, it participates in many important biological processes such as thyroid hormone production, enzyme formation, and reducing inflammation, including glutathione peroxidase, which helps control the levels of lipid peroxides that are damaged during heat stress (Abdel-Moneim *et al.,* 2022).Many reports have also confirmed the positive role of selenium in supporting the immune system and maintaining normal muscle function (Muhammad *et al.,* 2021; Khan *et al.,* 2023) in addition to its role as an antioxidant. Therefore, it has become necessary to use selenium supplements in poultry feed to meet the basic nutritional requirements and to obtain many potential health benefits, especially when the bird is exposed to stress. There are two main sources of selenium used in poultry nutrition, organic selenium (Se-Met) and inorganic selenium (sodium selenite). Organic selenium (including selenium-enriched yeast) has higher rates of bioavailability and product accumulation, as well as lower toxicity than the inorganic form (Han *et al.,* 2017).

Therefore, this study aimed to evaluate the supplementation of different levels of selenium-rich S. cerevisiae on productive performance, egg quality, antioxidant status, lipid peroxidation, and gut microbiota in laying hens under environmental heat stress conditions.

## MATERIALS AND METHODS

### *Hen management and experimental design:*

The Animal Care and Use Committee of Desert Research Center, Egypt approved all experimental procedures. A total of 200 23-week-age commercial Brown Lohmann laying hens were randomly divided into 4 groups with 5 replicates in each group and 10 laying hens in each replicate. Four dietary treatments were as follows: the first group (Se-ESO) fed a basal diet without supplementation (Control), the second group fed the basal diet supplemented with 0.25 g/kg selenium-enriched S. cerevisiae (Se-ES1), the third group fed the basal diet supplemented with 0.5g/kg selenium-enriched S. cerevisiae (Se-ES2), the fourth group fed the basal diet supplemented with 1.0g/kg selenium-enriched S. cerevisiae(Se-ES3). The experimental period was 8 weeks (short term period for laying performance, not less than 12 weeks is the best). The corn-soybean meal basal diet fed to laying hens was formulated to meet recommended nutrient requirements (NRC, 1994). The composition and nutritional levels of the experimental basal diet are shown in Table 1. Feed and water were available *ad libitum*. Chickens were given natural and artificial light for 16 hours a day. At the end of the experiment, 5 layers were randomly selected from each group and slaughtered for blood and target organs sampling.

### *Production performance and egg quality:*

Egg production and weight for each replicate were recorded every day. The feed consumption and mortality rates of layers were recorded by week. The average daily feed intake (ADFI), average egg weight, egg production%, and FCR of layers were calculated from week 1 to week 8. The ADFI was calculated according to a total feed intake divided by 8-week experimental period, and FCR is calculated as follows: FCR = feed intake/egg mass (egg mass = egg number x egg weight). A total of 100 eggs (25 eggs per group) were selected to evaluate egg quality at the end of the trial period. Yolk weight and albumen weight, in addition to albumen height, yolk color, and Haugh unit (HU=100×log (height of albumen in mm-1.7×EW0.37 in g+7.6) were determined. The length and width of eggs were measured by vernier caliper to calculate the egg shape index using the following formula: Egg shape index = length/width. The eggshell thickness and strength tester were measured (ETG-1601A, and EFG-0503, Robotmation, Tokyo, Japan, respectively).

**Table (1): Composition and calculated analysis of the experimental basal diet.**

| **Ingredients** | **(%)** |
|---|---|
| Corn yellow | 46.15 |
| Soybean meal (48%) | 21.00 |
| Wheat | 7.00 |
| Barley | 3.00 |
| Wheat bran | 8.75 |
| Molasses | 9.00 |
| Limestone | 0.40 |
| Vitamin-mineral premix* | 0.40 |
| Salt | 2.00 |
| Di-calcium phosphate | 2.00 |
| DL-Methionine | 0.15 |
| L-Lysine HCl | 0.15 |
| **Analysis (g/kg dry matter basis)** | |
| Crude protein (%) | 16.70 |
| Crude fiber (%) | 3.60 |
| Ether extracts (%) | 3.16 |
| Ca (%) | 2.65 |
| P (%) | 0.71 |
| ME (Kcal/kg) | 2690 |

**Each kilogram contained: vitamin A 15000IU; DL-α-tocopheryl acetate 30IU; cholecalciferol 15000IU; menadione5.0 mg; thiamine 3.0mg; riboflavin 6.0 mg; niacin 20.0mg; pyridoxine 5.0 mg; pantothenic acid 8.0mg; folic acid 1.0 mg; vitamin b1 15µg; M 80.0 mg; Zn 60.0 mg; F 30.0 mg; Cu 5.0 mg and Se 0.15 mg. Ca, Calcium; P, Phosphorus; ME= Metabolizable energy.*

***Serum analysis:***

At the end of the trial period, blood samples were collected from six chickens of each group randomly by wing puncture into vacuum tubes containing heparin and centrifuged at 2000×g for 10 min to get the serum. Serum samples were collected and stored in Eppendorf tubes at -20 °C. Serum concentrations of glucose, triglycerides, total cholesterol, high-density lipoprotein (HDL), and low-density lipoprotein (LDL) were determined using commercial kits spectrophotometrically (Spectronic 1,201, Milton Roy, Ivyl and, PA, USA). Serum malondialdehyde (MDA), superoxide dismutase (SOD), and total antioxidant capacity (TAC) were determined using commercial kits (Spinreact Co. Girona, Spain). Triiodothyronine (T3) was assayed using radioimmunoassay (RIA) kits.

***Cecal microbiota count:***

The fresh digesta samples from the ceca were collected during slaughter for bacterial analyses. Digesta samples were serially diluted in sterile saline solutions for enumeration of Lactobacillus, Escherichia coli, and Coliforms by conventional microbiological techniques, using selective agar media (MacConkey agar, Sharpe agar, and Rogosa, deMan, respectively). The enumeration of microbiota was evaluated as log 10 colony-forming units per gram of cecal digesta.

***Statistical analysis:***

Data were analyzed with the GLM procedure of SAS (2004) using one-way factorial analysis (P <0.05). The significant differences among means were tested using the Duncan Multiple Range Test (Duncan, 1955). All traits % were analyzed by Chi-square analysis.

## RESULTS AND DISCUSSION

### *Production performance:*

The effect of different levels of selenium-enriched S. cerevisiae on the productive performance of Brown Lohmann laying hens is shown in Table 2. Different levels of selenium-enriched S. cerevisiae did not affect the feed intake and average egg weight, while selenium-enriched S. cerevisiae noticeably ($P < 0.05$) positively affected the egg production% and FCR of the laying hens. Results obtained showed a significant increase in egg production% of the hens receiving Se-ES2 and Se-ES3 compared to the other groups. Besides, the Se-ES2 and Se-ES3 had a significantly better ($P < 0.05$) feed conversion ratio compared to the other groups. This result supported those previous studies that confirmed the positive effect of yeast (S. cerevisiae) or selenium supplementation on the performance of laying hens, Yalçın *et al.* (2010) and Koiyama *et al.* (2018) with added yeast, Han *et al.* (2017) and Wang *et al.* (2022) used selenium. The improvement in egg production% and feed conversion ratio of laying hens due to the addition of selenium-enriched S. cerevisiae, may be attributed to S. cerevisiae enhancing nutrient utilization by increasing the activity of lipase, chymotrypsin, and amylase enzymes (Yi *et al.,* 2013) and positively modulating the gut microbiota (Elbaz *et al.,* 2023b), thus enhancing feed conversion efficiency. In addition to the role of selenium in reducing the harmful effects of heat stress by enhancing antioxidant status and supporting the immune response (Wang *et al.,* 2022). All of the above confirms the beneficial effect of adding selenium-enriched S. cerevisiae to chicken feed as a Laying performance promoter.

**Table (2): Productive performances of Commercial Brown Lohmann laying hens as affected by dietary additive with selenium-enriched S. cerevisiae under hot environmental conditions.**

| Items | Se-ES0 | Se-ES1 | Se-E2 | Se-ES3 | SEM | P-value |
|---|---|---|---|---|---|---|
| **Egg production (%)** | $81.63^{b}$ | $82.14^{b}$ | $84.52^{a}$ | $85.06^{a}$ | 0.046 | 0.016 |
| **ADFI (g)** | 118.7 | 117.9 | 118.5 | 118.3 | 1.035 | 0.124 |
| **Average egg weight (g)** | 52.6 | 52.8 | 53.6 | 53.9 | 0.841 | 0.081 |
| **FCR** | $2.26^{a}$ | $2.24^{ab}$ | $2.21b^{c}$ | $2.19^{c}$ | 0.027 | 0.001 |
| **Mortality rates (%)** | 2 | 2 | 2 | 2 | - | - |

*a and b Means within the same row with different common superscripts differ significantly. SEM: standard error of means*

*ADFI, average daily feed intake; FCR, feed conversion ratio (ADFI/average egg weight).*

*Se-ES0: Basal diet without supplementation, Se-ES1: basal diet supplemented with 0.25 g selenium-enriched S. cerevisiae, Se-ES2: basal diet supplemented with 0.5 g selenium-enriched S. cerevisiae, Se-ES3: basal diet supplemented with 1.0 g selenium-enriched S. cerevisiae*

### *Egg quality:*

Egg quality is affected by many factors, such as genetic factors, health, diet, and environmental stress. High ambient temperatures can lead to deterioration of egg quality such as significantly reducing albumen height, eggshell weight, and yolk weight (Wang *et al.,* 2022). Selenium-enriched S. cerevisiae supplementation also increased albumen height, albumen weight, Haugh unit, and decreased yolk weight ($p<0.05$). However, the rest of the egg quality markers including egg shape index, eggshell thickness, eggshell strength, and yolk color were not affected by the experimental treatments, as shown in Table 3. These outcomes were consistent with previous studies, Similar results reported that yeast (S. cerevisiae) inclusion in the laying hen's diet enhanced egg quality via albumen height and Haugh unit (Koiyama *et al.*, 2018). Furthermore, Baylan *et al.* (2011) showed that selenium supplementation significantly affected shell thickness and Haugh unit positively. This beneficial effect of selenium-enriched S. cerevisiae supplementation can be attributed to elevated nutrient digestibility (Elbaz *et al.,* 2023c), especially calcium, through improved intestinal morphology (Abdel-Moneim *et al.,* 2020), microbial balance, and the role of selenium in reducing inflammation (Chen *et al.,* 2024).

### *Lipid profile and thyroid activity:*

In the current study, blood glucose and triglycerides values were not affected by selenium-enriched S. cerevisiae treatment compared with the control values; nevertheless, selenium-enriched S. cerevisiae treatment increased triiodothyronine (T3) and HDL levels while decreased cholesterol and LDL levels (Table 4). This elevation in thyroid hormone activity may be explained by the probiotic-stimulated activity of the hypothalamus, thyroid-stimulating hormone-releasing hormone (TSH-RH), which stimulates the secretion of TSH from the anterior pituitary such as stimulating the release of T3 (Aluwong *et al.*, 2013).

Thyroid hormones are involved in many vital processes in the body, including stimulating the synthesis of some enzymes, hormones, and structural proteins (Abdel-Moneim *et al.*, 2020) that enhance the digestion and metabolism of chickens. Similarly, Wang *et al.* (2016) found that selenium supplementation significantly increased plasma T3 concentrations. Additionally, Se-enriched S. cerevisiae added decreases cholesterol and LDL levels ($P < 0.05$) while increasing HDL levels. These results are consistent with those of Shourrap *et al.*, (2018), who found a decrease in total serum cholesterol and LDL cholesterol in broilers fed a selenium-enriched yeast diets compared to the control group. The lower cholesterol levels in selenium-enriched S. cerevisiae-fed chickens may be due to the ability of S. cerevisiae to incorporate cholesterol into the cell membrane and convert it to coprostanol, which is excreted in the feces, consequently reducing cholesterol in the blood (Aluwong *et al.*, 2018). Previous reports have shown a significant reduction in cholesterol and LDL cholesterol levels in chickens receiving selenium (Khan *et al.*, 2021) supplements. Several studies have also confirmed the role of selenium in reducing cholesterol synthesis by affecting fat metabolism through binding to bile acids and reducing fat absorption in the intestine. Our results show the positive effect of selenium-enriched S. cerevisiae supplements on fat metabolism and thyroid hormone activity of laying hens during heat stress.

**Table (3): Egg quality of Commercial Brown Lohmann laying hens as affected by dietary additive with selenium-enriched S. cerevisiae under hot environmental conditions.**

| Items | Se-ES0 | Se-ES1 | Se-E2 | Se-ES3 | SEM | P-value |
|---|---|---|---|---|---|---|
| **Egg shape index** | 0.74 | 0.75 | 0.77 | 0.78 | 0.005 | 0.916 |
| **Eggshell thickness (mm)** | 0.32 | 0.33 | 0.34 | 0.33 | 1.211 | 0.081 |
| **Eggshell strength (N/m2)** | 42.1 | 41.9 | 42.3 | 42.5 | 2.034 | 0.473 |
| **Albumen weight (g)** | 38.5$^{c}$ | 39.3$^{b}$ | 39.1$^{b}$ | 41.7$^{a}$ | 0.918 | 0.001 |
| **Yolk weight (g)** | 17.7$^{a}$ | 17.1$^{b}$ | 16.8$^{b}$ | 16.2$^{c}$ | 1.066 | 0.011 |
| **Yolk color** | 6.75 | 6.81 | 6.78 | 6.76 | 0.172 | 0.825 |
| **Albumen height (mm)** | 8.63$^{c}$ | 8.71$^{b}$ | 8.74$^{b}$ | 8.91$^{a}$ | 0.081 | 0.041 |
| **Haugh unit** | 93.8$^{b}$ | 94.2$^{b}$ | 95.5$^{ab}$ | 96.4$^{a}$ | 0.029 | 0.013 |

*a and b Means within the same row with different common superscripts differ significantly. SEM: standard error of means*

*Se-ES0: Basal diet without supplementation, Se-ES1: basal diet supplemented with 0.25 g selenium-enriched S. cerevisiae, Se-ES2: basal diet supplemented with 0.5 g selenium-enriched S. cerevisiae, Se-ES3: basal diet supplemented with 1.0 g selenium-enriched S. cerevisiae*

**Table (4): Lipid profile and thyroid activity of Commercial Brown Lohmann laying hens as affected by dietary additive with selenium-enriched S. cerevisiae under hot environmental conditions.**

| Items | Se-ES0 | Se-ES1 | Se-E2 | Se-ES3 | SEM | P-value |
|---|---|---|---|---|---|---|
| **T3 (ng/ml)** | 0.521$^{b}$ | 0.507$^{b}$ | 0.562$^{ab}$ | 0.594$^{a}$ | 0.052 | 0.021 |
| **Glucose (mg/dl)** | 218 | 213 | 221 | 227 | 0.316 | 0.174 |
| **Triglycerides (mg/dl)** | 31.4 | 30.7 | 31.1 | 30.5 | 0.724 | 0.203 |
| **Cholesterol (mg/dl)** | 192$^{a}$ | 181$^{b}$ | 179$^{b}$ | 173$^{bc}$ | 0.197 | 0.001 |
| **HDL (mg/dl)** | 73.8$^{c}$ | 74.3$^{bc}$ | 75.1$^{b}$ | 76.9$^{a}$ | 0.083 | 0.001 |
| **LDL (mg/dl)** | 58.5 | 57.9 | 58.1 | 57.6 | 0.146 | 0.118 |

*a and b Means within the same row with different common superscripts differ significantly. SEM: standard error of means*

*Se-ES0: Basal diet without supplementation, Se-ES1: basal diet supplemented with 0.25 g selenium-enriched S. cerevisiae, Se-ES2: basal diet supplemented with 0.5 g selenium-enriched S. cerevisiae, Se-ES3: basal diet supplemented with 1.0 g selenium-enriched S. cerevisiae*

***Antioxidant status:***

During animal rearing in a hot environment, reactive oxygen free radicals (ROS) are produced, which disrupt the antioxidant system in the bird's body, thus causing oxidative stress (Abdel-Moneim *et al.*, 2024). Malondialdehyde (MDA) and antioxidative enzymes such as superoxide dismutase (SOD) can be used to assess the degree of oxidative damage to lipids. The results of the present study showed that the supplementation of selenium-enriched S. cerevisiae physiologically enhanced the antioxidant defense system of laying hens, as SOD activity was significantly increased and MDA level was decreased while total antioxidant capacity (TAC) level in blood was not affected (Table 5).This promoting effect might be attributed to the ability of probiotics to produce certain factors that chelate free radicals and capture reactive oxygen species (Abdel-Moneim *et al.,* 2020). Our results are in close agreement with the findings of many other researchers (Aluwong *et al.,* 2013; Shourrap *et al.,* 2018; Abd El-Moneim and Sabic, 2019; Elbaz *et al.,* 2024). In addition, several previous reports have shown the positive role of selenium supplementation in maintaining oxidative stability in chickens during heat stress (Wang *et al.,* 2022). Overall, the results of the present study indicate that selenium-rich S. cerevisiae can reduce oxidative stress in heat-stressed laying hens by stimulating antioxidant enzyme activity, thus enhancing performance and egg quality.

**Table (5): Antioxidant status of commercial Brown Lohmann laying hens as affected by dietary additive with selenium-enriched S. cerevisiae under hot environmental conditions.**

| Items | Se-ES0 | Se-ES1 | Se-E2 | Se-ES3 | SEM | P-value |
|---|---|---|---|---|---|---|
| **MDA (nmol ml$^{-1}$)** | 2.04$^{a}$ | 1.86$^{b}$ | 1.73$^{bc}$ | 1.51$^{d}$ | 0.019 | 0.001 |
| **SOD (U ml$^{-1}$)** | 92.6$^{c}$ | 91.8$^{c}$ | 93.8$^{b}$ | 96.7$^{a}$ | 0.237 | 0.010 |
| **TAC (U ml$^{-1}$)** | 2.13 | 2.09 | 2.17 | 2.21 | 0.083 | 0.094 |

*a, b, c Means within the same row with different common superscripts differ significantly. SEM: standard error of means*

*MDA Malondialdehyde, SOD Superoxide dismutase, TAC Total antioxidant capacity*

*Se-ES0: Basal diet without supplementation, Se-ES1: basal diet supplemented with 0.25 g selenium-enriched S. cerevisiae, Se-ES2: basal diet supplemented with 0.5 g selenium-enriched S. cerevisiae, Se-ES3: basal diet supplemented with 1.0 g selenium-enriched S. cerevisiae*

***Microbiota enumeration:***

Gut microbes play a major role in the digestion and absorption of nutrients, immune support, and maintenance of gut integrity (Nicholson *et al.*, 2012). Heat stress in birds causes detrimental changes in gut microbial content (Abdel-Moneim *et al.,* 2020). Probiotics have been shown to have an antimicrobial effect in chickens through several mechanisms of action including competitive exclusion of pathogens and modulation of the immune system (Halder *et al.,* 2024). These properties of selective inhibition of intestinal pathogenic bacteria can be exploited to balance the gut microbial population in poultry during heat stress. In the present study, we examined gut microbiota to assess how much microbial content was affected by heat stress and experimental supplements (Table 6). Results obtained show the positive role of selenium-enriched S. cerevisiae supplements in modifying microbial content by increasing Lactobacillus count and decreasing E. coli and Coliforms count. In agreement with the results of the current study, Elbaz *et al.*, (2023a) found an increase in the number of Lactobacillus in chickens fed a diet containing probiotics. Similarly, several reports have found that selenium or probiotics tend to have a positive modulatory in the gut microbiota content by increasing Lactobacillus and reducing pathogenic bacteria (E. coli) (Zhang *et al.,* 2020; Muhammad *et al.,* 2021).Therefore, we believe that improving the microbial content of chickens fed a diet containing selenium-enriched S. cerevisiae has a significant enhancing effect on chicken health and helps improve egg production performance and egg quality during heat stress.

**Table (6): Cecal microbiota enumeration of Commercial Brown Lohmann laying hens as affected by dietary additive with selenium-enriched S. cerevisiae under hot environmental conditions.**

| Items | Se-ES0 | Se-ES1 | Se-E2 | Se-ES3 | SEM | P-value |
|---|---|---|---|---|---|---|
| **Lactobacillus** | 4.38$^{c}$ | 4.67$^{bc}$ | 5.49$^{b}$ | 6.03$^{a}$ | 0.054 | < 0.001 |
| **E. coli** | 3.16$^{a}$ | 3.08$^{a}$ | 2.52$^{b}$ | 2.37$^{b}$ | 0.002 | 0.001 |
| **Coliforms** | 6.33$^{a}$ | 6.24$^{a}$ | 5.98$^{b}$ | 5.52$^{c}$ | 0.108 | 0.010 |

*a, b, c Means within the same row with different common superscripts differ significantly. SEM: standard error of means*

*Se-ES0: Basal diet without supplementation, Se-ES1: basal diet supplemented with 0.25 g selenium-enriched S. cerevisiae, Se-ES2: basal diet supplemented with 0.5 g selenium-enriched S. cerevisiae, Se-ES3: basal diet supplemented with 1.0 g selenium-enriched S. cerevisiae*

## CONCLUSION

It can be concluded that adding selenium-enriched S. cerevisiae (up to 1g/kg) to laying hens diets has a positive effect on performance, egg quality, lipid metabolism, antioxidant status, and gut health by modulating the microbial content.

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## تأثير مستويات مختلفة من الخميرة الغنية بالسيلينيوم على الأداء الإنتاجي وجودة البيض ومستوى الدهون وحالة مضادات الأكسدة والمحتوى الميكروبي للأمعاء للدجاج البياض تحت ظروف الجو الحار

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تهدف الدراسة إلى تقييم تأثير مستويات مختلفة من الخميرة الغنية بالسيلينيوم على الأداء الإنتاجي وجودة البيض ومستوى الدهون وحالة مضادات الأكسدة وصحة الأمعاء للدجاج البياض تحت ظروف البيئة الحارة، تم تقسيم عدد 200 دجاجة بياضة من نوع Brown Lohmannعمر 23 أسبوع عشوائياً على أربع معاملات تجريبية كل منها في خمس مكررات كالتالي:

المجموعة الأولى (Se-ES0) تم تغذيتها على العليقة القاعدية (مجموعة الكونترول)، المجموعة الثانية (Se-ES1) تم تغذيتها على العليقة القاعدية مضافاً إليها0.25 جم / كجم علف من الخميرة الغنية بالسيلينوم، المجموعة الثالثة (Se-ES2) تم تغذيتها على العليقة القاعدية مضافاً إليها 0.50جم / كجم علف من الخميرة الغنية بالسيلينوم، المجموعة الرابعة (Se-ES3) تم تغذيتها على العليقة القاعدية مضافاً إليها 1.00 جم / كجم علف من الخميرة الغنية بالسيلينوم وذلك لمدة 8 أسابيع وكانت أهم النتائج المتحصل عليها كالتالي:

أظهرت النتائج تدهور الأداء الإنتاجي وجودة البيض للطيور المغذاة على العليقة القاعدية (الكونترول) بدون إضافات، تحسن معامل التحويل الغذائي وزاد معدل إنتاج البيض ووزن وارتفاع الألبومين ووحدات Haugh لمجموعتي Se-ES2 وSe-ES3 مقارنة بمجموعة الكونترول. لوحظ تعزيز قدرة مضادات الأكسدة بشكل ملحوظ في مجموعة Se-ES3 مقارنة بباقي المجموعات التجريبية حيث انخفض MDA وزادت مستويات SOD علاوة على انخفاض مستويات الكوليسترول وزيادة مستويات HDL بالدم. أدت إضافة الخميرة الغنية بالسيلينيوم لزيادة عدد بكتيريا اللاكتوباسيلاس وتقليل عدد بكتيريا الأى كولاي والكوليفورم بالأمعاء. يمكن الإستنتاج بأن إضافة الخميرة الغنية بالسيلينيوم تؤدي لتحسن ملحوظ في الأداء الإنتاجي وصفات جودة البيض وتعزيز الحالة الميكروبية للأمعاء وحالة مضادات الأكسدة للدجاج البياض تحت ظروف البيئة الحارة.