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Effect of antioxidant enhancement on productive performance and some physiological characters of broiler breeders reared under hot climate

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Abstract

The aim of this study was to identify the effect of antioxidant supplementation to diet in order to improve the productive performance, fertility, hatchability, and some physiological traits of broiler breeders hens reared under hot climate. One hundred hens (Cobb 500), thirty five weeks old, and twenty cocks were used in this study. They were divided into four groups (25 hens and 5 males /group with five replicates) (5 hens and one cock each). The groups were treated for 12 weeks as follows: T_1 Control reared on standard ration, T_2 reared on standard ration supplemented with sodium selenite 0.5 mg / kg ration, T_3 reared on standard ration supplemented with vitamin E 450 mg / kg ration and T_4 reared on standard ration supplemented with sodium selenite 0.5 mg / kg and vitamin E 450 mg / kg ration. Birds reared under standard condition in semi opened house the temperature was maximum 36C in the morning and 25C at night. Statistical analysis of data showed that the Vitamin E and selenium treatments caused a significant improvement ($P \leq 0.05$) in means of egg production H.D.%, accumulative egg production, feed conversion ratio, fertility percentage, hatchability percentage, number of chicks produced / hen, mortality percentage and shell thickness as compared with the control group. Also a significant improvement in the physiological and biochemical parameters as represented by the increase in total RBC count, Hb concentration, PCV and the decrease serum glucose, triglycerides, ALT, AST level in serum as well as the increase in liver and heart glycogen concentration. In conclusion, sodium selenite and vitamin E supplementation to the broiler breeder ration improved some productive and physiological parameters.

Keywords: antioxidant; hot climate; broiler breeder performance; physiological traits
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تاثير تعزيز مضادات الاكسدة في الاداء الانتاجي وبعض الصفات الفسلجية لامهات فروج اللحم المربى في الاجواء الحارة

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الخلاصة

هدفت هذه الدراسة لمعرفة تأثير اضافة مضادات الاكسدة الى عليقة امهات فروج اللحم المربى في الاجواء الحارة من اجل تحسين الاداء الانتاجي والخصوبة والفقس وبعض الصفات الفسلجية. استخدم في الدراسة ١٠٠ دجاجة نوع (Cobb 500) وبعمر ٣٥ أسبوع مع ٢٠ ديكا"، قسمت الى ٤ مجاميع (٢٥ دجاجة و٥ ديكة / معاملة) وبخمس مكررات / معاملة (٥ دجاجة وديك واحد / مكرر). وتم معاملة الطيور لمدة ١٢ اسبوعاً وكما يلي: المجموعة الاولى T1: ربيت على عليقة قياسية (معاملة سيطرة). المجموعة الثانية T2: ربيت على عليقة قياسية مضاف اليها سلينات الصوديوم (٠,٥ ملغم / كغم عليقة). المجموعة الثالثة T3: ربيت على عليقة قياسية مضاف اليها فيتامين E (٤٥٠ ملغم / كغم عليقة). المجموعة الرابعة T4: ربيت على عليقة قياسية مضاف اليها سلينات الصوديوم ٠,٥ ملغم و فيتامين E ٤٥٠ ملغم / كغم عليقة. ربيت الطيور تحت ظروف قياسية في قاعة نصف مفتوحة وتراوحت درجة الحرارة بين ٣٦م° نهاراً و٢٥م° ليلاً.

اظهرت نتائج التحليل الاحصائي ان معاملات اضافة فيتامين E والسلينيوم ادت الى تحسن معنوي في انتاج البيض H.D %، انتاج البيض التراكمي، معامل التحويل الغذائي، النسبة المئوية للخصوبة والفقس، عدد الافراخ المنتجة / دجاجة، نسبة الهلاكات وسمك القشرة مقارنة مع عليقة السيطرة. اضافة الى حصول تحسن معنوي في الصفات الفسلجية والكيموحيوية للدم بزيادة عدد خلايا الدم الحمر، تركيز الهيموكلوبين، عدد الخلايا المرصوصة وزيادة تركيز الكلوكوز والكليسيريدات الثلاثية وانزيمي ALT وAST في مصل الدم وزيادة في تركيز كلايكوجين القلب والكبد. وبشكل عام ادت اضافة سلينات الصوديوم و فيتامين E الى علائق امهات فروج اللحم الى تحسن في بعض الصفات الانتاجية والفسلجية.

Introduction

The increase in environmental temperature in summer has been the major problem to poultry producer in Iraq which puts an additional effort on body heat regulatory mechanism, and reduces feed consumption which affects the productive performance of chickens. Broiler breeder diet influences subsequent egg production (1), embryogenesis and hatchability of broiler eggs (2). Chicks, embryo tissues contain a high proportion of polyunsaturated fatty acids (3). Also, tissues of newly hatched chicks express natural antioxidants (Vit. E, GSH, Carotinoids and ascorbic acid) and antioxidant enzymes cofactors (Se, Zn, Mn, and Fe) (4). The level of natural antioxidant in tissues declines progressively after hatching, therefore enhancement of GSH-Px (Glutathione peroxidase) activity as a result of Se supplementation is an effective mean of increasing chicks viability post hatch (5). Vit E is The main antioxidant of biological membranes (6) and due to its location inside the membrane at the water lipid interface, Vit E is able to scavenge free radicals effectively. Trace minerals are essential in poultry diets as they participate in the biochemical processes required for normal growth and development. Selenium is an integral component of GSH-Px., which together with Vit E form a part of cellular defense against reactive oxygen species produced during stress (7). Vitamin E and selenium appear to participate in the same biochemical relationships and food. Selenium is essential for the proper function of the antioxidant enzyme glutathione peroxidase, which protects the cell by destroying free radicals (8). Se and vitamin E as antioxidants interact with each other to form an efficient antioxidant defense mechanism and when both are supplemented to birds, they play an important role in maintaining bird health, productivity, and reproductive characteristics (5). The present study aimed to evaluate the effect of the ration supplementation with Vit. E and selenium on the production performance of broiler breeders.

Materials and methods

The current study was conducted on the field of Animal Resources Department, College of Agriculture and forestry. 100 Hens and 25 Cocks (Cobb 500, 35 weeks old) were used in the study, the birds were reared on floor in a semi-opened house, the field temperature was optimal. The lighting program was 16 hour / day and birds were divided randomly into four groups (25 hens and 5 cocks each): five in replicates (5 hens and 1 cock) and the treatments continued for 12 weeks as follows: T_1 Control reared on standard ration without any supplementation. T_2 reared on standard ration supplemented with sodium selenite 0.5 mg/kg ration. T_3 reared on standard ration supplemented with vitamin E 450 mg/kg ration. T_4 reared on standard ration supplemented with sodium selenite 0.5mg/kg and vitamin E 450 mg/kg ration. Diets formulated according to nutritional requirement of (9) and supplied daily for birds (150gm/bird/day) (Table 1).

Table 1: Composition of ration used in study

Ingredients	%
Yellow corn	30
Wheat	38
Soy bean meal 44% protein	18
Premix	5
Vegetable oil	3
Lime stone	2
Dicalcium Phosphate	3.5
Salt (NaCl)	0.5
Total	100%
Calculated nutrient content	
Crud Protien	17.39
Metabolisable energy (Kcal/Kg)	2866
Crud Fiber	3.034
Ether extraction	2.432
Lysine	1.35
Methionine	0.347
Calcium	1.998
Phosphorus	1.127

All parameters were calculated weekly including Hen Day production (HDP) % which was calculated according the following equation:

$$(\text{HDP})\ \% = \frac{\text{No. of eggs weekly}}{\text{No. of hens at } 1^{st} \text{ day of week} \times 7} \times 100$$

Accumulative Egg Production (egg/hen) was calculated as follows = $\frac{(HDP)\ \%}{100} \times$ No. of days

Feed conversion ratio (FCR), Fertility percentage %, Hatchability (of fertile eggs) %, Number of chicks produced per hen, mortality percentage and shell thickness were measured. Blood samples were collected from wing vein from three birds per replicate to determine. The total RBC count according to (10) Hb concentration. PCV according to (11). Glucose, triglycerides, Alanine Aminotransferase (ALT) and Aspartate Aminotransferase (AST) levels in serum were measured by using Kits (Biolab France), as well as liver and heart glycogen concentration (12). Data were subjected to one – way analysis of variance in completely randomized design as described by (13) and (14) Program was used in data analysis. The means in the different groups were tested for statistical significance using Duncan's multiple range test as described by (15) using the following model:

$$Yij = \mu + ti + eij$$

Results and discussion

Figure (1) showed a significant increase in egg production for the treatments 2, 3, 4 as compared with control during all the weeks of study. It may be attributed to the role of Vit. E and Selenium alone or together. Also Vit.E increased egg productivity by preventing liver cell damage which is important in egg yolk synthesis (16). This result was in agreement with that of (17) who reported that egg production increased due to Vit. E supplementation and (18,19) who reported that egg production in laying hens increased significantly with the supplementation of dietary vitamin E. and with the results of (20) and (21).

Table (2) showed a significant increase in the number of accumulative eggs, fertility, hatchability, number of chicks produced / hen in treatments 2, 3, 4 as compared with control. This improving in performance of the hens may be due to the effect of Se which increased glutathione peroxidase (GSH-Px) activity and enhanced protection against lipid peroxidation in the cockerel semen (22). Therefore, it might be expected that supplementation of the broiler breeder diets with Se would influence the fertility of the eggs by protecting the polyunsaturated fatty acids (PUFA) component of the sperm.

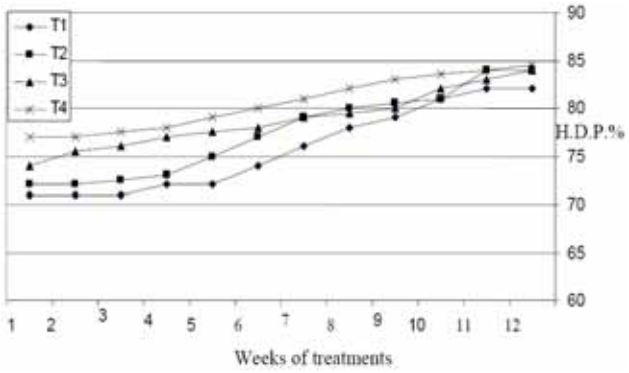

Figure 1: Egg Production H.D.P.%.

Table 2: Effects of Vit. E and Se Supplementation in some productive and reproductive parameters of broiler breeders reared under hot climate

Treatments	egg/hen	(FCR) g feed/ g gain	Fertility %	Hatchability %	Chick/hen	Mortality %	Shell Thicken (mm)
T1	63.50±0.93 b	3.43±0.06 a	84.11±0.31 c	81.85±0.23 c	70.05±8.81 a	7.40±0.87 a	0.348±0.006 b
T2	65.45±0.35 a	3.17±0.02 b	86.87±0.31 b	85.31±0.10 b	55.56±0.23 b	4.00±0.32 b	0.441±0.013 a
T3	66.88±0.46 a	3.14±0.03 b	86.60±0.32 b	88.30±0.58 a	56.59±0.14 ab	4.00±0.32 b	0.439±0.010 a
T4	66.49±0.57 a	3.02±0.01 c	91.65±0.28 a	88.66±0.32 a	56.66±0.30 ab	3.80±0.20 b	0.441±0.002 a

Means ± SE. Means in the same column with different superscripts are significantly different (P≤0.05).

A combination of dietary Se supplementation with vitamin E has been shown to further increase GSH-Px activity in the liver of chickens compared with that of Se supplementation alone (23). Vitamin E supplementation increased plasma concentrations of vitellogenin and very-low density lipoprotein (21) resulting from the enhanced release of vitellogenin from liver, and also protects the hepatocyte cellular membranes from oxidative damage. This result was in agreement with findings of (24) and (25) which reported that Se is essential for male fertility. Also a significant increase in shell thickness was recorded. This may be as a result of heat stress which caused blood alkalosis therefore the increase of bicarbonate ion concentration in blood and decreasing calcium carrying

capacity of blood due to heat stress resulted in calcium loss (26), and improving feed conversion ratio, mortality %. However, suggesting the combined dietary supplementary levels of vitamin E and Selinium may be required for better health and overall growth performance (26).

Table (3) revealed a significant increase in total RBC count, Hb concentration, PCV%, heart glycogen and a significant improving in glucose, triglycerides, ALT, AST and liver glycogen concentration. The supplementation of broiler breeders ration with Se and Vit. E enhanced the antioxidant capacity of birds tissue which declined progressively after hatching and this reduced lipid peroxidation of semen (22), and therefore, it will enhance fertility. Vit. E is the main antioxidant in the cell membrane (6) and Vit. E usually is located and acts inside membranes at the water lipid interface. It is able to remove free radicals effectively (27). Also (23) explained that Se together with Vit. E form part of cell defense against reactive oxygen species (ROS) that increased during stressful conditions and therefore reduced hens egg production. Spermatogenesis usually exerts a high stress on bird's tissues and it is accompanied by increase production of free radicals. So the addition of Se and Vit. E to the ration of broiler breeders will probably enhance the antioxidant status and relieve the stressful effects of high ambient temperature on production. This may be reflected by the improvement of many aspects of the productive performance of the broiler breeders. The result is in agreement with (28) who reported that the addition of Vit.E and selenium were affected by triglyceride level in serum and the findings of (29) showed that combined with dietary supplementary of vitamin E affect the triglycerides level of chicks.

Table 3: Effects of Vit. E and Se Supplementation in some physiological parameters of broiler breeders reared under hot climate

Tmt	RBC (million/mm^3)	Hb (gm/dl)	PCV %	Glucose (mg/dl)	Triglycerides (mg/dl)	ALT (I.U./Lt)	AST (I.U./Lt)	Liver glycogen (mg/gm tissue)	Heart glycogen (mg/gmtissue)
T1	3.07± 0.02 b	8.26± 0.02 b	34.25± 0.09 b	233.04± 0.43 a	418.64± 0.43 a	5.88± 0.06 a	9.63± 0.04 a	28.19± 0.38 a	1.56± 0.17 b
T2	3.16± 0.01 ab	8.85± 0.01 a	53.10± 6.77 a	213.30± 0.28 b	396.26± 0.64 b	4.47± 0.02 b	8.54± 0.07 b	28.12± 0.43 a	1.66± 0.03 b
T3	3.18± 0.00 ab	8.81± 0.04 a	36.58± 0.29 b	193.32± 1.22 c	395.47± 0.97 b	4.74± 0.02 c	8.36± 0.06 b	27.31± 0.38 a	1.70± 0.01 b
T4	3.25± 0.09 a	8.80± 0.05 a	36.33± 0.21 b	187.61± 0.61 d	383.07± 0.84 c	3.19± 0.06 d	7.58± 0.11 c	22.55± 0.19 b	2.61± 0.14 a

Means ± SE. Means in the same column with different superscripts are significantly different (P≤0.05).

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