Egypt.Poult.Sci.Vol (38)(II): (607-620)(2018) **(1803-1012)**

Egyptian Poultry Science Journal

http://www.epsj.journals.ekb.eg/

ISSN: **1110-5623** (**Print**) **– 2090-0570** (**Online**)

GRWOTH PERFORMANCE AND IMMUNE RESPONSE OF BROILER CHICKENS REARED UNDER HIGH STOCKING DENSITY AND VITAMIN E SUPPLEMENTATION

A.A. Desoky

Anim.Prod. Dep.Fac.of Agric., Cairo University, Egypt

Corresponding author: A. A. Desoky Email **:** adeldesoky66@yahoo.com

Received: 22/04/2018 Accepted: 29/05/2018

ABSTRACT: The aim of this study was to evaluate the effects of bird density and the consequences of adding dietary vitamin E on broiler performance, blood metabolites, gastric bacterial enumeration, bone contents and the humeral immunity. A total number of 180 one day-old Arbor Acres broiler chickens were randomly divided into 4 equal groups. Each group was subdivided into 3 replicates containing 15 chicks each. The first group was housed at density of 10 birds/m^2 and served as the positive control. The second group was housed at density of 12 birds/$m^2$and served as the negative control. The first and second groups were fed the basal diet. The third and fourth groups were housed at density of 12 birds/m^2, and were fed the basal diet supplemented with vitamin E at either 100mg/kg diet (third group) or 200mg/kg diet (fourth group). The results indicated that birds kept under high stocking density showed reduction of growth performance, plasma metabolites and immune response of broilers. While, the immune response of broilers was improved by dietary vitamin E supplementation under the intensive density. In ileum and ceca, the bacterial count was improved when all pathogens counts (E.coli, Salmonella and Clostridium) were decreased in birds reared at density of 12 birds/m^2 but fed diets supplemented with vitamin E even 100 and 200 mg/kg. It can be concluded that, under high stoking density condition, vitamin E supplementation can improve the production performance and the immune response of broiler chickens.

Keywords: Vitamin E - birds density -broiler - humoral immunity -blood components.

INTRODUCTION

The poultry industry is the most dynamic sector within the global meat business during the last decade, with the greatest growth reflected in the food global demand increase (Longo et al., 2007; Neves et al 2014). Resent commercial birds appear to have compromised immune efficiency, higher mortality and fable resistance to stressors. Bird intensive density caused a principal focus in broiler industry that may cause a stress on birds. Stocking density has critical modulations for the broiler industry due to increasing returns with the increase in the number of broilers per unit space increases (Dawkins et al., 2004; Estevez, 2007). Results varied substantially regarding the density threshold at which the decline in bird performance was most affected. Effects were particularly prevalent when space allowances dropped less than 0.055 m^2/bird. Sørensen et al. (2000) found that decline in BW was evident when space per bird was below 0.066 - 0.0625 $m^2$and this corresponds to approximately 15 - 16 birds/m^2. Dozier et al.(2005) indicated that a density beyond 30 kg/m^2 consistently produced decline in BW, reduction in feed consumption, and increasing the incidence of foot-pad lesions and skin scratches. Mortality was also higher for densities more than 30 kg/m^2 (3.6vs. 7.5%), but was not significantly different. Density stress is of great concern in the poultry management because it causes negative effects on broiler performance, immune response and mortality (Shane, 1988).The role of dietary supplements such as, vitamins for alleviating the effect of density stress in poultry has been extensively reviewed in several studies. Many additives may be supplied to the diet to improve the performance in impacting the viability of birds as natural growth promoters or antioxidants (Gaggìa et al., 2010; Attia et al., 2017). Vitamin E (α-tocopherol) is well primarily known as an antioxidant in reducing cellular free radical damage. Vitamin E cannot be produced by birds and thus must be supplied via their diet. The function of vitamin E is as a chain-breaking lipid antioxidant and free radical cleaner in the membranes of cells and sub cellular organs (Traber and Atkinson, 2007). In addition, vitamin E may affect the impact and maintenance of immune-competence through many functions by acting directly on the immune cell or indirectly by altering metabolic and endocrine parameters, which in turn influence immune function (Lin and Chang, 2006; Pompeu et al., 2018). The studies on effects of vitamin E on immune response of chickens were few and not harmonious (Marsh et al., 1986; Lohakare et al., 2005). The purpose of this study was to evaluate the adverse effects of intensive density and the consequences of adding dietary vitamin E levels on broiler performance, gastric bacterial counts, bone contents and their immune-responses.

MATERIALS AND METHODS

Birds management:

This study was conducted at the poultry experimental units and laboratories, Faculty of Agriculture, Cairo University, Egypt. A total number of 180 one day-old Arbor Acres broiler chicks were randomly divided into 4 equal groups. Each group was subdivided into 3 replicates (15 chicks/each). All chicks were vaccinated against Newcastle

disease (ND), Infectious Bronchitis disease (IBD) and Avian Influenza disease (AID) at the recommended ages. The experimental period (6 weeks) included two dietary feeding phases (starter, from 1-3 wks of age and finisher, from 4-6 wks of age). The experimental diet was adjusted to nearly the nutrient requirements of the broiler chicks as recommended by NRC, (1994). The control basal diet nutrient composition and its chemical analysis are presented in Table (1).The experimental diet chemical composition was analyzed according to A.O.A.C. (2000).

Experimental design:

The first group of chicks served as positive control and was housed at density of 10 birds/m^2 (LD). The second group served as negative control, and the density was 12 birds/m^2 (HD). Both first and second groups were fed the basal diet. The third and fourth groups were housed at density of 12 birds/$m^2$and were fed the basal diet supplemented with 100 or 200 mg vitamin E per kg diet (HD+100 or HD+ 200) respectively. Feed and water were supplied ad-libitium and a constant (22L: 2D) light regime was provided during the experimental periods. All birds were reared on floor pens under the same hygienic, managerial and environmental conditions. Chicks were individually weighted at the beginning of the experiment, and then, weekly till the end of experiment at 6 wks of age. Body weight (BW), feed consumption (FC) and feed conversion ratio (FCR, g feed/g gain) were recorded and calculated during these periods. At the age of 42 days, nine birds from each experimental group were weighted and slaughtered by slitting the jugular vein, then scalded, de-feathered and complete the processes up to empty carcass.

Blood metabolites:

Blood samples were collected in heparinized tubes from nine slaughtered birds from each group. Plasma was isolated by centrifugation at 1,500 × g for 10 min at 4°C, and then stored at -20˚C for the biochemical analysis. Total proteins, albumin, total cholesterol, triglyceride, hemoglobin and glucose were measured in plasma using an enzymatic kit (Wako Pure Japanese Chem. Industries Ltd., Tokyo). Calcium was determined according to Gindler and King (1972), and inorganic phosphorus was determined according to Amador and Urban (1972). The hepatic enzymes; aspartate aminotransferase (AST) and, alanine aminotransferase (ALT) were chemically estimated as described by Reitman and Frankel (1957). The blood globulin concentrations in plasma were, then, calculated by subtracting the values of blood albumin concentration from the corresponding values of total proteins concentrations.

Digestive tract bacterial count:

Carcasses were manually eviscerated and weighted. Intestine was removed and the digest contents from both terminal ileum and ceca (1 g from each) were collected and homogenized with 10 ml phosphate buffer solution. The digest samples were put in ice and packed to a specific academic laboratory (MERCIN, Microbiological Laboratory, Fac. of Agriculture, ASU) for counting of total bacteria, Salmonella, E. coli and Clostridium leptum groups.

Tibia Ca/P contents:

The bones of tibia were immersed for 48 h in ethyl alcohol to remove fats. Then,

they were well dried for 12 h at 110˚C and then weighted. Dried bone samples were put in an oven and ashed over night at 550˚C (Brenes et al., 2003). Ash samples (0.5 g) were digested in 5 ml nitric acid and 1 mlhydrogen peroxide using microwave digestion . Bone calcium was estimated according to Gindler and King (1972), and bone phosphorus was estimated according to Amador and Urban (1972).

Immune Response

The humoral immune response for ND, IBD and AID was estimated according to Van der zijpp et al. (1983) and Bachman and Mashaly (1986). Blood samples for immune response determinations were collected from nine birds in each group after 20 days of vaccination against each disease. The antibodies were measured using the micro-titer technique described by El-Kaiaty et al. (2002). Antibodies to ND and AID were determined using haemagglutination inhibition (HI) method. A quentity of twenty five µlof plasma containing antibodies was serially diluted into hydrophobic 96-well ground bottom plates with phosphate buffer saline (PBS). The same quentity of antigen of virus was added toreact and bind with the antibodies. ELISA kits were used for determination of IBD antibody titter (IDEXX Inc., Westbrook, ME 04092) as recommended by manufacturer's instructions (Snyder et al., 1984). Twenty µl of 100-fold buffer diluted serum from each chicken were used and read at 650 nm in a microplate reader.

Statistical analysis:

Data were statistically analyzed by using the general linear models (GLM) procedures of SAS (SAS, 2004). The analysis model was as follows:

$Y_{ij} = \mu + T_i + e_{ij}$

Where: Y_{ij} = the observations on the treatment, μ = overall mean, T_i= effect of the treatment, e_{ij} = random error treatment. The significant differences among treatment means were determined by Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Growth Performace:

Results of growth performance as affected by tratments are illustrated in Table (2). Obtained results indicate that the additon of vitamin E insignificantly affected body weight and feed conversion tell 21 days of age in all groups. Morover, there was a significant increase in feed intake was observed for birds reared at density of 12 birds/m^2 without supplementation tell 21 days of age. However, the control group (10 birds/m^2) showed significant increases in feed intake after 21 days. On the other hand, the highest BW was recorded, at 42 day of age, in the control goup (LD) and the forth group which supplemented with 200 mg vit. E (2.676 and 2.615kg, respectiviley). The value of feed conversion ratio (1-42 days) was 1.72 in the control group (HD) and was significantly differed from those found for the other three groups and ranged from 1.60 to 1.61.The lowest mortality was recorded in both groups supplemented with vit. E compared to the control unsupplemented groups. These findings indicated that

supplementation of the diet with vitamin E improved the broiler performance as growth and feed conversion ratio till 42-d-old under intensive birds density (12 birds/m^2) compared to the density of 10 birds/m^2.These results are in agreement with previous reports by Colnago et al. (1984) for broilers and Siegel et al. (2001) for laying pullets. Niu et al. (2009) reported that body weight gain (BWG) was effectively maintained by 100 mg/kg vit E supplementation. Whereas, Bartov and Frigg (1992) ; Pompeu et al. (2018) reported that BW gain was not significantly affected by the vitamin E treatments in broilers although, dietary vitamin E supplementation increased the meat contents.These results led to the assumption that vitamin E addition to the ingredients of corn-soybean meal diets was sufficient to meet the minimum requirement for growth performance of chickens.

Blood Metabolites:

Results of blood analysis are presented in table (3). Total proteins and albumin were significantly higher in the group supplemented with 200 mg vitamin E compared to the control group (HD). However, no significant differences were found in globulin levels in different groups. The cholesterol and triglycerides were significantly the highest in the group HD (12 birds/m^2) compared to the other groups. Our results concerning the superiority in total proteins values for birds in group of 12birds/m^2 and fed 200 mg vit. E (4.99 g/dl) are related with the impacted feed conversion ratio and BW gain. Blood metabolites and hematologic results are the important principal indicators of chicken physiological, tolerance and general health status. These findings were in agreement with early reports by Arslan et al. (2001) and Attia et al. (2017). It has also been proposed that vitamin E inhibits the oxidation of unsaturated fatty acids such as linoleic acid on the erythrocyte membrane (Bast et al., 1991). It has also been reported that the excess dietary addition of vitamin E (325 ppm) reduced plasma cholesterol and triglyceride levels and increased the hepatic enzyme ALP level in hens (Franchini et al., 1988). It was noted that the level of triglycerides increased due to the increase in fat stores, so as to reach the best fat/muscle rate necessary for growth performance. Hemoglobin was significantly increased and glucose was significantly decreased due to the supplementation of feed with vitamin E at both 100 and 200 mg/kg compared to the control group (12birds/m^2). No significant differences were found in calcium and phosphorus in different treatment groups. Franchini et al. (1988) proposed that the increase in Ca and P levels of broilers fed with excess dietary vitamin E was related to osteoblastic activity.

The feed supplementation with vitamin E had a significant effect on the activity of both AST and ALT. The decline in AST and ALT activities was significantly shown in the group fed with vitamin E at 200 mg/kg. The results reported in this study slightly differ from those obtained by Franchini et al. (1988).

Bacterial concentrations in the ileum and ceca

The concentrations of total bacteria, Salmonella, E.coli and Clostridium in both ileum and ceca are presented (Table 4). The total bacteria count decreased significantly in birds reared with density

of 12 birds/m^2 and fed diet supplemented with vitamin E by 100 or 200 mg/kg. The concentration of Salmonella was not significantly altered among birds in different groups. The concentrations of Escherichia coli and Clostridium leptum in the ileum content were significantly decreased by the supplementation of vitamin E at 200 mg/kg. The results are in agreement with early studies of Tengerdy and Brown (1977). These results could explain our observation concerning the mortality.

Salmonella are a common cause of food borne microbial diseases for humans, and their contamination of poultry meat is one of the greatest clinical concerns in poultry production (Gaggìa et al., 2010). We speculated that decreased concentrations of different bacterial count in the ileal and cecal content of birds may result from feeding diets containing vitamin E as antioxidant agent.

Tibia Ca/P contents:

The effects of density of birds and dietary treatments on tibia bone and its contents of ash, calcium and phosphorus are shown in Table (5). No significant differences were found between treatment groups for bone ash. The Ca and P concentrations in both control groups were significantly less than the concentration in the groups fed diet supplemented with vitamin E. However, the effect of α-tocopherol (vit.E) supplementation on bone contents in poultry has rarely been studied and is rather controversial. In chickens, bone mineralization was significantly correlated with bone breaking force ($r = 0.58$ to 0.68; $P < 0.001$) and bone ash weight ($r = 0.73$ to 0.99; $P < 0.001$) (Onyango et al., 2003; Mazzuco and Hester, 2005; Schreiweis et al., 2005). It was also reported that stress increases ash content.

Immune response

The effects of bird density and feed supplementation with vitamin E on immune responses of broiler chicks are shown in Table (6). Significant differences (<0.0001) in the immune response to ND, IBD and AID were observed among birds in all groups. The immune responses for all diseases were significantly higher in the groups fed diet supplemented with vitamin E at 100 or 200 mg/kg than the control groups. These results are in agreement with those of Lin and Chang (2006). They found that the addition of 20 mg vitamin E/kg diet significantly enhanced ($p<0.05$) the immune competence to SRBC when compared to those supplied with 0, 80 and 160 mg vitamin E/kg diet. In addition, they reported that supplementation of 20 mg vitamin E/kg diet had higher ($p<0.01$) antibody titre to IBDV than those added with 40-160 mg vitamin E/kg diet. The induction of humoral immune response (T-cell dependent) antigens require the presence of T helper cells. Erf et al. (1998) reported that dietary vitamin E increases the T helper cells, and in turn improves responsiveness to immunologic stimuli. Vitamin E may prevent peroxidation of lipids in membranes which caused by lipid peroxyl radicals. The catalysts of the production of free radicals are the infectious diseases which are the important factor for example as a consequence of macrophage functions. Also, they reported that 300 mg/kg of vitamin E may improve immune competence and could reduce the

mortality in poultry which were infected and challenged by E.coli.

CONCLUSION

The growth performance and liver functions of broiler chicks reared under intensive density for 42 days of age were significantly enhanced by the supplementation of feed with 200mg vitamin E/kg. The supplementation with vitamin E of 200 mg/kg also improved humeral immune response against Newcastle, Infectious Bronchitis and Avian Influenza diseases, and reduced mortality. In addition, supplementations of diet with vitamin E caused a decrease or disappear of E. coli, Salmonella and Clostridium colonies in the guts. With regard to broiler chicken density and performance, there seemed to be a relationship between dietary vitamin E supplementation, birds density and their general productive performance.

Table (1): Composition and chemical analysis of the basal diets.

MHA: Methionine Hydroxy-Analogue, ME: metabolizable energy, AP: Available phosphorus.

Ingredients	Dietary Treatments	
	Starter (0-3 Weeks)	**Grower (4-5 Weeks)**
Yellow Corn	54.50	57.50
Soybean Meal (44%)	33.00	28.00
Corn Gluten Meal (62%)	6.20	6.50
Soybean Oil	2.00	4.00
Di Calcium Phosphate	1.80	1.60
Calcium Carbonate	1.60	1.50
Salt	0.20	0.20
MHA	0.20	0.20
HCL Lysine	0.20	0.20
Premix	0.30	0.30
Total	100	100
Chemical Analysis		
Crude Protein %	23.00	21.24
ME Kcal/ Kg diet	2986	3179
Ca%	1.02	0.93
AP%	0.50	0.45
Lysine	1.29	1.17
Methionine &Cystein	0.95	0.91

Each 3 Kg of the premix contains: Vitamins: A: 12000000 IU; Vit. D3 2000000 IU; E: 10000 mg; K3: 2000 mg; B1:1000 mg; B2: 5000 mg; B6:1500 mg; B12: 10 mg; Biotin: 50 mg; Coline chloride: 250000 mg; Pantothenic acid: 10000 mg; Nicotinic acid: 30000 mg; Folic acid: 1000 mg; Minerals: Mn: 60000 mg; Zn: 50000 mg; Fe: 30000 mg; Cu: 10000 mg; I: 1000 mg; Se: 100 mg and Co: 100 mg.

Vitamin E - birds density -broiler - humoral immunity -blood components

Table (2): Effect of bird density and feed supplementation with vitamin E on broiler performance.

Age	Control LD	HD	HD+ 100	HD+ 200	S.D.	P value
	Body weight (g):					
0 days	42.8	43.1	42.8	42.9	0.1	0.509
21days	814	826	821	806	7.5	0.433
35days	1846[a]	1675[c]	1780[b]	1838[a]	17.9	<.0001
42 days	2676[a]	2392[c]	2511[b]	2615[a]	21.6	<.0001
	Feed consumption (g/bird/d):					
1-21 d	49.94[c]	51.07[a]	50.39[b]	49.42[d]	0.066	<.0001
22-35d	118.57[a]	106.00[c]	110.85[b]	118.68[a]	1.236	<.0001
36-42 d	218.14[a]	203.08[b]	191.36[c]	203.14[b]	1.429	<.0001
1-42 d	100.85[a]	94.71[c]	94.04[c]	98.12[b]	0.569	<.0001
	Feed conversion (feed/gain):					
1-21 d	1.36	1.37	1.36	1.36	0.004	0.214
22-35d	1.61[b]	1.75[a]	1.62[b]	1.61[b]	0.006	<.0001
36-42 d	1.84[b]	2.08[a]	1.83[b]	1.83[b]	0.006	<.0001
1-42 d	1.61[b]	1.72[a]	1.60[b]	1.60[b]	0.005	<.0001
	Mortality (%)					
1-21 d	2.2	2.2	0.2	2.2	0.2	1.0000
22-35d	2.2	2.2	0.0	0.0	0.14	0.5847
36-42 d	0.0	2.2	0.0	0.0	0.10	0.4182
1-42 d	4.4	6.6	0.2	2.2	0.22	0.5472

[a, b] Means within the same row with different superscripts are significant1y different ($p<0.05$).
LD = low density 10 birds/m^2, HD = high density 12 birds/m^2, HD+100 = high density 12 birds/m^2 supplemented by vitamin E 100mg/kg, HD+200 = high density 12 birds/m^2 supplemented by vitamin E 200mg/kg.

Table (3): Effect of bird density and feed supplementation with Vitamin E on blood metabolites in broiler.

Item	Control LD	HD	HD+ 100	HD+ 200	S.D.	P value
Total Protein (g/dl)	4.37 ^{ab}	3.82^{b}	4.72 ^{ab}	4.99 ^{a}	0.33	0.0504
Albumin (g/dl)	2.54 ^{ab}	2.02^{b}	2.89 ^{a}	3.21 ^{a}	0.223	0.0353
Globulin (g/dl)	1.83	1.80	1.83	1.78	0.08	0.7568
Cholesterol (mg/dl)	126.1^{b}	152.2^{a}	124.1^{b}	112.3^{b}	5.13	0.0016
Triglycerides (mg/dl)	141.1^{b}	168.8^{a}	138.2^{b}	120.1^{b}	6.81	0.0110
Hemoglobin (g/dl)	11.82 ^{a}	10.12^{b}	12.21 ^{a}	12.46 ^{a}	0.238	0.0018
Glucose (mg/dl)	214.2 ^{ab}	236.5 ^{a}	198.9^{b}	182.6^{b}	9.81	0.0310
Calcium (mg/dl)	11.62	10.43	11.98	12.42	0.61	0.2804
Phosphorus (mg/dl)	7.82	7.04	7.94	8.42	0.42	0.2404
AST (U/l)	24.33 ^{ab}	29.72 ^{a}	25.21 ^{ab}	22.13^{b}	1.903	0.0329
ALT (U/l)	15.76 ^{ab}	19.21 ^{a}	16.12 ^{ab}	14.31 ^{b}	1.201	0.0439

$^{a, b \text{ and } c}$ Means within the same main effects with different letters are significantly different ($p<0.05$).

LD = low density 10 birds/m^2, HD = high density 12 birds/m^2, HD+100 = high density 12 birds/m^2 supplemented by vitamin E 100mg/kg, HD+200 = high density 12 birds/m^2 supplemented by vitamin E 200mg/kg.

Table (4): Effect of bird density and feed supplementation with Vitamin E on intestinal bacterial count (CFU/g X10^6) in broiler**.**

Item	Control LD	HD	HD+ 100	HD+ 200	S.D.	P value
	Total bacteria count					
In ileum:	6.116^{a}	6.416^{a}	5.233^{b}	5.183^{b}	0.135	0.0014
In ceca:	6.416^{a}	6.600^{a}	5.616^{b}	5.583^{b}	0.193	0.0137
	Salmonella count					
In ileum:	0.633	0.900	0.533	0.533	0.285	0.8045
In ceca:	0.666	0.750	0.566	0.550	0.312	0.8838
	E. coli count					
In ileum:	3.266 ^{a}	3.283 ^{a}	2.866 ^{ab}	2.833^{b}	0.129	0.0122
In ceca:	3.433	3.366	2.650	2.616	0.146	0.1002
	Clostridium leptum group count					
In ileum:	1.900 ^{ab}	2.133 ^{a}	1.866 ^{ab}	1.816^{b}	0.0909	0.0158
In ceca:	2.100 ^{ab}	2.216 ^{a}	1.916 ^{ab}	1.816^{b}	0.102	0.0451

$^{a, b \text{ c}}$ Means within the same row with different letters are significantly different ($p<0.05$).

LD = low density 10 birds/m^2, HD = high density 12 birds/m^2, HD+100 = high density 12 birds/m^2 supplemented by vitamin E 100mg/kg, HD+200 = high density 12 birds/m^2 supplemented by vitamin E 200mg/kg.

Table (5): Effect of bird density and feed supplementation with Vitamin E on bone composition and contents in broiler.

Item	Control LD	HD	HD+ 100	HD+ 200	S.D.	P value
Bone ash	54.21	53.22	55.62	56.92	1.34	0.7862
Calcium (mg/dl)	32.15 ^{b}	30.21 ^{b}	35.82 ^{a}	36.82 ^{a}	1.0	0.0441
Phosphorus (mg/dl)	16.32^{bc}	15.22^{c}	17.92 ^{ab}	18.87 ^{a}	0.74	0.0265

$^{a, b\ c}$ Means within the same row with different letters are significantly different ($p<0.05$).
LD = low density 10 birds/m^2, HD = high density 12 birds/m^2, HD+100 = high density 12 birds/m^2 supplemented by vitamin E 100mg/kg, HD+200 = high density 12 birds/m^2 supplemented by vitamin E 200mg/kg.

Table (6): Effect of bird density and feed supplementation with Vitamin E on immunity responses in broiler.

Item	Control LD	HD	HD+ 100	HD+ 200	S.D.	P value
ND	8.444^{b}	8.000^{b}	9.777 ^{a}	10.444 ^{a}	0.235	<.0001
IBD	8.666^{b}	8.222^{b}	10.222^{a}	10.666^{a}	0.328	<.0001
AID	7.666^{b}	7.222^{b}	8.666^{a}	9.000^{a}	0.216	<.0001

$^{a, b\ c}$ Means within the same row with different letters are significantly different ($p<0.05$).
LD = low density 10 birds/m^2, HD = high density 12 birds/m^2, HD+100 = high density 12 birds/m^2 supplemented by vitamin E 100mg/kg, HD+200 = high density 12 birds/m^2 supplemented by vitamin E 200mg/kg.
ND=Newcastle disease, IBD= Infectious Bronchitis disease, AID= Avian Influenza disease

REFERENCES

A.O.A.C. 2000. Association of Official Analytical Chemists. Official Methods of Analysis, 21th ed. Washington, DC.

Amador, E. and J. Urban 1972. Simplified serum phosphorus analyses by continuous-flow ultraviolet spectrophotometry. Clinical Chemistry, 18: 601-604.

Arslan, M., M. Özcan, E. Matur, Ü. Çotel and E. Ergul (2001. The Effects of Vitamin E on Some Blood Parameters in Broilers. Turk. J. Vet. Anim .Sci., 25, 711-716.

Attia Y.A., M.A. Al-Harthi, A.S. El-Shafey, Y.A. Rehab, W.Kyun Kim 2017. Enhancing tolerance of broiler chickens to heat stress by supplementation with vitamin E, vitamin C and/ or probiotics. Ann. Anim. Sci., Vol. 17 (4) 1155–1169.

Bachman, S.E. and M.M. Mashaly (1986. Relationship between circulating thyroid hormones and immature male chickens. Developmental and Comparative Immunology, 10: 395-403.

Bartov, I. and M. Frigg 1992. Effect of high concentrations of dietary vitamin E during various age periods on performance, plasma vitamin E and meat stability of broiler chicks at 7weeks of age. Br. Poult. Sci. 33:393-402.

Bast, A., G. R. Haenen, M. M., C. J. A. Doelman 1991. Oxidants and antioxidants: State of the art. The Am. J. of Med., 91.

Brenes, A., A. Viveros, I. Arija, C. Centeno, M. Pizarro, and C. Bravo 2003. The effect of citric acid and microbial phytase on mineral utilization in broiler chicks. Anim. Feed Sci. Technol.110:201–219.

Colnago, G. L., L. S. Jensen, and P. L. Long 1984. Effects of selenium and vitamin E on the development of immunity to coccidiosisin chickens. Poult. Sci. 63:1136–1143.

Dawkins, M. S., C. A. Donnelly and T. A. Jones 2004. Chicken welfare is influenced more by housing conditions than by stocking density. Nature 427:342-344.

Dozier, W. A., J. P. Haxtun, S. L. Brinton, G. W. Morgan, D.M. Miles, W. B. Roush, B. D. Lott, and Y. Vizzier-Thaxton. 2005. Stocking density effects on growth performance and processing yields of heavy broilers. Poult. Sci. 84:1332–1338.

Duncan, D. B. 1955. Multiple range and multiple F test. Biometrics 11: 1-42.

EL-Kaiaty, A. M., A.Z.M. Soliman and M.S.H. Hassan 2002. The physiological and immunological effects of some natural feed additives in layer hen diets. Egyptian Poultry Science, 22: 175-203.

Erf, G. F., W. G. Bottje, T. K. Bersi, M. D. Headrick and C. A. Fritts 1998. Effects of dietary vitamin E on the immune system in broilers: altered proportions of CD4 T cells in the thymus and spleen. Poult. Sci. 77:529-537.

Estevez, I. 2007. Density Allowances for Broilers: Where to Set the Limits? Poultry Science, Vol. 86, Issue 6, Pages 1265–1272, https://doi.org/10.1093/ps/86.6.1265

Franchini, A., A. Meluzzi, S. Bertuzzi and G. Giordani 1988. High doses of vitamin E in the broilers diets. Arch. Gefügelk, 52 (1), 12-16

Gaggìa, F., P. Mattarelli, and B. Biavati 2010. Probiotics and prebiotics in animal feeding for safe food production. Int. J. Food Microbial. 141:S15–S28.

Gindler E. M., and J. D. King 1972. Rapid colorimetric determination of calcium in biologic fluids with methylthymol blue. Am. J. Clin. Pathol., 58(4):376-82.

Lin, Y. F. and S. J. Chang 2006. Effect of dietary vitamin E on growth performance and immune response of breeder chickens. Asian-Aust. J. Anim. Sci., 19: 884-891.

Lohakare, J. D., J. Y. Choi, J. K. Kim, J. S. Yong, Y. H. Shim, T.-W.Hahn and B. J. Chae 2005. Effects of dietary combinations of vitamin A, E and methionine on growth performance, meat quality and immunity in commercial broilers. Asian-Aust. J.Anim. Sci. 18:516-523.

Longo, F. A.; J. F. M. Menten; A. A. Pedroso; A. N. Figueiredo; A. M. C. Racanicci and J. O. B. Sorfara 2007. Performance and carcass composition of broilers fed different carbohydrate and protein sources in the prestarter phase. J. Appl. Poult. Res., 16: 171-177.

Marsh, J. A., G. F. Combs, M. E. Whitacre, and R. R. Dietert 1986. Effect of selenium and vitamin E dietary deficiencies on chick lymphoid

organ development. Proc. Soc. Exp. Biol. Med.182:425–436.

Mazzuco, H. and P.Y. Hester 2005. The effect of an induced molt and a second cycle of lay on skeletal integrity of White Leghorns. Poult. Sci., 84: 771-781.

Neves D. P. I., T. M. I. I. Banhazi and I. A Nääs 2014. Feeding Behaviour of Broiler Chickens: a Review on the Biomechanical Characteristics. Brazilian Journal of Poultry Science 16 (2) 1-16

Niu, Z. Y., F. Z. Liu, Q. L. Yan, and W. C. Li 2009. Effects of different levels of vitamin E on growth performance and immune responses of broilers under heat stress. Poult. Sci. 88:2101–2107.

NRC 1994. Nutrient Requirements of Poultry. 9th rev. ed. Natl. Acad. Press, Washington, DC, USA.

Onyango, E. M, P. Y. Hester, R. L. Stroshine and O. Adeola 20003. Bone densitometry as an indicator of percent tibia ash in broiler chicks fed varying dietary calcium and phosphorus levels. Poult. Sci., 82: 1787-1791.

Pompeu, M. A., L. F. L. Cavalcanti and F. L. B. Toral 2018. Effect of vitamin E supplementation on growth performance, meat quality, and immune response of male broiler chickens: A meta-analysis. Livestock Science, V. 208, 5-13

Reitman, S. and S. Frankel .1957. Calorimetric method for the determination of blood aminotransferase enzymatic activities. Am. J. Clin. Pathol., 28: 56–63.

SAS Institute, (2004). SAS/STATs User's Guide. Version 9.1, SAS Institute Inc., Cary, NC, USA.

Schreiweis, M. A., J. I. Orban , M. C. Ledur, D. E. Moody and P. Y. Hester (2005). Validation of dual-energy X-ray absorptiometry in live White Leghorns. Poult. Sci., 84: 91-99.

Shane, S. M. 1988. Factors influencing health and performance of poultry in hot climates. Crit. Rev. Poult. Biol., 1: 247-267.

Siegel, P. B., S. E. Price, B. Meldrum, M. Picard and P. A. Geraert 2001. Performance of pure line broiler breeders fed two levels of vitamin E. Poult. Sci. 80:1258-1262.

Snyder, D. B., W. W. Marquardt, E. T. Mallinson, P. K. Savage andD. C. Allen 1984. Rapid serological profiling by enzyme linked immunosorbent assay. III. Simultaneous measurements of antibody titers to infectious bronchitis, infectious bursa disease, and Newcastle disease viruses in a single serum dilution. Avian Dis. 28:12-24.

Sørensen, P., G. Su, and S. C. Kestin 2000. Effects of age and stocking density on leg weakness in broiler chickens. Poult.Sci. 79:864–870.

Tengerdy R. P. and J. C. Brown 1977. Effect of vitamin E and A on humoral immunity and phagocytosis in E. coli infected chicken. Poult. Sci. 1977;56(3):957-63.

Traber, M. G. and J. Atkinson 2007. Vitamin E, antioxidant and nothing more. Free Rad. Biol. Med.,43: 4–15.

Van der Zijpp, A. J., K. Frankena, J. Boneschancher and M. G. B. Nieuwland 1983. Genetic analysis of primary and secondary immune response in the chicken. Poultry Science, 62: 565-572.

الملخص العربى

الأداء الإنتاجي والإستجابة المناعية لدجاج التسمين المربى تحت كثافة عالية والمغذى على علائق مضاف إليها فيتامين هـ

عادل عبد المنعم دسوقى

قسم الإنتاج الحيوانى، كلية الزراعة، جامعة القاهرة، مصر

الهدف من هذه التجربة هو تقييم تأثير كثافة الطيور وإضافة فيتامين هـ على الأداء الإنتاجي ومكونات الدم وعدد بكتريا القناه الهضمية ومحتوى العظام والمناعة لدجاج التسمين. تم استخدام عدد 180 كتكوت تسمين أربر إيكرز عمر يوم وتم تقسيمهم عشوائيا إلى أربعة مجاميع متساوية وقسمت كل مجموعة إلى ثلاثة مكررات بكل مكرر 15 كتكوت. تم تسكين المجموعة الأولى بواقع 10 طائر/م^2 (كنترول +)، بينما سكنت المجموعة الثانية بواقع 12 طائر/م^2 (كنترول -)، وتم تغذية المجموعتين على العليقة الأساسية، بينما تم تسكين المجموعة الثالثة والرابعة بواقع 12 طائر/م^2 وتغذيتهم على العليقة الأساسية مضاف إليها فيتامين هـ بمعدل 100ملجم/كجم (المجموعة الثالثة) و 200ملجم/كجم (المجموعة الرابعة)... أوضحت النتائج أن الطيور المرباه تحت كثافة عالية أظهرت إنخفاض في الأداء الإنتاجي وأثرت سلبيا على مكونات الدم والمناعة .. بينما ظهر تحسن في رد الفعل المناعي للطيور المرباه تحت كثافة عالية ومغذاه على فيتامين هـ. إضافة فيتامين هـ بمعدل 100 أو 200 ملجم/ كجم عليقة للطيور المرباه تحت كثافة عالية أدى إلى خفض العد البكتيرى لبكتريا السالمونيلا والإيكولاى والكولستريديم فى الأمعاء. وعلى هذا يمكن إستنتاج أن إضافة فيتامين هـ لعلائق دجاج التسمين المرباه تحت كثافة عالية يعمل على تحسين الأداء الإنتاجى ورد الفعل المناعى لهذه الطيور.