GROWTH PERFORMANCE, CARCASS CHARACTERISTICS AND INTERNAL ORGANS OF BROILER CHICKENS FED DEXAMETHASONE WITH ORGANIC SELENIUM AND VITAMIN E UNDER CHRONIC STRESS.

[1*]Omotoso, O. B., [2]Bako, M. I., [3]Ishaya A. and [4]Emmanuel, A.
[1,2,3,4] Department of Animal Production and Health, Faculty of Agriculture and Life Sciences, Federal University Wukari,
*Corresponding author: opebetty08@gmail.com

ABSTRACT
The study was carried out to determine the growth performance, carcass characteristics and internal organs of broilers chickens fed dexamethasone with organic selenium and vitamin E under chronic stress. One hundred and thirty-five day-old Arbor acre broiler chicks were randomly assigned to three treatments: control diet (T1), diet with 1mg dexamethasone (T2), and diet with 1 mg dexamethasone + selenium and vitamin E (T3). Each treatment was replicated three times with 15 birds per replicate. The birds were fed a maize/soybean meal-based broiler starter and finisher diet according to the NRC (1994) nutrient requirement for broiler chickens. Dexamethasone was administered in the drinking water for 14 days, and the 1 mg dexamethasone + selenium and vitamin E Treatment contained organic selenium supplemented in the test diet. The feeding trial lasted eight weeks, during which feed and water were provided ad – libitum. The results were subjected to a one-way analysis of variance (ANOVA) in a Completely Randomized Design and Tukey's post-hoc was used to test for significance. The results showed that dexamethasone inhibits the growth performance of broiler chickens significantly ($P < 0.05$) because it reduces feed intake which in turns affect the growth rate and the feed conversion ratio. Except for the drumstick and thigh all other parameters had the lowest values for the birds fed dexamethasone only. The kidney and spleen weights were not significantly ($P > 0.05$) different among the treatments but the liver weight increased with the inclusion of dexamethasone, which is regarded as one index of stress condition. The birds fed dexamethasone with selenium and vitamin E performed better and this is as a result of Vitamin E and selenium roles in alleviating stress. Therefore, it is not recommended to feed birds dexamethasone as it has been shown to have detrimental effects on the carcass and some of the internal organs considered. But if dexamethasone should be used, selenium and vitamin E can be used to supplement the diet as birds fed dexamethasone with vitamin E and selenium shows a better result.
Keywords: Broilers, Dexamethasone, Selenium, Chronic stress, Vitamin E

INTRODUCTION

The economic importance of poultry sub-sector and products cannot be overemphasized. It serves as source of income to the farmers, protein in diets and the by-products, such as feathers, are used in making household items like decorations while the droppings are used for organic manure. The poultry industry contributes approximately 58.2% of the overall animal production in Nigeria (Amos, 2006). As such, the demand for poultry products has been on the increase due to many factors; some of which are rising population, urbanisation and increasing income (Food and Agricultural Organisation, 2020).

Poultry birds may be exposed to a variety of potential stressors including the thermal demands of the transport micro-environment, acceleration, vibration, motion, impacts, fasting, withdrawal of water, social disruption and noise (Abeyesinghe *et al.,* 2001). Each of these factors and their various combinations may impose stress upon the birds, but it is well recognized that thermal challenges and in particular heat stress constitute the major threat to animal well-being and productivity (Mitchell 2006). The imposition of thermal loads upon the birds in transit will result in moderate to severe thermal stress and consequent reduced welfare (Mitchell *et al.,* 2001), increased mortality due to either heat or cold stress (Hunter *et al.,* 2001) and induced pathology including muscle damage and associated changes in product quality (Mitchell 1999).

Poultry nutrition research in the use of inorganic and organic selenium sources has yield significant improvement in growth performance and antioxidant capacity of broiler chickens (Surai, 2002). Improvement in antioxidant capacity is attributed to inducible Selenium (Se) dependent antioxidant enzyme (Surai, 2002). Selenium is an integral component of glutathione peroxidase (E.1.11.9, $GSHP_x$). $GSHP_x$, in alliance with dexamethasone, forms part of the cell's defence against reactive metabolites of oxygen which are produced excessively under stress condition. Stress is defined as any change that causes physical, emotional, or physiological strain to an animal (Surai, 2002).

Dexamethasone (DEX) is a synthetic derivative of glucocorticoids, whose major therapeutic usage derives from their anti-inflammatory and immunosuppressant properties. It has also been found to induce stress in chickens (Watteyn *et al.,* 2013).

When birds exposed to stress, selenium is used in antioxidant enzymes to decrease the harmful effects of free radicals. In this regard, the source of selenium is important to provide enough protection. Studies have reported that a dietary supplementation of Se can help to effectively mitigate the negative effects induced by a high stocking density and heat stress in different animal species (Shakeri *et al.,* 2020). The protective action of Se against a high stocking density and adverse heat stress induced effects, which is related to an adequate Se supplementation of the feed and an optimal Se status of the body, has been shown to be associated with an enhanced antioxidant capacity and immune functions (Safdari *et al.,* 2017).

MATERIALS AND METHODS

Study area

The study was carried out at the Poultry Unit of the Livestock Teaching and Research Farm, Department of Animal Production and Health, Federal University Wukari, Taraba State, Nigeria. Wukari is located at a longitude of 9.47° E and a Latitude of 7.51°N. It has an annual rainfall of about 1058mm to 1300mm, relative humidity that ranges from 5-39%, and an average temperature of 39^0c. (Taraba State diary 2008).

Experimental design, diets and management of birds

One-hundred-and-thirty-five-day old *Arbor acre* broiler chicks were used in this study. They were procured from Amo sieberer hatchery, Awe, Oyo, Oyo State. They were randomly assigned to three dietary treatments of Forty five chicks per treatment, having fifteen chicks per replicate in a Completely Randomized Design. The control diet designated as (A), the treatment with 1 mg dexamethasone (B) and another treatment with 1 mg dexamethasone + selenium + vitamin E (C). A maize/soybean meal-based broiler starter and finisher diet was formulated according to NRC (1994) nutrient requirement for broiler chickens as shown in Table 1 and fed to all birds during the first week for acclimatization.

Daily doses of dexamethasone (1 mg) was administered by dissolving in a litre of water and supplied for 14 days beginning from the 2nd week for the 2nd treatment (B), the 3rd treatment (C) which contains 1 mg dexamethasone + selenium and vitamin E were also fed to the birds from the beginning of the 2nd week. Dexamethasone administration was terminated at the end of the 3rd week to allow a three-week readjustment phase. Birds receiving no dexamethasone (0 mg) in their drinking water served as the control.

The birds were raised on deep litter and housed in 2.5 m x 1.96 m space for each replicate with feed and water provided *ad libitum*. All routine and management practices were strictly adhered to. Parameters measured include initial weight, feed intake and final weight while weight gain and feed conversion ratio were calculated as follows:

$$\text{Weight gain} = \text{Final weight} - \text{Initial weight}$$

$$\text{Feed Conversion Ratio} = \frac{\text{Total feed intake}}{\text{Total weight gain}}$$

Initial weight was taken at the start of the experiment at day 1 after the acclimatization period while feed intake and weight gain was taken weekly. Mortality records were taken.

Organ collection and examination

On day 42 of the experiment, two birds per replicate having a total of six birds per treatment were slaughtered and eviscerated. Body weights, eviscerated weights, the weight of the breast, back, thigh, wing, as well as weight of organs which includes the liver, kidneys, spleen were measured using a sensitive digital scale.

Data analysis

All data collected from the experiments were subjected to analysis of variance (ANOVA) using the General Linear Model Procedure of JMP SAS (2012). Where the result of ANOVA was statistically significant, Tukey's (1949) post-hoc test for multiple comparisons was performed to compare means with significant difference.

RESULTS AND DISCUSSION

Results for growth performance, carcass characteristics and internal organs of broiler chickens fed selenium and vitamin E supplemented diet under chronic stress condition are presented in Tables 2, 3 and 4, respectively.

Table 2 presents the growth performance of broiler chickens fed selenium and vitamin E supplemented diet under chronic stress condition from day 1-42. It shows that broilers fed the control diet had higher ($p<0.05$) daily feed intake (100.21 g/b/d), daily weight gain (48.42 g/b/d), final weight (1815.87 g/b) and FCR (2.07 g).

The daily weight gain of the broilers fed dexamethasone treated diets were lower as compared to the control diet as presented in Table 2. Consumption of corticosteroid in diet stimulated protein catabolism suppresses body weight gain and decrease feed efficiency in broiler chickens as reported by (Hayashi *et al.,* 1994). The decrease in body weight may be due to excessive catabolism, muscle atrophy and mobilization of free fatty acids from adipose store as reported by Song *et al.,* (2011). Sabeur *et al.,* (1993) found out that chickens that received dexamethasone

has muscular dystrophy and reduced growth rate. However, the oxidative stress induced by dexamethasone, could be alleviated by excessive supplemental dietary Vitamin E (Eid *et al.,* 2006) as stress induced by glucocorticoids significantly suppressed the growth of broiler chickens Malheiros *et al.,* (2003). Siegel *et al.,* (2001) reported increase BW gains from laying pullets fed on a 300 mg vitamin E/kg which supports the dexamethasone treated diet supplemented with selenium and 250 mg/kg Vit E that shows an increase in body weight gain.

Table 1: Ingredient Composition and Calculated Analysis of the Diet for Starter and Finisher Broiler Chickens

Ingredients	**Composition(%)**	
Maize	55.00	62.50
Soybean cake	24.00	18.00
Groundnut cake	14.00	15.00
Maize offal	2.00	0.00
Bone meal	3.00	3.00
Limestone	1.00	0.50
Common salt	0.30	0.30
Vitamin premix	0.30	0.30
Lysine	0.20	0.20
Methionine	0.20	0.20
Total	**100.00**	**100.00**
Calculated analysis		
ME KCal/kg	2860	2950
Crude protein (%)	23.06	21.05
Ether extract (%)	4.62	4.48
Crude fibre (%)	4.25	3.77
Calcium (%)	1.22	1.03
Available phosphorus (%)	0.52	0.51
Lysine (%)	1.24	1.09
Methionine (%)	0.60	0.58

Nutrivitas broiler premix provided per 1 kg of diet Vitamin A, 4,000,000 I.U; Vitamin D_3, 800,000 I.U; Vitamin E 16,000 mg; Vitamin K_3, 800 mg; Vitamin B_1, 600 mg; Vitamin B_2, 2,000 mg; Vitamin B_6, 1,600 mg; VitaminB_{12}, 8 mg; Niacin, 16,000; Calpan, 4,000; Folic acid, 400 mg; Biotin, 40 mg; Choline chloride, 120,000 mg; Manganese, 32,000 mg; Iron, 16,000 mg; Zinc, 24,000 mg; Copper, 3,200 mg; Iodine, 320 mg; Cobalt, 120 mg; Selenium, 80 mg. ME – Metabolizable Energy

Sahin and kucuk (2001) reported that a combine use of 250 mg/kg Vitamin E and mg/kg selenium improved performance, feed intake and feed conversion ratio of Japanese quail under constant heat stress due to possible synergistic mode of action between this nutrient in alleviating the negative impact of oxidative damage. Addition of 0.4 mg/kg organic selenium in broilers diet shows a significant increase in body weight gain and feed intake as reported by safiullah *et al.,* (2019). Seven *et al*. (2009) suggested that the growth response of birds to Selenium supplementation would also depend on the birds' stress level, with stressed birds being more responsive

Table 2: Growth performance of broiler chickens fed selenium and vitamin E supplemented diet under chronic stress condition (day 1-42)

Parameters	**Dietary levels of Dex and Antioxidants**			**SEM**	**P-value**
	Control	**Dex**	**Dex Sel + Vit E**		
Initial weight (g/b)	121.11	121.11	123.33	0.91	0.2160
Daily feed intake (g/b/d)	100.21[a]	81.76[b]	82.61[b]	3.30	0.0124
Daily weight gain (g/b/d)	48.42[a]	33.72[b]	34.87[b]	1.50	0.0008
Final weight (g/b)	1815.87[a]	1301.27[b]	1343.94[b]	52.92	0.0008
FCR (g)	2.07[a]	2.43[b]	2.37[b]	0.06	0.0148

Dex – Dexamethasone, Sel - Selenium

The increase in feed conversion ratio indicates that the administration of dexamethasone-induced physiological stress where glucose metabolism is favoured over protein synthesis had a negative impact on feed to tissue conversion as reported by (Virden *et. al.,* 2007) which is in line with the result gotten where the treatment having only dexamethasone had the highest feed conversion ratio value. The improved FCR of broilers fed organic

selenium (Se) supplemented diet could be related to the increased concentrations of the active form of thyroid hormone in the serum of chickens supplemented with organic selenium as well as to the immune modulating properties of selenium and suggested that improvement in FCR could be related to the better feathering of chickens fed with a diet supplemented with organic selenium (Hoffman, 2007).

Data on the carcass characteristics of broiler chickens fed control and test diets were presented in Table 3. All parameters measured except for the wing, whose values were not statistically ($P \geq 0.05$) different from each other, shows that the control diet, having the highest values was significantly ($P \leq 0.05$) different from the other two treatments. However, the indices varied thus: Live weights ranged from 1275.00 to 1808.33 (g/b), dressed weights from 980.67 to 1447.17, dressing percentage from 76.71 to 80.06%, breast weight ranged from 19.65 to 25.16 with broilers fed only dexamethasone having the least values while broilers fed the control diet recorded the highest values. The values for the thigh and drum stick ranges from 10.16 to 11.33 and 4.57 to 5.43 with broilers fed dexamethasone + selenium and vitamin E having the least values while broilers fed the control diet recorded the highest values. The values recorded for wings ranged from 3.82 to 4.07. The values reported shows that birds fed dexamethasone had a decrease in the live weight, dressed weight and dressing percent. This is in line with the report of Bobade *et al.,* (2009) which shows a decrease in the live weight, dressed weight and dressing percentage of birds fed dexamethasone. The decreasing trend observed for final weight could be as a result of the attempts by the birds to combat the additional stress caused by dexamethasone which resulted in reduced feed intake and weight loss. Aengwanich (2007) also reported that the body weight of broilers who received dexamethasone in diets was significantly lower than control group and this decrease was consistent with increasing levels of dexamethasone. Breast weight of birds fed dexamethasone had the lowest value and was significantly affected. This contradict the report by Wang *et al.,* (2012) who studied dexamethasone-induced intramuscular lipid accumulation in chickens and reported no significant ($P>0.05$) effect of dexamethasone on breast muscle mass. The thigh and drumstick values of chickens fed dexamethasone were a bit lower than the control but higher than those fed dexamethasone + selenium and Vitamin E. Virden *et al.* (2007) reported that thigh cuts were significantly suppressed by corticosterone treatments. From a meat production standpoint, this points to the detrimental effect of dexamethasone in catabolising structural protein to free amino acids such as glutamine and alanine for use as gluconeogenic substrates (Puvadolpirod and Thaxton, 2000).

The result of organs weight (%) is presented in Table 4. Some of the parameters measured which include the kidney and spleen were not significantly ($P \geq 0.05$) different while the remaining shows that they were significantly different from each other ($P \leq 0.05$).However, the indices varied thus: heart weight ranged from 0.48 in broilers fed control diet to 0.62 in broiler fed C (selenium + dexamethasone + vitamin E) diet, Gizzard from 2.01 in broiler fed control diet to 2.82 in broiler fed B (dexamethasone) diet. Liver weight ranged from 1.90 in broiler fed A (control) diet to 2.34 in broiler fed with C(selenium + dexamethasone + vitamin E) diet. The weight of the kidney and spleen ranged from 3.82 to 4.07, 0.08 and 0.10 with broilers fed only dexamethasone having the lowest value and those ones fed control diet having the highest value.

Table 3: Carcass characteristics of broiler chickens fed dexamethasone with organic selenium and Vitamin E supplemented diet.

Parameters	A	B	C	SEM	P. VALUE
Live weight (g\b)	1808.33[a]	1275.00[b]	1341.67[b]	50.32	0.00
Dressed weight(g\b)	1447.17[a]	980.67[b]	1063.17[b]	43.24	0.00
Dressing percent (%)	80.06[a]	76.71[b]	79.30[ab]	0.84	0.03
Cut-up parts expressed as % of Live weight					
Breast	25.16[a]	19.65[c]	21.87[b]	0.49	0.00
Thigh	11.33[a]	10.25[ab]	10.16[b]	0.32	0.03
Drum stick	5.43[a]	4.64[ab]	4.57[b]	0.22	0.02
Wing	3.85	3.82	4.07	0.18	0.57

[abc] Means with different superscript on the same row differ significantly ($p<0.05$)
A= Control , B= Dexamethasone, C= Dexamethasone +Selenium +Vitamin E
SEM=Standard Error of the Mean

Liver weights were observed to increase with inclusion of dexamethasone. Increased liver weight is always regarded as one index of stress condition (Puvadolpirod and Thaxton, 2000). Liver result from the dexamethasone study agrees with previous studies where liver weight has been consistently shown to increase in broilers treated with corticosterone or ACTH (Malheiros *et al.,* 2003). In this study an increase in liver weight of up to 25% was observed relative to the control. This is probably due to an increase in liver lipid due to the process of gluconeogenesis, because liver lipids have been shown to increase significantly in broilers treated with ACTH

(Puvadolpirod and Thaxton, 2000). This may also be partially attributable to liver tissue enlargement because corticosteroids have been shown to stimulate protein synthesis in the liver (Baxter and Rousseau, 1979). The kidney and spleen weights were not significant (P>0.05). The non-significant differences in visceral organ (kidney and spleen) weights observed is in agreement with Vahdatpour *et al*. (2009) who observed no significant (P<0.05) effects on visceral organ weights with elevated corticosterone intake.

Table 4: Internal organs of broiler chickens fed dexamethasone with selenium and vitamin E supplementation

Parameters(%)	A	B	C	SEM	P. VALUE
Heart	0.48[b]	0.56[ab]	0.62[a]	0.03	0.01
Gizzard	2.01[b]	2.82[a]	2.43[ab]	0.13	0.00
Kidney	3.85	3.82	4.07	0.18	0.57
Spleen	0.10	0.08	0.10	0.02	0.74
Liver	1.90[b]	2.20[ab]	2.34[a]	0.10	0.01

[abc] Means with different superscript on the same row differ significantly (p<0.05)
A= Control, B= Dexamethasone, C= Dexamethasone + Selenium + Vitamin E
SEM=Standard Error of the Mean

CONCLUSION

The study showed that the consumption of dexamethasone by broiler chickens can lead to a reduction in body weight and feed efficiency due to its ability to stimulate protein catabolism, leading to excessive catabolism, muscle atrophy, and mobilization of free fatty acids from adipose stores. It also has a detrimental effect on their live weight, dressed weight, dressing percent, carcass and some of the internal organs. This decrease in weight could be due to the additional stress caused by dexamethasone, resulting in reduced feed intake and weight loss. The liver weight was observed to increase with the inclusion of dexamethasone, which is usually regarded as one index of stress condition. The administration of dexamethasone-induced physiological stress where glucose metabolism is favored over protein synthesis, which had a negative impact on feed to tissue conversion, resulting in higher feed conversion ratios.

Inclusion of Vitamin E and selenium in the diet of some birds shows a better result reflecting its mitigating effect which could be attributed to the role of Vitamin E and selenium in alleviating stress.

RECOMMENDATION

It is recommended that birds should not be fed with dexamethasone as it has been shown to have detrimental effects on their growth performance, carcass characteristics as well as on organs weight and when to be fed, it should be at a minimal (1mg) level with the supplementation of Vitamin E or Selenium.

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