# Growth and Physiological Response of Local Turkey (*Meleagris gallopavo*) Offered Dietary Vitamin C.

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## ABSTRACT

This study investigated the effects of dietary supplementation of vitamin C on growth and physiological response of local turkey (*Meleagris gallopavo*). One hundred and twenty day-old unsexed turkey poults were fed with different levels of vitamin C (0, 2, 3, and 4g/kg diet) supplemented diet. The turkey were randomly allocated into four dietary treatments T1, T2, T3, and T4 (containing 0, 2, 3, and 4g/kg diet, respectively). The trial lasted for 56 days during which data collected were analyzed by method of least squares of SYSTAT. Results showed no effect on feed conversion ratio of turkey dietary treatments even at higher levels of inclusion.

Body weight gain, daily weight gain and feed intake were significantly (P< 0.05) affected. The haematological indices of turkeys were significantly influenced (P< 0.05) by vitamin C supplementation. There was no mortality or morbidity recorded in the course of this study, indicating that vitamin C showed no toxicity in the birds. It was concluded that dietary supplementation of vitamin C at 2g/kg improved growth response, feed conversion ratio and body weight gain and rectal temperature in turkey birds.

(Keywords: poultry health, feed, dietary treatment, physiological response. ascorbic acid)

## INTRODUCTION

There has been an increased poultry production in tropical countries. There is however an adverse militating effect of climatic conditions which has not enabled the birds raised in this region to attained their intrinsic genetic potential. In view of this setback, several feed additives have been added to combat the adverse climatic condition and improve poultry production. Among the feed additives added to poultry feed is ascorbic acid

The influence of supplementary vitamin C on the harmful effect of physiological stress has met with rising interest in recent times. The physiological requirement of vitamin C has been shown to exceed the vitamin C synthesizing ability of chicken under stressful condition like high ambient temperature, humidity, production rate and parasitic infection (Sahin et al., 2002; Sahin and Kucuk 2001).

Supplementation of vitamin C has been shown to be effective in preventing the deleterious effects of heat stress (Gous and Morris, 2005; Whitehead and Keller, 2003), protecting the oxidation of DNA and protein (Njoku, 1986). Also, addition of vitamin C in the diet has been found to increase feed intake and weight gain in broilers (Gross, 1988), decrease malondialdehyde and adrenocorticotrophic hormone concentrations and increase serum thyroxine and triiodothyronine concentration in laying hens reared under high ambient temperature (Sahin et al., 2002). All these parameters give indication of reduced effects of stress. Though, the report so far quoted proved that vitamin C is efficacious but most of them are from experiments carried out in climate chambers in the temperate countries. The available breeds in Nigeria may respond differently to this. Additionally, there is dearth of information on the effect of supplementation of vitamin C on turkey.

Several studies have been conducted to show the importance of supplementary vitamin C in poultry production during stress periods. However, Studies with vitamin C in local turkeys are very limited. There have not been consistent reports

on the effects of vitamin C on the performance of turkeys (Konca, 2008). Therefore, this study seeks to investigate the growth and physiological response of Nigerian local turkeys fed diet supplemented with vitamin C.

## MATERIALS AND METHODS

### Experimental Site

The experiment was conducted at the Research Farm of the Federal University of Agriculture Abeokuta (FUNAAB), Abeokuta, Nigeria. The climatic condition is humid with a mean annual rainfall of 1037mm. The annual mean temperature and humidity are $34^0$C and 82 % respectively level (Amujoyegbe et al., 2008).

### Experimental Birds and Management

One hundred and twenty day- old unsexed local poults were obtained from a commercial hatchery. The poults were brooded in a deep litter system for four weeks with wood shavings littered as beddings. The poults were weighed individually between twelve identical pens with each pens containing 10 birds. During brooding, temperature were controlled at $38^0$C from 0 to 3 days, and then gradually reduced by $2^0$C per week to a final temperature of $32^0$C at the last week of brooding. Feed and water were provided were supplied *ad libitum*. The composition of the experimental diet (pre starters, starter) is shown in Table 1.

### Dietary Treatment

The feeding trial commenced at the expiration of the brooding phase (28 days) and lasted for 8 weeks. A standard basal diet containing no supplemental vitamin C was formulated as control while three additional experimental diets were formulated to contain supplemental vitamin C at 0, 2, 3 and 4 g/kg respectively. There were 40 birds assigned to each treatment. The treatment was allotted such that 3 pens (each containing 10 birds) were allocated to each dietary treatment. The crude protein and metabolizable energy contents of the feeds were balanced within the recommended range for growing turkeys (NRC, 1994). The experiment lasted for 56 days (28-84 days).

## DATA COLLECTION

### Growth Performance

Weekly live weights of the birds in each replicate was taken throughout the experimental period. Weight gain was calculated from the data obtained. The amount of the feed supplied was measured weekly. Determination of intakes of feed was by done by subtracting the left-over feed. The feed intakes and feed conversion ratio was calculated as ratio of feed to weight gain and recorded. There was no mortality recorded throughout the period or the experiment.

**Table 1:** Composition of Experimental Diets for Turkey.

| Ingredient | Pre starter phase (%) | Starter Phase (%) | Grower Phase (%) | Finisher phase (%) |
|---|---|---|---|---|
| Maize | 44.00 | 50.00 | 55.00 | 48.00 |
| Soyabean meal | 31.00 | 27.00 | 20.00 | 20.00 |
| Fish meal | 5.00 | 3.50 | 2.00 | 1.00 |
| Wheat offal | 10.00 | 12.55 | 7.00 | 20.00 |
| Bone meal | 5.60 | 3.20 | 12.50 | 3.50 |
| Oyster shell | 3.00 | 2.50 | 2.50 | 2.50 |
| Broiler premix | 0.40 | 0.50 | 0.50 | 0.30 |
| Salt | 0.40 | 0.25 | 0.75 | 0.25 |
| DL – Methionine | 0.40 | 0.20 | 0.10 | 0.20 |
| Lysine | 0.20 | 0.10 | 0.15 | 0.10 |
| Choline chloride | 0.00 | 0.10 | 0.00 | 0.00 |
| Total | 100.00 | 100.00 | 100.00 | 100.00 |

## Physiological Parameters

The rectal temperature (RT) of four birds randomly selected out of each replicate was measured with clinical digital thermometer ($0.1^0$C accuracy) inserted into the rectum (colon) of the birds for 1 minute. Respiratory rate (RR) of the birds was taken as the number of breath per minute. Data on RT and RR were collected on the last one day of each week by 08.00h and 16.00h throughout the experimental period.

## Haematological Parameters

Blood samples were collected from the birds by selecting 4 birds per pen randomly. Blood was obtained by puncturing the wing vein and collection was done into EDTA vials for the determination of haematological parameters.

## Statistical Design and Analyses

The data collected were analyzed using a completely randomized design. The model is shown below:

$Y_{ij} = \mu + T_i + \Sigma_{ij}$
$Y_{ij}$ = Observed value of dependent variable
$\mu$ = Population mean
$T_i$ = $i^{th}$ effect due to Vitamin C (I = 1 …4)
$\Sigma_{ij}$ = Residual error.

## RESULTS

The performance characteristics of turkey fed with supplemental Vitamin C is shown in Table 2. All the parameters measured with the exception of feed conversion ratio were affected by dietary supplementation of vitamin C. Turkey fed diet supplemented with 2g/kg dietary supplementation of Vitamin had the highest live weight, body weight gain and daily weight gain. Beyond 2g/kg dietary vitamin C supplementation, final live weight and weight gain reduced significantly. The observation recorded in this trial agrees with the findings of Sahin et al. (2002) and Sahin et al. (2003) who reported that improved feed weight gain in broiler chicken fed with Vitamin C was observed. However, our finding negates the result of Değirmencioğlu and Ak (2003) who found that including vitamin C in turkey diets did not significantly affect body weight gain.

The increased feed intake recorded with increasing dietary inclusion recorded with vitamin C could be as a result of reduced body stress. This reduction in physiological stress could be responsible for increased feed intake. Birds that are less stressed will eat more. This is in conformity with the observation of Sahin et al. (2001) and Wong et al. (1977) who reported improved feed intake with broiler chickens fed with vitamin C supplementation. Dietary supplementation of vitamin C reduces physiological stress hence improving feed intake in turkeys. On the contrary, our findings is at variance with the report of Değirmencioğlu and Ak (2003)who reported that adding vitamin C to turkey diet had no significant difference in the feed intake.

Despite the improved feed intake observed following increasing dietary supplementation of Vitamin C, feed conversion ratio were not affected by the supplementation of Vitamin C in the feed of turkeys.

**Table 2:** Performance Characteristics of Turkey Fed Vitamin C.

| Parameter (g/bird) | Vitamin C Inclusion Levels | | | | |
|---|---|---|---|---|---|
| | 0% | 40% | 60% | 80% | SEM |
| Average initial weight | 304 | 326 | 320 | 300 | 6.24 |
| Average final weight | 2521[d] | 2807[a] | 2671[c] | 2736[b] | 60.95 |
| Average body weight gain | 2217[d] | 2481[a] | 2351[c] | 2436[b] | 58.06 |
| Average daily weight gain | 21.73[d] | 26.45[a] | 24.13[c] | 25.64[b] | 1.04 |
| Average total feed intake | 3950[d] | 4750[c] | 4820[b] | 4930[a] | 7.08 |
| Average daily feed intake | 70.54 | 84.82 | 86.07 | 88.04 | 4.00 |
| Feed conversion ratio | 1.78 | 1.91 | 1.87 | 2.02 | 0.06 |
| Mortality, % | 0.00 | 0.00 | 0.00 | 0.00 | |

[abcd] mean on the same row having different superscripts are significant (P < 0.05)

This corroborates the findings of Değirmencioğlu and Ak (2003) who found that including vitamin C in turkey diets at 0, 50, 100 and 150 ppm did not significantly affect feed conversion ratio. Moreover, Lohakare et al. (2005) also noted that vitamin C supplementation did not affect feed intake and feed conversion ratio. However, Okan et al. (1996) reported that an improved feed conversion ratio by Ascorbic acid supplementation to Japanese quail reared under high temperature. Mckee et al. (1995) also detected an improvement in feed conversion ratio of broilers as result of vitamin C supplementation.

The results presented in Table 2 shows that mortality rate of birds during the experimental period were not influenced by dietary supplementation of vitamin C. Similar results were obtained by Orban et al. (1993). This implies that Vitamin C supplementation had no toxicity with the birds. The fact that the feed conversion ratios were similar in all the dietary treatment showed that the supplementation was not toxic to the birds.

Rectal temperature of turkeys fed dietary treatment is presented in Table 3. The turkeys in the control group had the highest ($P < 0.05$) rectal temperature at week 7 while the temperature reduced with an increase in the level of vitamin C supplementation. The trend of rectal temperature at week 9 also followed similar pattern. However, there was no significant difference observed at the other weeks of this study.

Elevation in body temperature is one of the responses of birds to high ambient temperature (Kadim et al., 2008). Chickens maintain a constant body temperature but when the internal heat production and heat gain from the environment are greater than the rate of heat dissipation, body temperature increase. There are several studies which demonstrated that supplemental ascorbic acid reduces rectal temperatures in heat-stressed birds (Attia, 1976; Kutlu and Forbes, 1993). Similarly, Ahmad *et al.* (1967) reported significantly lower body temperatures in ascorbic acid supplemented birds at environmental temperatures of 29.4 and 35.0$^{o}$C. Ascorbic acid supplementation at 100, 50, 25 or 0 mg/kg diet resulted in body temperature increases of 0.33, 0.39, 0.56 and 0.89$^{o}$C, respectively in birds maintained at 32$^{o}$C over an initial ambient temperature of 15$^{o}$C (Attia, 1976). This finding would suggest that ascorbic acid either decreases heat load by lowering heat production or increases heat loss by influencing a venues of thermal exchange between the body and the environment (Change *et al.,* 1993).

In the present study, the trend observed in is consistent with Attia (1976) and Kutlu and Forbe (1993) who reported reduction in rectal temperature of broilers and layers given supplemental vitamin C. This phenomenon is due to the fact that vitamin C reduces the heat load of poultry birds, increases the heat loss and birds tolerance to high ambient temperature. The possible explanation for the insignificant difference at some of weeks of this study may be due to the fact that the temperature was not high enough to impose stress on the birds.

**Table 3:** Rectal Temperature of Turkeys Fed Dietary Treatment.

| Week | T1 | T2 | T3 | T4 | SEM | P Value |
|---|---|---|---|---|---|---|
| 5 | 41.55 | 41.65 | 41.70 | 41.30 | 0.177 | 0.421 |
| 6 | 41.50 | 41.58 | 41.73 | 41.48 | 0.136 | 0.576 |
| 7 | 41.95[a] | 41.93[a] | 41.50[b] | 41.40[b] | 0.100 | 0.003 |
| 8 | 41.33 | 41.78 | 41.68 | 41.48 | 0.217 | 0.485 |
| 9 | 41.65[a] | 41.60[ab] | 41.43[ab] | 41.33[b] | 0.074 | 0.031 |
| 10 | 41.40 | 41.73 | 41.85 | 41.53 | 0.187 | 0.368 |
| 11 | 40.75 | 40.98 | 41.10 | 41.20 | 0.178 | 0.355 |
| 12 | 41.15 | 40.95 | 41.30 | 41.20 | 0.195 | 0.644 |
| Average | 41.33 | 41.43 | 41.59 | 41.47 | 0.070 | 0.082 |

[ab] mean values with different superscripts are significantly different

Table 4 shows the respiratory rate of turkeys fed with different levels of vitamin C. The welfare in the turkey was not affected by varying vitamin C supplementation. This is at variance with the report of Curca et al. (2004) who reported that supplementation of vitamin C reduces environmental stressors. This could be due to the fact that the ambient temperature as at the period of the experiment was not stressful enough to impose any significant effect on the birds.

## Haematological Profile

The haematological profile of turkeys fed with different levels of vitamin C is shown in Table 5. Feeding of various levels of vitamin C elicited significant differences ($P < 0.05$) in the PCV, Hb, RBC, and WBC contents. The different parameters of the turkey blood were significantly ($P < 0.05$) affected by the treatments. The addition of vitamin C improves the PCV, Hb, RBC and WBC of the birds compared with those that did not receive Vitamin C.

Birds offered 2g/kg of vitamin C had a significantly higher PCV than that of the control and other experimental group. Birds that were not offered vitamin C at all (the control) had the lowest PCV. Altan *et al*., (2000) reported that broilers subjected to heat-stress had reduced PCV. It can then be explained that adminstration of vitamin C ameliorated the effect of heat stress on the birds in this group.

The haematological parameters of present finding resembles that of Dukes (1955), who reported that the number of erythrocytes and other components of blood varied due to the influence of nutritional status. However, our observation does no agrees with the findings of Tuleun et al. (2011) who reported that there was no significant difference in the haematological parameters observed in Japanese quail offered vitamin C.

Limiting the dosage of vitamin to 2g/kg was better than higher dosage. The higher PCV in treatment 2 and the general significant ($P < 0.05$) difference recorded in this study is at variance with the report of Deaton et al. (1969) which indicated RBC and PCV are lower in birds reared at 32.2 and $30^0$C compared to those reared at lower temperature.

**Table 4:** Respiratory Rate of Turkeys Fed with Different Levels of Vitamin C.

| Week | T1 | T2 | T3 | T4 | SEM | P Value |
|---|---|---|---|---|---|---|
| 5 | 41.00 | 43.00 | 45.00 | 51.00 | 3.958 | 0.354 |
| 6 | 36.50 | 37.00 | 39.00 | 45.00 | 3.603 | 0.364 |
| 7 | 39.00 | 39.00 | 41.00 | 47.00 | 3.512 | 0.365 |
| 8 | 46.00 | 43.00 | 43.00 | 45.33 | 3.949 | 0.893 |
| 9 | 50.50 | 60.00 | 44.00 | 44.50 | 4.449 | 0.085 |
| 10 | 39.50 | 39.50 | 42.00 | 47.00 | 4.108 | 0.548 |
| 11 | 45.00 | 59.00 | 73.00 | 58.00 | 8.827 | 0.208 |
| 12 | 47.00 | 55.00 | 65.00 | 50.00 | 4.664 | 0.081 |
| Average | 43.31 | 46.94 | 49.00 | 48.88 | 2.068 | 0.182 |

[ab] mean values with different superscripts are significantly different

**Table 5:** Haematological Parameters of Turkeys Fed with Different Levels of Vitamin C.

| | T1 | T2 | T3 | T4 | SEM | P Value |
|---|---|---|---|---|---|---|
| PCV | $29.00^{b}$ | $34.50^{a}$ | $33.00^{ab}$ | $33.50^{ab}$ | 0.791 | 0.028 |
| HB | $9.65^{b}$ | $11.50^{a}$ | $11.00^{ab}$ | $11.15^{ab}$ | 0.262 | 0.027 |
| RBC | $1.65^{b}$ | $2.05^{a}$ | $1.90^{ab}$ | $1.95^{ab}$ | 0.066 | 0.050 |
| WBC | $4.95^{b}$ | $5.65^{a}$ | $6.10^{a}$ | $5.80^{a}$ | 0.106 | 0.006 |

[ab] mean values with different superscripts are significantly different

## CONCLUSION

Dietary supplementation of vitamin C at 2g/kg improved growth response, feed conversion ratio and body weight gain. Although there was a slight reduction in the pulse rate following dietary supplementation of Vitamin C, this reduction did not show any regular pattern.

Addition of vitamin C resulted in improved PCV, Hb, RBC, and WBC of turkeys. Dietary supplementation of vitamin C at 2g/kg showed improved haematological parameters.

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