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EFFECTS OF ASCORBIC ACID SUPPLEMENTATION ON THE PERFORMANCE INDICES OF STARTER PULLETS IN A HOT - HUMID ENVIRONMENT

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ABSTRACT

Two studies were conducted to evaluate the nutritional effects of supplementary ascorbic acid (AA) at levels of 0, 100, 200, and 300 mg/kg in the diets of starter pullets reared at different seasons (harmattan season and rainy season) in a hot humid environment. Two hundred and forty day-old Harco pullet chicks were used in each trial, they were randomly assigned to each of the four dietary treatments in three replications of twenty chicks per replicate. Each trial lasted 8 weeks during which data were collected and a 2 X 4 factorial arrangement was employed in the analysis of data collected. Results showed significant ($p<0.05$) effect of treatments on feed conversion ratio of birds fed dietary treatments. Season of presentation of ascorbic acid significantly affected ($p<0.05$) feed intake with higher value obtained in the rainy season compared to the dry season (41.89g vs. 39.59).

Key words: Season, heat stress, supplementary, starter, harmattan, Ascorbic acid

INTRODUCTION

The importance of vitamins as biological catalysts needed to sustain the development and well-being of the animal is already established. Nutritionists have agreed that thirteen vitamins are essential to farm animals. An important compound is, however, left out of this list and the name of the compound is called Ascorbic acid (AA), commonly called vitamin C. It has been assumed that birds are always able to produce enough vitamin C to meet their needs, thus, the classification as a non-essential ingredient of poultry diet, (Garrick and Hauger, 1925). Research conducted mainly in recent times, however, has shown that this statement can no longer be supported. In chicks, the level of ascorbic acid synthesis in first day after hatching was low. However, this increased several fold until 20-30 days of age (Hornig and Frigg, 1979). The influence of supplementary AA in combating the harmful effects of physiological stress associated with hot humid

Environment has met with rising interest, with several reports showing inconsistent values of supplementary AA. Njoku *et al*. (1990) reported the effect of dietary supplementation of 500mg/kg of ascorbic acid on the production of eggs and egg component in laying chicken at temperatures of 20^0C and 35^0C. Also AA supplementation has been reported to increase egg production, semen production, sperm concentration and testicular weight (Pardue and Thaxton, 1986) and supplementation was most effective during periods of elevated temperature. Raja and Qureshi (2000) carried out an experiment on chicks during the hot season in Pakistan, supplementation of 100mg AA/kg improved body weight, feed efficiency and livability. The possibility of AA in bringing about a better nutrient digestion and performance in broilers was investigated by Marron *et al.* (2001). They observed a 20% decrease in-vivo viscosity of ilea digest in broilers fed a diet supplemented with 250mg AA/kg, but this failed to have any effect on performance. This study was therefore, designed to investigate the performance of pullet chicks on supplemental ascorbic acid.

MATERIALS AND METHODS

Experimental Location

The two trials were carried out at the Teaching and Research Farm, University of Agriculture, Alabata, Abeokuta Nigeria.

Experimental Design and Animal Management

The study was a 2x4 factorial design in which there were two seasons and four levels of ascorbic acid. There were two trials, each lasting eight weeks. The first trial was carried out during the rainy season between June and August while the second trial was carried out during the harmattan season between November and January. Atmospheric conditions of the periods are shown in Table 1. The experimental diet composition is as shown in Table 2. Four experimental diets were formulated, three of which contained ascorbic acid at 100, 200 and 300 mg/kg of the diet. The experimental diet without ascorbic acid served as the control. A week before the arrival of the chicks, the brooder pens were thoroughly cleaned, washed and disinfected. Two hundred and forty (240) day old Harco pullet chicks were used in each trial of the study. Immediately on arrival on the farm, sixty (60) chicks were randomly assigned to each of the four dietary treatments in three replicates of twenty chicks per replicate. The birds were raised on deep litter pens of 1.0x1.5m dimension with dry wood shavings as litter materials. The experimental birds started receiving dietary treatments as from day old and routine vaccination and medication were carried out as and when due with feed and water given *ad libitum*.

Chemical and Statistical analyses

The proximate composition of the basal diet was determined by AOAC (1995). Data were subjected to a 2 X 4 factorial analysis. The analysis of variance was done according to the procedure of the Statistical Analysis System (SAS, 2001).

RESULTS

The result of the main effects of dietary treatment (level of ascorbic acid, AA) and season on performance characteristics and cost benefit analysis of starter pullet is presented in Table 3. The interaction effects of AA level and season on the measured indices is presented in Table 4. Analysis of variance indicated a significant difference ($p<0.05$) in feed: gain ratio due to dietary treatments. Although, ANOVA did not indicate

Table 1: Atmospheric conditions of experimental site

Season	Month	Max. Temp. ^{0}C	Min. Temp. ^{0}C	Mean Temp. ^{0}C	Rainfall (mm)	Relative Humidity (%)
Rainy	June	32.20	17.10	24.65	168.60	87.20
	July	29.20	15.30	22.25	55.70	95.00
	August	28.90	12.20	20.55	48.70	94.80
Harmattan	November	34.70	10.90	22.80	54.50	82.50
	December	35.40	9.90	22.65	-	90.70
	January	35.10	11.50	23.30	12.30	60.00

Significant ($p>0.05$) difference in the growth rate, there was an improvement in weight gain in the AA treated birds vis-à-vis control birds. Furthermore, feed intake was found to increase across the dietary treatments with increasing level of supplemental ascorbic acid. The period of feeding AA with average temperature of 20.5^0 C and mean relative humidity (RH) of 91% in the rainy season and 25^0 C and 81% RH in the harmattan season significantly ($p<0.05$) affected feed intake with higher intake in the rainy season with an average value of 41.89g per bird compared to 39.59g/ bird recorded in the harmattan season. Body weight gain were not significantly ($p>0.05$) affected by season. Birds, however, grew better during the rainy compared to the harmattan period. The rate of mortality decreased across the dietary treatments as the level of AA is increased, although no significant difference was observed. There was no significant interaction effect ($p>0.05$) of ascorbic acid levels X season for all the parameters measured. Birds fed 300mg AA/kg recorded the highest cost of N28.69 per kg feed. However, the cost of feed per kg weight gain was lowest in birds fed 100mg AA/kg. The mean values of the cost of feed per kg weight gain ranged from N179.88 to N201.01.

DISCUSSION

The increased weight gains observed in the AA treated birds compared to the control birds at the starter phase agrees with the earlier works of March and Biely (1953), Schmeling and Nockels (1978), Alisheikhov (1980) and Nockel (1984). These workers recorded an increased final body weight and average daily body weight gain in chicken fed diets with AA supplementation. Similarly, Kafri and Cherry (1984) showed improved weight gain with ascorbic acid supplementation for birds. Nockel (1984) reported that the increased weight gain might be due to an effect of AA on thyroid function, Perek (1984) reported the gain in weight might be through its effect on the metabolism of tyrosine and phenylalanine, which are precursors of thyroid hormones.

Table 2: Percentage Composition of Experimental Basal Diets (Starter Mash)

	Levels of Ascorbic Acid (mg/kg) supplementation			
Ingredient	0	100	200	300
Maize	43.00	43.00	43.00	43.00
Soya bean Meal	10.00	10.00	10.00	10.00
Groundnut Cake	15.00	15.00	15.00	15.00
Fish Meal	2.00	2.00	2.00	2.00
Wheat Offal	13.00	13.00	13.00	13.00
Brewers Dried Grain	12.30	12.30	12.30	12.30
Bone Meal	2.00	2.00	2.00	2.00
Oyster Shell	2.00	2.00	2.00	2.00
*Premix (Starter)	0.25	0 25	0.25	0.25
Salt	0.25	0.25	0.25	0.25
Methionine	0.10	0.10	0.10	0.10
Lysine	0.10	0.10	0.10	0.10
Vitamin C	-	+	++	+++
Total	**100.00**	**100.00**	**100.00**	**100.00**
Calculated Analyses				
Crude Protein (%)	21.48	21.48	21.48	21.48
M.E (kcal kg^{-1})	2636.00	2636.00	2636.00	2636.00
Ether Extract (%)	4.32	4.32	4.32	4.32
Crude Fibre (%)	4.72	4.72	4.72	4.72
Calcium (%)	1.39	1.39	1.39	1.39
Phosphorus (%)	0.57	0.57	0.57	0.57
Determined Analyses				
Crude Protein (%)	18.95	18.95	18.95	18.95
Crude Fibre (%)	4.87	4.87	4.87	4.87
Ether Extract (%)	4.06	4.06	4.06	4.06

* Provided the following per kg of feed:

* Starter Premix

Vit. A = 15,000,000 iu ; Vit. D_3 = 3,000,000 iu ; Vit.. B_1 = 1,000mg;Vit. B_2 = 6,000mg; Vit. B_{12} = 20mg; Vit. K_3 = 3,000mg; Vit. E = 30,000mg; Biotin = 50mg; Folic acid = 1,500mg; choline chloride = 250,000mg; Nicotinic acid = 30,000mg; calcium pantothenate = 15,000mg; Cobalt = 400mg; Copper = 8,000mg; Iron = 32,000mg; Iodine = 800mg; Zinc = 40,000mg; Manganese = 64,000mg. Sodium = 160mg; BHT = 5,00.

Table 3: Main effects of Ascorbic Acid Levels and Season on performance of Starter Pullets

	Levels of Ascorbic acid (mg/kg)					Season		
Parameters	0	100	200	300	SEM	Rain	Harmattan	SEM
Ave. Initial Weight (g)	34.09	34.79	34.56	34.67	0.43	35.55	33.01	1.24
Ave. Final Weight (g)	379.75	396.66	396.68	390.50	6.94	394.29	377.50	7.04
Ave. Weight Gain (g)	345.67	361.88	362.11	356.83	6.84	358.75	344.50	6.96
Ave. Daily Wt gain (g/d)	6.17	6.46	6.47	6.31	0.17	6.41	6.15	0.12
Ave. Daily Feed Intake (g)	39.61	40.78	40.99	41.58	0.97	41.89[a]	39.59[b]	0.88
Feed: Gain Ratio	6.42[b]	6.34[b]	6.33[b]	6.96[a]	0.16	6.55	6.48	0.18
Mortality (%)	8.00	6.50	4.83	3.66	1.32	5.00	6.50	1.23
Cost of feed (N)/kg diet	28.15	28.33	28.51	28.69	0.30	24.69	32.15	3.73
Cost of feed (N)/kg weight gain	180.85	179.88	180.29	201.01	11.14	162.03	208.49	7.17

Means within the same row for each main effect with differing superscripts are significantly different ($p<0.05$).

Table 4: Interaction Effects of Ascorbic Acid Levels x Season on Performance of Starter Pullets

Parameters	Levels of Ascorbic acid (mg/kg)								
	0		100		200		300		
	Rain	Harm	Rain	Harm	Rain	Harm	Rain	Harm	SEM
Ave. Initial Weight (g)	35.04	33.13	35.75	33.83	35.73	33.39	35.66	31.67	1.27
Ave. Final Weight (g)	389.50	370.00	393.33	400.00	393.33	400.00	401.00	340.00	10.32
Ave. Weight Gain (g)	354.46	336.67	357.58	366.17	357.60	366.61	365.34	308.33	10.35
Ave. Daily Wt gain (g)	6.33	6.02	6.39	6.54	6.39	6.55	6.58	5.51	0.19
Ave. Daily Feed Intake (g)	41.40	37.82	41.70	39.87	41.05	40.94	43.43	59.74	1.01
Feed: Gain Ratio	6.55	6.29	6.51	6.10	6.43	6.25	6.65	7.28	0.21
Mortality (%)	5.00	11.00	6.67	6.33	5.00	4.67	3.33	4.00	1.8

Additionally, the observed weight gains might have been due to the fact that the supplemental AA assisted the chicks to overcome the stress of early development. This is because the chicks were yet to develop biosynthetic ability for AA which happens sometime after hatching (Hornig and Frigg, 1979), thus, maximizing subsequent performance. Also, consistent with the earlier work of Zakaria *et al.* (1998) where birds receiving the injection of 2mg AA and the oral dose of 2mg AA from day old to 49 days of age showed better growth than birds on control.

The non-significant ($p>0.05$) increase in feed intake across the dietary treatments is in agreement with the earlier works of Thorton (1962), Ahmed *et al.* (1967) and Attia (1976). It was opined that the increased feed intake might have been due to increased appetite by the AA treated birds as a result of the role of ascorbic acid in reducing possible heat stress by lowering the body temperature. In the meantime the lower feed intake in the harmattan period with an average temperature of 25^0C and 81 % RH may be related to another mechanism of ameliorating heat stress by the birds. Birds are known to eat less feed during the period of high environmental temperature in order to reduce body heat load. Generally, the pattern of performance result following the inclusion of ascorbic acid in the diets at both rain and harmattan periods of the starter phase might be due to the fact that responses to supplemental AA took place under non stressful or thermo neutral conditions. The lower performance indices observed in birds with increasing dietary level of AA when fed in the harmattan period agrees with the report of Kutlu and Forbes (1994) that under non stressful environmental conditions, dietary AA supplementation does not have any beneficial effects on birds' performance and on occasions may result in slightly poorer performance.

The mortality recorded in this trial, although not limited to any dietary treatment or season was not directly due to experimental treatments. The post-mortem performed on dead birds showed that mortality recorded at the starter phase of the experiment was due to coccidian infection. Furthermore, the decreasing mortality with increasing levels of AA observed might be due to the fact that ascorbic acid or vitamin C regulates the synthesis of corticosterone, the stress hormone. Nockels *et al.* (1973) reported that ascorbic acid aside its role in steroid biosynthesis, might also increases the rate of excretion of cortisol or its precursor from the body. Edens and Siegel (1975) suggested that insufficient adrenal cortex hormones in stressed birds' results in failure of different metabolic processes in the body leading to the death of the birds. Environmental heat is known to trigger off the incidence or occurrence of some diseases. This perhaps, explains the higher mortality recorded in the harmattan period of this study.

There was a significant effect on feed: gain ratio due to dietary treatment with improved feed: gain ratio in the AA treated birds. Several reports of improvement in feed conversion ratio following ascorbic acid supplementation have been made (Fah, 1978; Alisheikhov, 1980; Njoku and Nwazota, 1989; and Njoku *et al.,* 1990). Evidence abounds in this study to confirm some beneficial effects of supplementing pullet chicks' diets with AA and optimum responses occurred with supplementation of 200 mg/kg.

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