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Ascorbic Acid Supplementation: Effects on the Growth and Packed Cell Volume of Broiler Chickens

Nnamonu, Emmanuel Ikechukwu[1]; Okoye, Chidiebere Bridget[2]; Ufele, Angela N. [2]; Nwabor, Forstinus Ozioma[3]; Iloegbu, Adaeze Chinenye[4]; Martins, Paul Emenike[3]; Odiachi, Osita[3]; Eze, Tochukwu Rex[5]

1. Department of Zoology, University of Nsukka
2. Department of Zooology, Nnamdi Azikiwe University Awka
3. Department of Microbiology, University of Nsukka
4. Department of Agricultural Economics, Anambra State University
5. Department of Biochemistry, University of Nsukka

Corresponding author's email: nnamonuei@yahoo.com

Abstract
This study was conducted to observe the effect of natural and artificial ascorbic acid supplementation on the growth and packed cell volume using broiler chicks. The chicks were divided into groups A, B, C and D. They were fed with the same quantity of feed but different type of ascorbic acid in a litre of water were also administered to groups B to D. Group A which served as the control group received no ascorbic acid and groups B was given 150 g of natural and 150 g of artificial ascorbic acid per litre of water, C received 300 g of natural and 300 g artificial ascorbic acid while D was given 300 g of artificial ascorbic acid per litre of water. The result of the supplement effects on the birds showed that birds feed with natural ascorbic acid recorded the highest weight gain 1.22 kg followed by those feed with mixture of natural and artificial ascorbic acid 1.09kg. Birds that were feed artificial ascorbic acid recorded a weight gain of 0.89 kg while the control group produced the least weight gain of 0.79 kg. The mixture of natural and artificial ascorbic acid proved to be most effective on PCV 21.23, followed by that of artificial ascorbic acid 18.1. Whereas control group recorded a PCV level of 12.84 natural ascorbic acid recorded the least PCV level of 9.93. The result of the experiment indicated that natural ascorbic acid elevated body weight while mixture of natural and artificial ascorbic acid boosted PCV in broiler when given in the right proportion.
Keywords: ascorbic acid; packed cell volume; supplementation; natural; artificia

Introduction

Poultry is a general term for birds of several species such as chicken or domestic fowls, ducks, geese, guinea fowls, pigeons, ostriches and other game birds (Okunnade *et al.*, 2000). In Nigeria, different poultry species contribute significantly to the animal protein supply of the populace in terms of eggs laid (Orumuyi *et al.*, 2007) and meat produced. The general objective of poultry nutrition is to maximize the production performance of birds (Uchegbu *et al.*, 2007). Profitability in the poultry industry depends largely on the biological efficiency of the birds in terms of high egg production, efficiency of feed consumption and life ability. The economic efficiency of chicken meat appears to be dependent on the growth rate of the birds (Adegbola, 1990). Over the years, poultry industry, chicken in particular has been the major source of animal protein in Nigeria. A substantial proportion of Nigeria foreign exchange goes to the importation of livestock, day old chicks and other foreign inputs in order to satisfy the local demand. However, the massive importation of poultry meat cannot provide a lasting solution to the problem of increasing animal poultry demand in Nigeria. Therefore, a planned development of livestock industry and increased poultry production would appear to be a better way of closing the protein gap at both short and long demand. Increase in egg and meat production can be achieved through proper nutrition (Etim and Oguike, 2010). Feed is an important aspect of poultry production (Adenkola *et al.*, 2013). Poultry production especially broiler chicken remain one of the viable way of achieving sustainable and rapid production of high quality animal to meet the increasing demand of the Nigerian teeming population. However, high cost of energy and protein concentrates used in formulation of poultry feeds has remained a significant challenge to the poultry industry, (Apata and Ojo, 2000).

Ascorbic acid belongs to the water soluble group of vitamins and it is a vitamin found mainly in fruits and vegetables. Fruits such as citrus fruits such as orange and lemon, pineapple, mango, watermelon and strawberries contain comparatively high amount of the vitamin. Vegetable source of ascorbic acid includes red and green pepper, tomatoes, cabbage, leafy greens and spinach. Because it is derived from glucose, many animals including birds are not able to produce it but they require it as a dietary micronutrient. Ibiyo *et al.*, (2006) also have a detailed account of the importance of ascorbic acid as follows: it improves immune function and improve growth. Research data indicate that supplementation with ascorbic acid should be considered as management alternative to prevent vitamin C deficiencies when poultry are stressed (Quarles and Adrian, 1989). There are different methods to supplement ascorbic acid such as injection, dietary supplementation or water supplementation as found by Pardue and Thaxton (1985). Quarles and Adrian, 1989 indicated that when vitamin

C was supplemented at a level of 976 ppm/128 gal in the drinking water for 24 hours prior to pick up for slaughter, carcass yield was significantly increased. Under stress conditions a differential leucocytes count indicated that the percentage of lymphocytes decreased and the percentage of hetrophils increased (Woldford and Ringer, 1962). Other results shown by Gross *et al.*, (1980) revealed that exposure of birds to high environmental temperature causes an increase in the plasma corticosterone that subsequently depressed the activity of the lymphoid organs and total leucocytes count. The role of ascorbic acid as mentioned earlier by Schemling and Nockles (1978) reduced the amount of corticosterone in the plasma with subsequent maintenance of the normal leucocytes count. Several researchers have reported beneficial effects of vitamin C supplements as an anti-stress agent given either in diets and/or in drinking water (Gross, 1981; Sayed and Shoeib, 1996).

The aim of the study was to determine the effect of natural and artificial ascorbic acid supplementation on the growth performance and packed cell volume of broiler chickens.

Materials and Methods

Site of Experiment: The experiment was carried out at the Animal Breeding Unit, Department Zoology, Nnamdi Azikiwe University which is located at Awka South Local Government, Awka Anambra State, Nigeria.

Procurement and Preparation of Ascorbic Acid: Sweet oranges were purchased from Eke Awka market. Each orange was peeled and the juice squeezed out, sieved and measured with a measuring cylinder. Vitamin C tablets were procured from Guaze Pharmacy in Nnamdi Azikiwe University, Awka. It was administered through drinking water at 3 tablet/litre of water.

Procurement and management of experimental Birds: The birds had no history of drug consumption (i.e. they have not been used for any investigation). The twenty broilers of three weeks old were purchased from a poultry farmer at Afor Nnobi in Idemili South Local Government Area of Anambra State. The birds were transported in a wooden basket with enough opening to allow adequate ventilation. They were acclimatized for the first one week. This is done in order to adapt them to the new environment. Commercial prepared feed (Top Brand) were used throughout the experiment. The birds were fed to chick mash starter for four weeks and growers mash feed for the remaining one week. The chicks were brooded on a deep litter using 200W electric bulb and kerosene lantern for four weeks. This was aimed at providing light and heat during this period. The experiment lasted for five weeks, during this time, the birds were subjected to similar sanitary treatment; clearing of the droppings once in a week, washing of feeders and drinkers every morning and clean water was also provided daily in each cage. Routine vaccines against infectious diseases were also given to the birds.

Experimental Design: The experiment was designed in such a way that five broiler chicks were randomly assigned to each of the four cages (one of the cages however, served as control). The cages were labeled. The control group is labeled cage A, cage B contain chicks treated with natural ascorbic acid with 300g per litre of water, and cage C contained chicks treated with a mixture of natural and artificial ascorbic acid with 150g each per litre of water while cage D contained chicks treated with artificial ascorbic acid with 300g per litre of water. The birds were given the respective treatments for five weeks. The chicks were marked with permanent blue coloured marker on their head (animal A), right leg (animal B), tail (animal C), right wing (animal D) and trunk (animal E). The quantity of feed given to the birds each time was measured. The quantity left over at the end of each week was measured to enable weekly feed consumption to be determined.

Determination of Body Weight:

All the birds were weighed at day 0. They were also weighed before collection of blood samples at day 7, day 14, day 21, and day 28. Records of the weight were taken and kept for statistical analysis.

Weight Gain (g): $\frac{W_1 - W_0}{T_1 - T_0}$

Where:

W_1 = Final Weight (g)

W_0 = Initial Weight (g)

$T_1 - T_0$ = Time (weeks)

Specific Growth Rate: $\frac{(\ln W_1 - \ln W_0)}{T_1 - T_0} \times 100$

Where:

$\ln(W_1)$ = Natural logarithm of final weight

$\ln(W_0)$ = Natural logarithm of initial weight

$T_1 - T_0$ = Time (Weeks)

Blood sample collection and analysis: Blood samples were collected from over-night fasted broiler chickens per treatment using syringe and needle through the wing vein. Samples were collected into a set of sterilized tubes containing Ethylene Diamine Tetra-acetic Acid (EDTA) labeled bottles as anti-coagulant, for the analysis of packed cell volume (PCV). Blood sample anticoagulated with EDTA was made to enter a plain glass capillary tube, one end of which was later sealed with non absorbent sealer clay. The tube was then spun at 11,000 rpm for 5 minutes in a microhaematocrit centrifuge. The PCV value was then read, using a microhaematocrit reader.

Statistical Analysis

Data analysis was carried out with SPSS (statistical package for social sciences) version 17 ANOVA (One-way analysis of variance). All results were expressed as Mean ± S.D. while $p < 0.05$ served as the significance level.

Results

The result of the supplement effects on the birds as showed in Table 1 indicates that natural ascorbic acid recorded the highest weight gain 1.22 kg followed by mixture of natural and artificial ascorbic acid 1.09kg. Artificial ascorbic acid recorded a weight gain of 0.89 kg while the control group produced the least weight gain of 0.79 kg. This result on body weight shows a trend that the bird's body weight increased by age except at control group where a varied result was obtained. Table 2 reveals that the mixture of natural and artificial ascorbic acid proved to be most effective on PCV 21.23, followed by that of artificial ascorbic acid 18.1. Whereas control group recorded a PCV level of 12.84 natural ascorbic acid recorded the least PCV level of 9.93. However, this Table 2 shows a varied result except at group fed with the mixture of natural and synthetic which showed a sustainable increase in PCV levels from baseline values (day 0) through day 28.

Discussion

Analysis of the overall weight gain data indicated a higher weight gain of broilers fed with natural ascorbic acid (1.22kg), followed by birds fed with natural and artificial ascorbic acid (1.09kg). Broilers fed with artificial ascorbic acid recorded a weight gain of (0.89kg) while the control group has the least weight gain of (0.79kg). The result of this study is in agreement with those of Quarles and Adrian (1989) who reported that when vitamin C was supplemented at a level of 976 ppm/128 gal in the drinking water for 24 hours prior to pick up for slaughter, carcass yield was significantly increased. Result from the study has shown that mixture of natural and artificial ascorbic acid has a significant increase in the PCV of broilers when compared with natural and artificial ascorbic acid individually. Broilers fed with natural and artificial ascorbic acid recorded the highest PCV gain (21.23). This may be attributed to the fact that vitamin C is part of a matrix involving many beneficial phytochemicals like cyanidin-3-glucoside, flavanones and carotenoids, (Kurl *et al.*, 2002).

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Table1. Effect of Ascorbic Acid on the Body Weight of Broilers

	Mean Weekly Body Weight (kg)					
Treatment/Groups	Day0 (Initial)	Day 7	Day 14	Day 21	Day 28	Weight Gain
Control	1.21±0.11389	1.21±0.12438	46±0.17880	1.76±0.33429	2.00±0.40825	0.79±0.38228
Natural AA	0.91±0.21147	1.02±0.26599	1.27±0.38655	1.83±0.48296	2.13±0.55770	1.22±0.58835
Natural & Artificial AA	0.99±0.36810	1.06±0.36640	1.34±0.57933	1.90±0.68069	2.08±0.72744	1.09±0.66539
Artificial AA	0.99±0.46805	1.03±0.50075	1.29±0.61088	1.67±0.75961	1.88±0.86790	0.89±0.70009

Table2. Effect of Ascorbic Acid on the Packed Cell Volume of Broiler

	Mean Weekly Value of PCV (%)					
Treatment/Groups	Day0 (Initial)	Day 7	Day 14	Day 21	Day 28	PCV Gain
Control	36.56±6.0011	44.20±19.818	53.20±15.61906	47.12±15.0943	49.40±19.9960	12.84±15.56917
Natural AA	29.82±4.1167	50.80±27.886	46.72±7.67769	40 .32±8.8959	39.75±8.52389	9.93±15.06288
Natural & Artificial AA	28.02±6.9049	44.58±16.031	46.75±16.55587	49.15±13.3727	49.25±12.3119	21.23±14.68754
Artificial AA	30.94±8.8985	46.44±7.8095	58.86±2.38705	57.92±11.5359	49.04±8.51546	18.1±12.82920

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