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GROWTH PERFORMANCE, CARCASS CHARACTERISTICS AND ECONOMIC BENEFITS OF SUPPLEMENTAL ASCORBIC ACID ON BROILER STARTERS EXPOSED TO HEAT STRESS

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ABSTRACT

A 35-day feeding trial using 7-day old 120 Anak 2000 broiler chicks was conducted to evaluate the growth performance, carcass characteristics and economic benefits of supplemental ascorbic acid on broiler starters exposed to heat stress. Dietary treatments were made up of a basal diet which contained 0mg of ascorbic acid which served as the control; while diets 2, 3 and 4 contained 150mg, 300mg and 450mg of ascorbic acid per kilogram of feed respectively. There were significant ($P < 0.05$) differences among the treatments in body weight gain, feed conversion ratio, net returns and mortality. Birds fed ascorbic acid supplemented diets performed significantly ($P < 0.05$) better than the control in terms of weight gain, feed conversion ratio and net economic returns. Feed intake and carcass characteristics were not significantly ($P > 0.05$) influenced by the dietary treatment. The results of this study suggest that ascorbic acid played positive role in alleviating the adverse effects of stress on the performance on starter broiler.

Keywords: broilers starters, ascorbic acid, carcass characteristics, economic benefits, heat stress, growth performance.

INTRODUCTION

In Nigeria, poultry production has evolved as one of the most efficient industries producing food for human consumption. The expansion and improvement of the industry has been the major focus of the federal government. This is due to the fact that it contributes greatly to the animal protein consumption in Nigeria. In addition, the recent ban on the importation of poultry products by the federal government of Nigeria has caused a turn around in the poultry industry. For instance, in the year 2004 poultry production grew by 10.3% as compared to 0.3% in 2003 (CBN, 2004).

With the increasing concentration of poultry in Nigeria has come the need to better appreciate the effect of heat stress on the performance of the animals. Heat stress is known to be one of the major problems facing broiler industry in the tropical and subtropical areas (Sabah *et al*., 2008). This is because broilers can only attain the desired economic market weight in a stress free environment. Although, Gray *et al*. (2003) demonstrated that broilers subjected to high temperature exhibit many behavioural changes which allow them to reestablish heat balance with their surrounding. Fuquay (1981) had earlier reported that in hot environment, emphasis should be placed on diets to increase intake or alter the levels of proteins, amino acids or other nutrients to improve the conversion of feed to meat. Blaha *et al*. (2000); Raja and Qureshi (2000) and McCormack *et al*. (2001) reported the beneficial effect of anti-stress factor in ascorbic acid to maximize broiler production in the temperate region. The beneficial effect of ascorbic acid in facilitating calcium absorption for adequate bone formation and strength was also reported by Newman and Leeson (1999) and McCormack *et al*. (2001). However, in Nigeria, there is still paucity of information on the utilization of dietary ascorbic acid in ameliorating the adverse effect of heat stress in broilers. Therefore, this study was conducted to evaluate the effect of supplemental ascorbic acid on the performance carcass characteristics and economics of broilers exposed to heat stress.

MATERIALS AND METHODS

In order to investigate the effect of supplemental ascorbic acid on growth performance, carcass characteristics and economic benefits of broiler starters exposed to heat stress; a study was conducted at the Poultry Research Unit of the Department of Animal Science, Ebonyi State University, Abakaliki, Ebonyi State, Nigeria.

Experimental birds and management

One hundred and twenty (Anak 2000) unsexed day old broiler chicks were brooded on Ascorbic acid free diet for one week (adaptation period). At the 8th day, the chicks were randomly assigned to four experimental diets giving 30 birds per treatment. Each group was further subdivided into three replicates having 10 birds per replicate in a completely randomized design (CRD). The birds were raised on conventional deep litter system, with open sided house. All the pens were located in one house to have identical environment. Each pen was provided with a feeder and drinker. Experimental diets and clean water were provided ad libitum throughout the trial during which time; feed intake, weight gain, conversion feed ratio and mortality were recorded. Recommended vaccination and other medicaments were administered as and when due. The experiment was carried out during the dry season and it lasted for 35 days.

Experimental diets

The dietary treatments were made up of the basal diet which contained 0mg of ascorbic acid and served as the control. Diets 2, 3, and 4 contained ascorbic acids at 150mg, 300mg, and 450mg per kilogram of the basal diet, respectively (Table-1). The basal diet (0mg ascorbic acid/kg) was analyzed for its proximate composition according to the methods of AOAC (1995). Nitrogen free extract was determined by difference from other proximate composition (Table-2).

Table-1. Ingredient composition of the experimental diets.

Ingredients	T_1	T_2	T_3	T_4
Maize	48.00	48.00	48.00	48.00
Groundnut cake	24.00	24.00	24.00	24.00
Maize offal	10.00	10.00	10.00	10.00
Palm kernel cake	8.00	8.00	8.00	8.00
Fishmeal	6.00	6.00	6.00	6.00
Bone meal	3.00	3.00	3.00	3.00
Salt	0.25	0.25	0.25	0.25
Premix*	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25
Ascorbic acid mg/kg	0.00	150mg	300mg	450mg

*Broilers vitamin premix supplied the following vitamins and trace elements per Kg diet: Vit A 7812.50IU; Vit D 1562.50IU; Vit E 25mg; Vit K 1.25mg; Vit B1 1.88mg; Vit B2 3.44mg; niacin 34.38mg; calcium pantothenate 7 .19mg; V it B 36 .13mg; V it B 102 .016mg; Choline chloride 312.50 mg: Folic acid 0.62 mg; Biotin 0.05; Mn 75mg; Fe 62.5mg: Zn 50mg; Cu 5.31 mg; Iodine 0.94 mg; Co 0.19 mg; Se 0.07mg and Antioxidant 75mg.

Table-2. Proximate composition of the basal diet.

Nutrients	
Crude protein	22.97
Crude fibre	4.90
Ether Extract	5.92
Calcium	1.43
Phosphorus	0.41
Lysine	0.90
Methionine	0.63
ME (Kcal/kg)	3029.50

Carcass characteristics

At the end of the feeding trial, three birds per replicate were fasted for 12 hours, slaughtered and eviscerated. Weight of the thigh, shank, breast muscle, wing, back, liver, heart, gizzard and kidney were recorded and expressed as a percentage of the live weight.

Economic analysis

The cost of birds, feed, medication, transportation and miscellaneous expenses incurred during the five weeks of the experiment were recorded. Revenue generated from the sale of the birds and manure was also recorded. The cost per kilogram gain, total profit and returns to naira invested were also calculated.

Statistical analysis

Data collected were statistically analyzed with the standard procedures of analysis of variance (ANOVA), using Completely Randomized Design. Means were compared for significance of differences using Duncan's New Multiple Range Test as outlined by Obi (2002). The statistical package (SAS, 1998) was used to perform the above analysis on computer.

RESULTS AND DISCUSSIONS

The result on the performance of the birds fed supplemental ascorbic acid is as shown in Table-3. There were significant ($p < 0.05$) differences in the weight gain of the birds among the treatments. Birds fed supplemental ascorbic acid recorded significantly higher body weight gain than the control. 300mg of ascorbic acid supplementation of broiler starter diet gave significantly ($p < 0.05$) the highest body weight gain. The depressed weight gain of the birds fed un-supplemented (control) diet suggest that endogenous synthesis of ascorbic acid by the birds was not enough to meet up the birds requirement under heat stress. Gross and Siegel (1983) had earlier reported that stress conditions affect the effectiveness of endogenous synthesis of ascorbic acid adversely. This observation agrees with the findings of Oruseibio and Alu (2006); Raja and Qureshi (2000) and Sabah *et al*. (2008) who reported depressed weight gain of heat stressed birds fed un-supplemented ascorbic acid diet.

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Table-3. Performance of broiler starter fed ascorbic acid supplemented diets.

Parameters	**T_1**	**T_2**	**T_3**	**T_4**	**SEM**
Initial body weight (g)	303. 33	286. 00	283 .66	283. 33	
Final body weight (g)	1210.11^{c}	$1367. 21^{ab}$	$1500. 30^{a}$	$1340. 33^{bc}$	32.78
Body weight gain (g)	$906. 78^{c}$	$1081. 21^{ab}$	$1217. 64^{a}$	$1057. 00^{b}$	33.12
Daily feed weight (g)	$25. 90^{c}$	$30. 88^{b}$	$34. 61^{a}$	$30. 20^{b}$	1.18
Total feed intake (g)	3422. 46	3466. 83	3463. 98	3492. 60	12.00
Daily feed intake (g)	97. 77	99. 05	98. 96	99. 79	11.86
Feed conversion ratio	$3. 78^{c}$	3.21^{ab}	2.86^{a}	$3. 30^{b}$	0.53
Mortality (%)	$13. 33^{c}$	$6. 67^{b}$	$3. 33^{a}$	$6. 67^{b}$	0.26

Means in the same row with different superscripts are significantly different (P<0.05),
NS- not significantly different.

The improved weight gain of birds fed ascorbic acid supplemented diets indicated that supplemental ascorbic acid ameliorated the adverse effect of heat stress on the weight gain of the birds. This observation strengthened the findings of Sabah *et al*. (2008); Sobayo *et al*. (2008); Bolu *et al*. (2008) and Mckee *et al*. (1997) who reported that supplemental ascorbic acid improved the weight gain of birds exposed to heat stress.

Supplemental ascorbic might have helped the chicks to overcome the stress of early development since according to Horning and Frigg (1979), the biosynthetic ability of the chicks to meet minimum requirement of ascorbic acid does not develop until sometime after hatching. In addition, Perek (1984) suggested that the improved weight might be due to the effect of ascorbic acid on the metabolism of tyrosine and phenylalmine which are precursors of thyroid hormone. The improved weight gain of the birds at the three levels of inclusion indicates that these levels were within the tolerable limit of the birds. Excessive supplemental acid have been reported to reduce the performance of broiler chicks by Salah *et al*. (2008) and Kutlu and Forbes (1993). However, this was not observed in this study.

There was no significant (P > 0.05) difference in feed intake among the birds. This result is not surprising since the temperature of the poultry house is the same at any given time. According to Dale and Fuller (1980) feed intake of birds decreases as the environmental temperature increases. However, the slight increase in feed intake of the birds fed supplemental ascorbic acid though not significant (P > 0.05) could be due to increased appetite of the birds fed the diets resulting from the lowering of the body temperature by vitamin C. This finding is in agreement with the reports of Salah *et al*. (2008); Oruseibo and Alu (2006) and Dale and Fuller (1980).

There were significant (P < 0.05) differences in feed conversion ratio (FCR) of the birds. Supplemental ascorbic acid had significantly (P < 0.05) positive effect on the feed conversion ratio of the starter broilers. Birds fed 300 mg of ascorbic acid recorded the best feed conversion ratio. There was significant (P < 0.05) difference between the FCR of birds fed 150mg and 450mg of ascorbic acid /kg of feed. The enhanced FCR of ascorbic acid treated birds suggests that ascorbic acid encouraged efficient conversion of feed to meat under heat stress. The observation corroborates the findings of Alisheikor (1980); Njoku *et al.* (1990) Blaha *et al*. (2000), who reported improvement in FCR following ascorbic acid supplementation.

Birds fed the control diet recorded significantly (P < 0.05) the highest mortality. Birds fed 300mg ascorbic acid /kg of feed recorded significantly (P < 0.05) the lowest mortality rate while no significant (P > 0.05) difference existed among birds fed 150mg and 450mg ascorbic acid/kg feed. In the course of this experiment it was observed that the birds had coccidial infection which is very common at this stage of bird's growth. However, the mortality recorded among the treated cannot be attributed to coccidial infection completely. The reduction in mortality rate of birds fed treated diets might be due to the positive effect of ascorbic acid in alleviating stress induced suppression of body immunity. According to Gross and Siegal (1983) ascorbic acid ameliorates stress induced suppression of hormoral and cell-mediated immunity and improved chickens response to cell-mediated immunity. Moreso, Sobayo *et al.* (2008) also reported that decreased mortality rate achieved by ascorbic acid supplementation might be due to the fact that ascorbic acid regulates the synthesis of corticosterone, the stress hormone. This reduction in mortality achieved by 300gm ascorbic acid/kg corroborates the finding of Add-Ellah (1995).

Table-4. Effect of ascorbic acid on the carcass characteristics of the birds.

Parameters	**T_1**	**T_2**	**T_3**	**T_4**	**SEM**
Thigh	10.71	9.92	10.45	10.02	0.30
Breast	12.35	12.64	12.59	12.32	0.65
Wings	8.23	8.30	7.96	8.12	0.19
Drumstick	8.85	8.68	9.84	9.29	0.28
Back	14.28	14.18	14.36	14.42	0.49
Neck	4.93	4.97	5.02	4.90	0.21
Head	4.32	4.18	4.26	4.30	0.42
Shank	5.94	5.84	4.26	4.30	0.17
Heart	0.49	0.51	0.46	0.50	0.31
Gizzard	4.01	4.19	4.09	4.24	0.21
Liver	2.94	2.83	2.97	2.90	0.15
Spleen	0.19	0.18	0.19	0.20	0.20

Ascorbic acid supplementation of broiler starter diets did not exert any significant (P>0.05) effect on the carcass characteristics of the birds. Its effect on carcass characteristics did not follow any definite trend (Table-4). This agrees with the findings of Bolu *et al.* (2004) that ascorbic acid has no significant effect on the carcass characteristics of birds.

Table-5. Effect of ascorbic acid supplementation on the economic analysis of starter broiler production.

Parameter	**T_1**	**T_2**	**T_3**	**T_4**
Total feed intake/bird(g)	3422.40	3422.40	3422.40	3422.40
Feed cost/kg (₦)	51.69	51.69	51.69	51.69
Cost of bird (₦)	176.90	176.90	176.90	176.90
Cost of bird (₦)	170.00	170.00	170.00	170.00
Labour and expenses/bird (₦)	200.00	200.00	200.00	200.00
Total cost of production (₦)	546.90	546.90	546.90	546.90
Cost of 1 kg meat (₦)	750.00	750.00	750.00	750.00
Total revenue/bird (₦)	847.08	847.08	847.08	847.08
Total net returns/bird (₦)	300.18	300.18	300.18	300.18

The economic analysis of feeding supplemental ascorbic acid to broiler starter is shown in Table-5. The cost of feed consumed and the total cost of production increased slightly with increase in ascorbic acid inclusion in the diet. Revenue generated from the sale of the birds was significantly higher for birds fed ascorbic acid supplemented diets. 300mg ascorbic acid/kg of feed gave the best result in terms of total revenue and total net returns. The economic results shows that it is more profitable to fed dietary ascorbic acid to birds exposed to heat stress.

CONCLUSIONS

The desire of every poultry farmer is to produce large quantity of meat throughout the year irrespective of the environmental temperature. However this can only be achieved in a stress free condition. The result of this study indicated that supplemental ascorbic acid has beneficial effects on the performance and economics of production of broiler chicks exposed to heat stress. The result of the study also suggest that 300mg of Ascorbic acid gave the best result in terms of performance and total net returns and therefore should be encouraged.

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