Effects of dietary vitamin C addition on the performance of broilers in a hot, humid environment

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SUMMARY

In an experiment lasting 7 weeks; 288 one-day-old unsexed broiler chicks were used to assess the effect of supplementary vitamin C on the performance and carcass characteristics of broiler chicks raised in a hot, humid environment. The birds were randomly alloted in equal numbers to four dietary treatments based on maize and fishmeal to which were added 0, 100, 150 or 200 mg vitamin C per kilogram, respectively. The diets were isocaloric and isonitrogenous, containing 12.51 MJ (ME) and 212.4 g crude protein per kg. Each treatment had three replicates. Feed and water were supplied *ad libitum*. Supplementary vitamin C had no significant effect on all the performance and carcass traits studied, including feed intake, growth rate, and feed conversion efficiency. No economic advantage was gained by adding vitamin C to broiler feed.

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RÉSUMÉ

OSEI, S. A., HAGAN, J. A., DONKOH, A. & ATUAHENE, C. C.: *Les effets de l'addition de vitamine C diététique sur la performance de poulets de chair dans un environnement chaud et humide.* Dans une expérience durant 7 semaines 288 poussins de chair au sexage desquels on n'a pas procédé, ayant l'âge d'une journée, étaient utilisés pour évaluer les effets de vitamine C supplémentaire sur la performance et les caractéristiques de carcasses de possins de chair élevés dans un environnement chaud et humide. Les volailles, réparties en nombres égaux, étaient assignées au hasard aux quatre traitement diététiques basés sur le maïs et le guano de poisson auxquels étaient ajoutés 0, 100, 150 ou 200 mg de vitamine C par kilogramme respectivement. Les régine étaient isocalorie et isoazoté, contenant 12.51 MJ (ME) et 212.4 g de protéine brute par kg. Chaque traitement avait trois réplications. Régime et eau étaient fournis *ad lib*. La vitamine C supplémentaire n'avait des effets considérables sur toutes les traits de performance et de carcasses étudiés, y compris la consommation de régime, la proportion de croissance, et l'éfficacité de conversion de régime. Aucun avantage économique n'était gagné par l'addition de vitamine C au régime de poulet de chair.

Introduction

Vitamin C or ascorbic acid has generally been excluded from poultry diets, since birds can synthesize adequate amounts of the vitamin to meet normal growth and metabolic demands (Sealock & Goodland, 1951; Sifri, Kratzer & Norris, 1977). Research indicates, however, that in stressful environments, such as the high ambient temperatures that characterize tropical regions, the chicken's ability to biosynthesize the vitamin may be compromised, leading to the border-line deficiencies (Behm, Dresser & Kemme, 1978; Sykes, 1978). Under such conditions, one would expect supplementary ascorbic acid to exert beneficial effects on bird performance. Indeed, Thompson (1962) called vitamin C an "antistressor" while Ahmad, Moreng & Muller (1967) reported that it alleviated the effects of environmental heat stress. Pardue (1987) quotes earlier work (Pardue, 1983) in which no positive effect of dietary vitamin C (up to 1000 ppm) was observed in broiler cockerels, although in the same studies females grew significantly faster on vitamin C than without it. Faruga (1975) and Sifri,

Kratzer & Norris (1977) had earlier reported that supplementary vitamin C did not affect the growth or development of birds. Other workers had, however, shown an improvement in the growth rate of broilers receiving exogenous vitamin C (Alisheikov, 1980; Kafri & Cherry, 1984; Pardue, Thaxton & Brake, 1985; Njoku, 1986).

Ambient temperatures in the hot, humid regions of Ghana during the dry season lasting from November to March generally exceed 32 °C and coincide with declining performance of both broilers and layers (Osei, 1984).

This study therefore assessed the beneficial effects, if any, of vitamin C added to the diets of broiler chicks during the dry harmattan season.

Materials and methods

Two hundred and eighty-eight one-day-old Shaver Tropicbro broiler chicks (from Pomadze Poultry Enterprise Limited, Winneba, Ghana) of mixed sex were randomly divided into four treatment groups and housed in deep-litter pens allowing a floor space of 0.14 m^2 per chick. Each pen was used as a brooder during the first 4 weeks with heat being supplied by two 100-watt incandescent bulbs per room. Each treatment was replicated three times, and the experiment lasted for 7 weeks between November and January in the midst of the dry harmattan season in Ghana.

Each treatment group was fed a combined starter-finisher mash based on maize and fishmeal to which were added 0, 100, 150, and 200 mg per kg vitamin C, respectively. The diets contained 212.4 g crude protein and 12.51 MJ of metabolizable energy per kilogram (Table 1). Feed and water were supplied *ad libitum*. Among the traits measured were growth rate, feed intake, feed conversion efficiency, and carcass parameters. Growth rate, feed consumption, and feed conversion efficiency were measured weekly while carcass traits were measured at the end of the trail. For carcass parameters, three birds were randomly selected from each replicate treatment, slaughtered by slitting the throat, and bled with the head pointing downward. They were scalded in boiling water and then defeathered by hand. The carcass parameters studied included feather weight and weights of viscera, liver, crop, gizzard and small intestines. Data collected in the trial were analyzed by simple regression analysis of variance according to Steel & Torrie (1980). In addition, a simple linear correlation coefficient, r, was calculated for the relationship between levels of vitamin C and the main performance parameters (body weight, feed intake, feed conversion efficiency, and dressing percentage).

TABLE 1

Composition and Analysis of Basal Diet Used in the Experiment

Ingredient	*Kg per 100 kg of diet*
Maize	57.5
Wheat bran meal	21.0
Fishmeal	19.5
Dicalcium phosphate	1.0
Oyster shell	0.5
Common salt	0.25
Vitamin-mineral premix*	0.25
Nutrient analysis (kg per 100 kg as fed except ME)	
Crude protein[2]	21.4
Crude fibre[2]	4.2
Ash[2]	6.6
Dry matter[2]	90.0
Calcium	1.2
Phosphorus (available)	0.7
Lysin	1.01
Methionine + Cystine	0.70
ME (MJ per kg DM)	12.51

Vitamin-mineral premix supplied per 100 kg of diet: vitamins A, 2 000 000 IU; D, 400 000 IU; E, 3 000 IU; K, 200 IU; B_1, 200 mg; B_2 900 mg; B_{12}, 2400 mg; niacin, 5 000 mg, and minerals: Fe, 9 000 mg; Cu, 500 mg; Mn, 12 000 mg; Co, 100 mg; Zn, 10 000 mg; I, 400 mg; Se, 40 mg. [2]Analyzed, all others calculated.

Results and discussion

Table 2 shows the summary of performance data. The addition of vitamin C to broiler diets had no significant effect on the main performance criteria measured in the study: feed intake, weight gain, and feed conversion efficiency. Birds receiving supplementary ascorbic acid in their diets tended, however, to consume less feed, and to grow less

TABLE 2

Effects of Vitamin C on Broiler Performance

Performance trait	*Vitamin C levels (mg per kg diet)*				*Overall*	*r*	*Y¹ =*
	0	*100*	*150*	*200*	*SEM*		
Initial body weight, g	35.0	35.0	35.0	35.0	-	-	-
Final body wt., g/bd.	1726.1	1681.1	1670.4	1681.5	59.3	-0.13	1694.6 - 8.25X
Mean wt gain, g	1691.1	1646.1	1635.4	1646.5	59.3	-0.13	1659.6 - 8.25X
Total feed intake, kg	3.7	3.8	3.6	3.5	0.12	-0.53	3777.5 - 69.82X
Ave feed intake, g/bd.	75.5	73.5	73.5	71.4	8.04	-0.10	-
Feed efficiency	2.2	2.3	2.3	2.12	0.18	-0.05	2.31 - 0.029X
Dressing percentage	62.2	60.5	62.2	61.5	6.50	-0.20	61.6 - 0.025X
Feather weight[2]	10.7	9.8	9.6	9.5	0.81	-	-
Liver weight[2]	2.4	2.6	2.6	2.6	0.12	-	-
Crop weight[2]	4.2	4.5	4.4	4.3	0.16	-	-
Weight of viscera[2]	11.9	12.8	11.7	11.4	0.72	-	-
Wt. of small intestine[2]	3.3	3.3	3.4	3.4	0.11	-	-
Weight of gizzard[2]	3.3	3.2	3.4	3.3	0.08	-	-

Y^1 = parameter under study, e.g., body weight; X = level of vitamin C

[2]Expressed as percent of liveweight

rapidly, although their feed conversion was non-significantly better than birds receiving no additional vitamin C. Supplementary vitamin C did not affect any of the carcass traits under study ($P>0.05$). The use of vitamin C made only slight changes in the production of broilers as well as the profit margins.

The lack of effect of vitamin C on the performance of broilers has been previously reported by investigators elsewhere (Faruga, 1975; Sykes, 1978; Freeman, Manning & Flack, 1983; Stilborn *et al.*, 1988). Other workers who have, however, shown the positive effects of vitamin C on broiler performance include Kafri & Cherry (1984), Pardue, Thaxton & Brake (1985), and Njoku (1986). Beneficial effects were, however, obtained if the chickens were exposed to acute heat stress (Pardue, Thaxton & Brake, 1985) or to temperatures above 30 °C (Njoku, 1986; Kutlu & Forbes, 1993). Daily recordings of ambient temperature during the trial showed that air temperature during the trial ranged from a low of 23 °C to a high of 27 °C, a surprising observation, since November, December, and January fall within the hot, dry season in Ghana. Thus, the ambient temperatures may not have been severe enough to induce stress effect. Kutlu & Forbes (1993) have provided data which indicate that unheated broiler chicks receiving added vitamin C during normal brooding (30 °C reducing to 24 °C) gained significantly less weight, consumed less feed and had poorer feed efficiency than those fed on the control diets without added vitamin C.

The results of this trial suggest that when the environmental temperature ranges from 23 to 27 °C, broiler chicks may not require supplementary ascorbic acid.

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