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Research Article

Improving Performance of Broilers by Fortifying their Feeds with Additional Levels of Antioxidants (Vitamins C and A&E)

Ezeibe FIO*, Nwizu VC, Kenneth-Chukwu OM and Akpan CAN

Department of Veterinary Physiology and Pharmacology, Michael Okpara University of Agriculture Umudike, Nigeria

***Corresponding Author:** Ezeibe FIO, Department of Veterinary Physiology and Pharmacology, Michael Okpara University of Agriculture Umudike, Nigeria.

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Abstract

Fifty one (51) day old broiler-chicks were randomly allocated to three groups of 17 each. They were fed a commercial feed with one treatment-group placed on the feed with additional level of Vitamin-C as recommended for improving immunity by the American research council. One other group was fed the feed with the addition being of Vitamins-A&E. Water was provided*, ad libitum* and the study was terminated whenever any of the groups attained ≥ 1.4 kg mean-live weight (based on 75 % dressing percentage) for 1 kg chicken ("hotel size"). Although the additional Vitamin-C group had highest feed-intake, by age 4-weeks they attained 1.41 kg-weight, had lowest feed conversion ratio (FCR: 0.19) and lowest cost of producing 1 kg, chicken (#1,292.00) against the Vitamins A&E-group (1.12 kg; 0.23; #1,610.00) and control (0.91kg; 0.27; #2,214.00). Fortifying broiler feeds with Vitamin C would improve profitability by enhancing live-weight, reducing FCR and shortening production-cycle.

Keywords: Antioxidants; Feed Conversion Ratio; Cost of Production; Profitability

Introduction

Broiler farming is one of the fastest-growing farming enterprise and contributes significantly to food and nutritional security [1]. Health and performance of broilers are hampered by oxidative stress [2]. Oxidative stress results from imbalance between free radicals and biological systems [3]. Free radicals may be defined as the unstable harmful molecules or compounds that the body produces as a reaction to environmental and other pressures [4] while Antioxidants are substances that protect the cells against free radicals [5]. Quite a number of nutritional, environmental, pathological and physiological factors are responsible for triggering production of excess free radicals, exceeding the natural antioxidant capacity of the broilers and hence, causing oxidative stress. Therefore, there is need to protect these birds from oxidative stress to enable them grow fast, perform well and yield profit within a short time thereby reducing cost of production. Dietary antioxidants are considered to be the main protective means to deal with various stresses in poultry production [6].

Surai [7] wrote that antioxidants exhibit their protective function against free radicals either by inhibiting the activity of the pro-oxidant enzymes or by directly scavenging the free radicals in the body of biological organism.

Hurell, [8] classified antioxidants into two groups namely; Natural and Synthetic antioxidants. The natural antioxidants are natural fat-soluble antioxidants (vitamins A and E, ubiquinones, carotenoids, etc.), water-soluble antioxidants (vitamin C, taurine, uric acid, etc.), antioxidant enzymes: (glutathione peroxidase (GSH-Px), catalase (CAT) and superoxide dismutase (SOD) and a thiol-redox (glutathione and thioredoxin system) and Synthetic which includes diludin, ionol, phenozan, santochin, phenoxane, etc. [2].

Feed conversion ratio (FCR) may be defined mathematically as the feed given divided by weight gained [9]. This ratio measures an animal's ability for converting feed into the desired output, which in the case of broiler chickens is meat, or the animal's body mass. When animals receive diets that meet their exact nutritional requirements, they convert feed more efficiently, which lowers the ratio [10].

In poultry farming, feed accounts for up to 70 % of total production costs [11], and is an intrinsic factor which determines the sustainability and profitability of poultry business [12]. It is therefore pertinent to formulate inexpensive diets that would meet the animal's requirement and reduce cost of production.

In earlier research by [13], improvement in broiler performance and reduction in cost with additional levels of Vitamins A, C and E combined in broiler feeds were recorded.

This work was designed to identify which of the antioxidants was responsible for the observed improved performance in broilers.

Materials and Methods

Fifty one (51) day-old broilers were assigned to three groups of 17 birds each (A, B and C). Group A was fed the commercial feed and water. Group B was fed the commercial feed fortified with 10mg of Vitamin C alone to 25 kg (American research council 1994) and water. Group C was fed the same commercial feed fortified with Vitamin A (375mg) and Vitamin E (75 mg) combined to 25 kg (American research council 1994) and water.

The study was terminated at the time any of the groups attained a mean weight of 1.4 kg (based on 75 % dressing percentage). Quantity of feed served was weighed using a balance (Camry; China) daily before introducing it into their feeding trough and the left over were weighed before fresh feeds were introduced.

The quantities of feed consumed per day from each group were calculated by subtracting the weight of the left over feed from the weight of the quantity of feed served.

Mean feed consumption by each group was calculated by dividing the total amount of feed consumed by the number of bird in that group.

From the feed consumed and the chicks-weights, feed conversion rate and cost of producing a kilo of chicken were calculated for each group.

Statistical analysis

Means of; Quantities of feed consumed, Weight gained, Feed conversion ratios and Cost of 1kg of chicken for the three groups were tested for statistical differences with appropriate statistics. Values of $P \leq 0.05$ were considered significant.

Results

The feed intake across the groups varied significantly ($P < 0.05$) from week one to week four with the group fed additional vitamin C giving highest value as shown in table 1 below. The group fed additional Vitamin C gained weight rapidly and by week-4, it had attained a mean live weight of 1.41 kg whereas the control and the additional Vitamins A&E combined group weighed only 0.91kg and 1.12 kg per bird, respectively which cannot give I kg of dressed chicken.

Duration	Group	Feed intake/ bird (g)	Weight/Bird (kg)	FCR
Week 1	A	47.26 ± 0.00^{c}	0.09 ± 2.73^{b}	0.55 ± 0.01^{a}
	B	48.29 ± 0.00^{b}	0.12 ± 4.81^{a}	0.41 ± 0.02^{b}
	C	48.96 ± 0.01^{a}	0.10 ± 2.67^{a}	0.48 ± 0.03^{b}
Week 2	A	102.24 ± 0.01^{c}	0.36 ± 0.00^{b}	0.28 ± 0.00
	B	134.38 ± 0.00^{a}	0.44 ± 3.17^{a}	0.30 ± 0.00
	C	122.54 ± 0.00^{b}	0.37 ± 2.64^{b}	$0.34. \pm 0.00$
Week 3	A	173.91 ± 0.00^{c}	0.75 ± 0.01^{c}	0.44 ± 0.00^{a}
	B	209.35 ± 0.00^{a}	1.0 ± 0.00^{a}	0.36 ± 0.00^{c}
	C	195.39 ± 0.00^{b}	0.88 ± 0.00^{b}	0.37 ± 0.00^{b}

Week 4	A	253.48 ± 0.00^{c}	0.91 ± 0.00^{c}	0.27.00 ± 0.00^{a}
	B	274.13 ± 0.00^{a}	1.41 ± 0.00^{a}	0.19 ± 0.00^{c}
	C	262.21 ± 0.00^{b}	1.12 ± 0.33^{b}	0.23 ± 0.00^{b}

Table 1: Growth performance of broilers fed additional levels of antioxidants (Vitamins C alone and Vitamins A&E combined).

Note: Values are presented as mean ± S.E (Standard error of mean). Different superscript letters across treatment groups indicate significant ($p < 0.05$) differences. T1 = Normal commercial broiler feed; T2 = Broiler feed fortified with vitamin C, T3 = Broiler feed fortified plus Vitamin A, D and E.

At that week-4, 0.19 ± 0.00 FCR of the group fed additional Vitamin C was significantly ($P < 0.05$) lower than 0.27 and 0.23 of the control and the additional Vitamins A & E combined group as shown in table 1 below.

Benefit cost ratios of vitamin C (1.50) and vitamin A&E (1.16) groups were significantly higher ($p \leq 0.05$) than that of the control (-0.69). See table 2 below.

	Items	T_1	T_2	T_3
	Number of day old chick	17	17	17
Expenditure	Cost of day old chicks (₦)	6800	6800	6800
	Cost broiler starter (₦)	11800	11800	11800
	Cost of broiler finisher (₦)	5384	6580	6098
	Cost of vaccination (₦)	1600	1600	1600
	Cost of charcoal (₦)	400	400	400
	Cost of wood shaving (₦)	1600	1600	1600
	Cost of Vitamin C (₦)	-	200	
	Cost of Vitamin A,D,&E (₦)	-	-	400
	Nylon (₦)	2000	2000	2000
Total cost (TC) of production from day old to 4 weeks		29584	30980	30668
Total weight gain per bird (kg)		0.91	1.41	1.12
Cost of 1 kg (₦)		2,167	1,292	1,610
Dress weight per bird (kg) at 4 weeks		0.68	1.09	0.84
Total Revenue (TR) at 4 weeks of age (₦) at #2500 per kilo		20400	46325	35700
Net margin (TR-TC) (₦)		-9,184	15,345	5,032
Benefit-Cost ratio ( )		-0.69	1.50	1.16
Market efficiency (× 100)		69.00	150.00	116.41

Table 2: Cost-benefit analysis of broilers fed with additional levels of vitamin c and additional levels of vitamins A&E.

Note: Result presented in percentages (descriptively) and real monetary values. T_1=commercial feed only; T_2=commercial feed + vitamin C; T_3= commercial feed + vitamin A&E.

Cost of producing a broiler to 1.4 kg with the additional Vitamin C feed was # 1,292 which was significantly lower than the group with additional Vitamins A&E combined (#1,610) and with the control (# 2,214) as shown in table 2 below.

Discussion

The variation in feed intake across the groups from week one to week four with the group fed additional vitamin C giving highest value suggests that vitamin C reduced oxidative stress to improve appetite more than those in the control and in the group of Vitamins A&E. The finding agrees with that of [14] who reported achieving better feed intake by supplementing feeds with Ascorbic acid (Vitamin C).

The higher weight recorded with the group fed additional Vitamin C from week 1 to 4 when compared with the control and the additional Vitamins A& E combined groups suggests that the additional levels of Vitamin C enhances weight gain to shorten production cycle. The results are supported by reports of [14] that Vitamin C improves growth performance.

Feed conversion ratio which is simply the amount of feed it takes to grow a kilogram of broiler meat. From this study, the group of additional Vitamin C recorded 0.19 ± 0.00 FCR at that week-4, which is lower than 0.27 and 0.23 of the control and the additional Vitamins A & E group. It means that for vitamin C group, it took 274.13 ± 0.00^{a}grams of feed to produce 1.41kg live weight of broiler meat. The lower FCR suggests that Vitamin C makes broilers more efficient at converting feed to muscle mass (meat) as reported by [15]. This also means that a low FCR is a good indication of a high quality feed.

Benefit cost ratios (BCR) is an indicator showing the relationship between the relative costs and benefits of a proposed project expressed in monetary or qualitative terms, [16]. BCR of vitamin C (1.50) and vitamin A&E (1.16) groups showed efficient production because their ratios are more than 1.

Cost of producing a broiler to 1.4 kg with the additional Vitamin C feed was # 1,292 while with additional Vitamins A& E or with the control, it was # 1,610 or # 2,214 respectively which means that additional Vitamin C improved profitability (@#2500 selling price per kilo).

The findings also suggest that raising broilers with just commercial feeds at current prices may be leading to loses instead of profit.

Conclusion

With lower FCR, higher weight gain and reduced production cycle, additional level of Vitamin C in broiler feeds leads to increased profit.

Conflict of Interest

There is no conflict of interest among the authors.

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