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Enhancing Levels of Vitamins A, C, and E (Anti-oxidants) in Broiler-Feeds to Improve Their Feed Conversion Ratios and Reduce Cost of Production

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Authors' contributions

This work was carried out in collaboration between both authors. Author FIOO designed the experiments and drafted the manuscript. Author FOU analyzed the data while author FIOO processed the manuscript for publication. Both authors read and approved the final manuscript.

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ABSTRACT

To evaluate effects of additional levels of Vitamins A, C, E (Antioxidants) in Broiler feeds on feed conversion ratio (FCR) and cost of producing 1kg weight of Broiler (meat).

The research was carried out at the poultry unit of the Teaching and Research farm of the college of veterinary medicine, Michael Okpara University of Agriculture, Umudike, Abia State between September and October 2019.

50 day old chicks were randomly allocated into two groups of 25 birds each: Group A and Group B. Group A, the treatment group received commercial feed plus additional levels of Vitamins A, C, E while group B, the control received only commercial feed. Water was given to both groups *ad libitum*. The birds were weighed weekly till approximately 1.3 kg live weight was recorded. Both the age at which they weighed 1.25 kg and the cost were calculated and recorded. Other Parameters evaluated include: daily feed intake, weight gain, and Feed conversion ratio. At 4th week, the group fed with antioxidants weighed 1.25 kg live weight at #650 cost of production, while the control group weighed 1.3 kg at 5th week at the cost of #944. There were significant differences in feed intake (P=.05), in average weight gain (P=.05) and FCR (P=.05) between the two groups.

This study suggests that additional levels of Vitamins A, C, and E enhanced growth performance, decrease FCR and reduce cost of production.

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1. INTRODUCTION

Broiler production is one of the fastest growing animal industries and has a substantial contribution to food security and nutrition, [1]. Weight loss, reduced immune response to vaccination; poor growth rate, reduced performance and high cost of production are associated with oxidative stress in broilers [2].

Oxidative stress results when there is a counterbalance between free radicals and the biological antioxidant system of living organism [3].

Free radicals may be defined as 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]. The free radicals can either donate an electron to or accept an electron from other molecules, therefore behaving as oxidants or reductants [6]. Examples of free radicals are hydroxyl radical, superoxide anion radical, hydrogen peroxide, oxygen singlet, hypochlorite, nitric oxide radical, and peroxynitrite radical. Antioxidant systems consist of both enzymes such as glutathione peroxidase, superoxide dismutase, catalase, lipoic acid, etc. and non-enzymes such as selenium, vitamin E, C and A, [7].

They exert their protective function against free radicals either by inhibiting the activity of pro-oxidant enzymes or by directly scavenging the free radicals in the body of biological organisms or promoting their decomposition [8,9].

Factors responsible for the production of excess free radicals in broilers can be broadly categorised into nutritional, physiological or pathological and environmental causes [10].

There is need to protect our birds (broilers) from oxidative stress to enable them grow fast, perform well and yield huge profit within a short period of time thereby reducing cost of production. It is considered that the components of the feeding will have a modulating effect in the maintenance of this balance [11]. Inclusion of additional levels of antioxidants such as vitamin A, C, and E in broiler feeds as recommended by NRC, [12] is one of the ways to achieve this goal in broiler production.

Vitamin A (B-carotene) have anticarcinogenic effect by altering the liver metabolism effects of carcinogens [13]. The possible mechanisms by which vitamin C may affect carcinogenesis include antioxidant effects, blocking of formation of nitrosanimes, enhancement of the immune response, and acceleration of detoxification of liver enzymes [14]. Vitamin E, an important antioxidant, plays a role in immune competence by increasing humoral antibody protection, resistance to bacterial infections, cell-mediated immunity, the T-lymphocytes tumor necrosis factor production, inhibition of mutagen formation, repair of membranes in DNA, and blocking micro cell line formation [15]. The administration of a mixture of the above three antioxidant reveled the highest reduction in risk of developing cardiac cancer [16].

Feed conversion ratio (FCR) or feed conversion rate is a ratio or rate measuring the efficiency with which the bodies of livestock convert animal feed into the desired output (milk, egg, meat etc.), [17]. Reports of improved FCR, growth response and immunity with Vitamin C and Vitamin E supplementation are available [18].

Cost of producing a kilo of chicken in Nigeria is high thus reducing profitability of broiler business. Inclusion of additional levels of antioxidants such as vitamin A, C, and E in broiler feeds as recommended by NRC, [12] was implemented in this study to combat oxidative stress and enhance growth performance, decrease feed conversion ratio and reduce cost of production.

2. MATERIALS AND METHODS

Fifty (50) day old chicks purchased from a reputable hatchery were randomly allocated into two groups of 25 birds each, namely: group A and group B. Group A is the treatment group and birds were fed commercial feed plus additional levels of antioxidants (Vitamin A, C, E) and water. Group B is the control and birds were fed commercial feed and water only. The quantities of antioxidants given to birds in group A were calculated based on National Research Council [12] recommendations for broilers. It recommended that to a 25 kg bag of feed; add 375 mg of vitamin A, 10 mg of vitamin C and 75 mg of vitamin E. They were raised on deep liter system, treated against coccidiosis and vaccinated against Newcastle and Infectious bursa diseases. The birds were weighed on

arrival and then weekly till they weigh at least 1.25 kg live weight so that when they are dress, their dress weight will not be less than a kilo. The cost of producing them from day old to the time they attained 1.25 kg live weight was calculated and recorded for each group separately. Quantities of feed served to both groups and their leftovers were weighed so that feed consumed for each group can be calculated. Also evaluated for each group are feed conversion ratios and cost of producing a kilo of broiler (meat).

Means of quantities of feed consumed, means of weight gained by the birds, means of feed conversion ratios and means of costs of 1 kilo of chicken for the two groups were tested for statistical differences by *the Students paired T-test*. Values of *P*=.05 were considered significant.

3. RESULTS

3.1 Feed Intake (kg)

The means of feed intake or quantities of feed of the group fed with additional vitamins (0.09±0.01) was significantly (*P*=.05) lower than that (0.10±0.01) of the control group. Also, the time taken for both groups to consume the quantities of feed that produced a kilo of meat varied significantly. The group fed with antioxidants took 4 weeks while the control group took 5 weeks time. The treated group consumed 360 grams of feed per bird to produce a kilo of broiler which is the hotelier size while the control group consumed 520 grams per bird to produce a kilo.

3.2 Weight Gain (kg)

The means of weight gain of the group treated with antioxidants varied significantly (*P*=.05) from the untreated group. The birds in the treated group attained a liveweight of 1.25 kg within 4 weeks whereas the control group took 5 weeks to weigh 1.3 kg liveweight. Meanwhile at 5 weeks, the other set of birds in the treated group were weighing 2 kg liveweight.

3.3 Feed Conversion Ratio (FCR)

There is significant difference (*P*=.05) between the means of FCR of the treated group and control. The group fed with additional vitamins in their feed had FCR of 0.14 for 1.25 kg liveweight at 4 weeks while the control group also had FCR of 0.14 for 1.3 kg liveweight but at 5 weeks.

3.4 Cost of Production (#)

The cost of producing a kilo of broiler in the group treated with additional vitamins (650 naira) was significantly (*P*=.05) lower than that (944 naira) of the control group. The profit made from the treated group is #16250 while that of the control group is #8900. Also, the cycle of production in the treatment group was shorter than that of the control.

4. DISCUSSION

There were statistical differences in the quantities of feed consumed, weight gained, feed conversion ratios and cost of producing a kilo of broiler between the group fed with antioxidants (additional vitamins A, C and E) and the control group. This work agrees with the study done by Sanda, et al. [19].The combination of Vitamin C & E in broiler diets markedly increased body weight gain and decrease FCR [20].

Antioxidants in the feed of the treated group were able to combat oxidative stress which could be of nutritional, environmental physiological or pathological origin. It also boost or improved the bird's immunity and appetite that they were able to consume enough feeds that yielded the liveweight of 1.25 kg in a shorter time (4 weeks) and with a lower feed conversion ratio than those of the control. In this study we chose 1.25 kg liveweight because the dressing percentage of broilers is 75% [21] so when they are sacrificed, the carcass weight will be no less than 1kilo and this is the hotelier size. Dressing percentage can be defined as the percentage of the live animal weight that becomes the carcass weight at slaughter. It is determined by dividing the carcass weight by the live weight, then multiplying by 100, [22]. The results of this study suggests that the production cycle can be just every 4 weeks implying that up to 11-12 turnovers can be done in a year and at a cheaper cost. Instead of keeping our birds longer to consume more feed to acquire enough weight, we can include additional vitamins in their feed to make consume less feed, gain more weight within a short time and with low feed conversion ratio. See Tables 1 and 2.

The goal of commercial broiler production is to achieve optimal slaughter weight at maximum

profitability [23]. The different components that constitute the total cost per broiler and per kilogram live weight are presented in Table 3. The average total cost for the group fed with additional vitamins was #16250 (for the 25 birds i.e 25 kg) and #650 per a kg of broiler while cost of production of the control was #23600 and #944 is for 1 kilo of broiler. The difference between these two costs is #294 which is a lot of money in poultry business and when this is multiplied by 25 (number of birds in this study) we will have #7350. This (#7350) is what we have saved by including additional vitamins A, C and E to broiler feeds according to National Research Council recommendations, [12]. Also, when this (#7350) is multiplied by 12 because the turnover or the cycle is in 4 weeks, we will get #88,200 as the profit margin between the treated group and control. Therefore, one can use the value for a kilo to multiply the number of birds one intends to raise to get one's profit in a month or year.

Also recorded in this study were zero mortality in the treatment group and two (2) mortalities in the control. This may suggest that the antioxidants (vitamins) which are immune stimulants were able to improve the immunity and survival rate of the birds that were fed additional vitamins perhaps by maintaining a stable oxidative state in their cells/ tissues. Brigden and Riddell [24] stated that the presence of a blood clot in the

Table 1. Effect of antioxidants, vitamin A, C and E supplemented diet on growth parameters of broilers in group A, (treatment) and B (Control)

Duration	Group	Feed intake/ bird (kg)	Weight gain / Bird (kg)	FCR
Week 1	A	0.02±0.00	0.12±0.00[a]	0.17±0.02[b]
	B	0.01±0.00	0.09±0.00[b]	0.11±0.04[a]
Week 2	A	0.06±0.00	0.37±0.04[a]	0.16±0.01[b]
	B	0.06±0.00	0.29±0.04[b]	0.21±0.02[a]
Week 3	A	0.11±0.01	0.83±0.10[a]	0.13±0.02[b]
	B	0.10±0.01	0.61±0.09[b]	0.16±0.02[a]
Week 4	A	0.17±0.01	1.25±0.00[a]	0.14±0.01[b]
	B	0.17±0.00	1.01±0.01[b]	0.17±0.00[a]
Week 5				
	B	0.18±0.01	2.00±0.00[a]	0.14±0.01[a]

*[a,b,,] are Means in the same raw with different superscripts are significantly different, *Means significant at P=.05.*

Table 2. Cost analysis for producing a kilo of bird in treatment group A

Item s	Expenditures	Unit/number/ bag	Unit price (₦)	Total (₦)
Cost of production	Cost of purchase of day old bird	25	250	6250
	Antioxidant (Vit. A, C & E)		100	100
	Starter Feed	2	3700	7400
	Vaccination/medication	-	1000	1000
	Light/kerosene	-	1000	1000
	Wood shavings	-	500	500
	Total cost			16,250
Revenue				
	Sales at week 4	25	1300	32 ,500
	Total revenue			16250
Profit	Total profit : Total revenue – total cost			#16,250

Table 3. Cost analysis for producing a kilo of bird in control group B

Items contd	Expenditures contd	Unit/number/bag	Unit price (₦)	Total (₦)
Cost of production	Cost of purchase of day old bird	25	250	6250
	Starter feed	2.5	3700	9250
	Finisher feed	1	3600	3600
	Vaccination/medication	-	3000	3000
	Light/kerosene	-	1000	1000
	Wood shavings	-	500	500
	Total Cost			23,600
Revenue				
	Sales at week 5	25	1300	32,500
	Total revenue			32,500
Profit	Total profit: Total revenue – Total cost		#8,900	

heart of dead chicks at necropsy may suggest low level or absence of certain vitamins in their diets. Another study proposed that giving birds additional vitamins improved body weight and survival rate [25].

5. CONCLUSION

There was significant difference in feed conversion ratio (FCR) of broiler chicken fed with feeds fortified with antioxidants. Age at which broilers attain dressing weight (1.25kg) is reduced. Hence production cycle was reduced and profitability increased. The fortified feed has significant difference in weight gain. It is evident by the weight gain of 1.25kg liveweight within four weeks of age. Therefore, the cost of raising a kilo of broiler was significantly reduced from #944 to #650.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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