Trop. Anim. Prod. Invest. 23 (1): 09-13 (2020)
ISSN: 1115-2540
http://animalsci.agric.ui.edu.ng/TAPI/index.php/tapijournal/index

ORIGINAL RESEARCH ARTICLE

Performance and bioeconomics of feeding broilers at different periods of the day

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ABSTRACT
An experiment was conducted to investigate the growth response and bioeconomics of feeding broiler chickens on different feeding regimes at finishing phase. Sixty 4-week old broiler chickens were randomly divided into three dietary treatments with two replicates of 10 birds each in a completely randomized design. The birds were fed at different times of the day and each treatment group was subjected to one of the three feeding regimens: morning (6:00am) and evening (7:00pm) feeders (T1), day feeders (T2) and night feeders (T3). The results indicated that birds which had access to feed during the day significantly (P<0.05) consumed more feed with concomitant increase in cost of feed compared with those on the other treatments. There was non-significant (P>0.05) difference in the average daily body weight gain, feed conversion ratio, protein efficiency ratio ,feed cost per kg gain, revenue per bird. Total feed and cost of feed consumed was encouraging in T1 and T3 unlike T2 which incurred more cost on feeding. This study, therefore, recommends the feeding of broiler chickens using either night or day and evening feeding regime program at 4 weeks aged finishing phase.

Keywords: heat stress, feeding regime, growth performance, bioeconomics, broiler chicken

INTRODUCTION

Heat stress is an important stress factor in farm animals (Campbell and Lasley, 1985). Ambient temperature is one of the most important environmental factors influencing broiler production in hot climates. Birds perform optimal within a relatively wide range of temperatures. Kampen (1984) found that the highest growth rate of broilers occurs in the range of 10-22°C while maximum feed efficiency is at about 27°C. Charles (2002) reviewed the literature on the optimum temperature for performance and concluded that for growing broilers it is 18-22°C. It is known, however, that what is ideal for growth is not ideal for feed efficiency. Modern fast-growing commercial broilers show decreased weight gain and feed intake, increased mortality, and poorer performance under heat stress (Howlinder and Rose, 1989; Leenstra and Cahaner, 1991; Eberhart and Washburn, 1993). Research data clearly showed that the survival rate of broilers decreases as feed intake increases during heat stress, especially during the hottest part of the day (Butcher and Richard, 2012). The reason for changing feeding time by providing additional light at night to allow broilers to feed during the cooler part of the day is to reduce heat production during the hotter daylight hours and alleviate the adverse effect on performance.

Several approaches such as provision of cool drinking water, selection of heat-tolerant commercial strains combined with high productivity (Cahaner *et al.*, 1992), management practices (Enete and Uguru, 2012) and dietary adjustment (Washburn, Peavey and Renwick, 1980; Leeson, 1987), as well as the alteration of feeding times (Daghir, 1995) have been employed to improve production performance of broiler chickens in hot conditions. However, management approaches have to be directed in finding ways to help animal maintain maximum production in the face of emerging climatic changes (Enete and Uguru, 2012). The conventional management routine is to feed broilers in the morning but with the over increasing heat stress which begins in the early part of the day, there is need for a paradigm shift to feeding the birds at the time when the heat load is less. This present study was therefore designed to assess the performance and bio-economies of feeding broilers at different periods of the day.

MATERIALS AND METHODS

Experimental site

The study was conducted at the Poultry unit of the Department of Animal Science Teaching and Research Farm, University of Nigeria, Nsukka. Nsukka lies in the derived Savannah region and is located on longitudes 60 25´ N and Latitude 70 24´E (Ofomata, 1975) at an altitude of 430m high above the sea level (Breinholt *et al.*, 1981). The climate is a typical humid tropical setting with a relative humidity range of 65-86%. Average diurnal minimum temperature ranges from 22.0 ^{0}C-24.7 ^{0}C while the average maximum temperature ranges between 33 ^{0}C-37 ^{0}C (Okonkwo and Akubuo, 2007). The experiment was conducted in April, 2013

Experimental design and management of birds

Sixty 4-week old broiler chickens were allocated to three dietary treatments with 2 replicates of 10 birds each in a completely randomized design (CRD). The birds were housed in deep litter pens. All the vaccination and medication routines were administered appropriately. Water was provided *ad libitum.*

Experimental layout

The same experimental diets were offered to the broilers in the three treatment groups at different periods. The birds were fed at the same number of hours. Night feeders were provided with light and an opaque material (wood and black nylon) was used to demarcate the pens from pens with lighting. Treatment 1 received their ration both morning (6:00am) and evening (7:00pm). The amount of feed offered per day was divided into two equal portions. A portion was given in the morning while the remaining portion was given in the evening. Treatment 2 were fed only during the day from 6:00am – 7:00pm. The experimental diet was offered to the birds at once in the morning by 6:00am. No light was provided at night. Treatment 3 were fed only during the night. Lighting was provided to birds in treatment 3 which were fed during the night hours of 6:00pm - 7:00am.

Growth indices

Initial and final weights of birds were taken at the start (4 weeks) and the end of finisher phase (8 weeks). Weight gain and feed intake was feed/gain ratio and protein efficiency ratio calculated.

Economic indices

Economic cost analysis of production was calculated based on some specific items such as prevailing market prices of chicks, feed and vaccine. This was used to determine whether the different feeding regimes of broiler chickens have economic advantage or not. The following parameters were calculated; feed cost/Kg gain = feed cost per Kg x FCR, cost of feed consumed, total weight gain, cost of chicken, Revenue = cost of chicken/Kg (₦) x total weight gain (Kg), Gross margin = Revenue – cost of feed consumed.

Table 1:Percentage composition of broiler finisher mash

Maize	54.0
Soybean meal	25.0
Wheat offal	5.0
Palm kernel cake	9.0
Limestone	2.0
Bone meal	4.0
Lysine	0.25
Methionine	0.25
VMP	0.25
Table salt	0.25
Total	**100**
Crude protein	20.05
Crude fibre	4.21
Ether extract	3.38
Energy (ME/Kcal/kg)	2833

Statistical analysis

Data were subjected to analysis of variance (ANOVA) and significant differences between means were separated using Duncan's New Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

Results of performance indices of broilers fed at different periods of the day are presented in Table 2. The result shows non-significant (P>0.05) difference in average final body weight, body weight gain, feed conversion ratio and protein efficiency ratio, whereas significant (P<0.05) difference was observed for average daily feed intake. The mean daily feed intake values for (T1) morning and evening, (T2) day (6:00am – 7:00pm) and (T3) night feeders were 126, 140 and 116.6 g/bird respectively. Day feeders consumed more feed (P<0.05) than day/evening and night feeders.

This agrees with the work of Lee and Leeson (2001) who showed that birds subjected to feed restriction ate less feed than *ad libitum* control birds. This result disagrees with the work of Camacho *et al*. (2004); Zhan *et al*. (2007) and Sahraei and Shariatmadari (2007) who reported that feed restriction increases feed intake. The highest amount of feed consumed by birds on Treatment 2 (day feeders) compared to those on the other treatments might be attributed to their access to feed from 6:00am – 7:00pm. The result showed that birds which had access to feed during the night (6:00pm - 7:00am-T3) when the ambient temperature was much cooler consumed lower amounts of feed when compared to birds which had access to feed during the day light hours (6:00am – 7:00pm-T1). It was expected that this would have significant impact on feed intake of birds on Treatment 1 and 3, yet this did not result in any considerable difference.

This work agrees also with the work of Donkoh and Yirenkyi (2000) who also reported increased feed consumption of birds fed during the day. This current finding contradicts the earlier work of Dvorak and Bray, 1978; Howlinder and Rose, 1989; Eberhart and Washburn, 1993). These authors indicated that lowering the ambient temperature significantly stimulates feed consumption.

Table 2: Performance indices of broiler chickens fed at different periods

Parameters	D/E feeders	DY feeders	NG feeders
Av. initial body weight (g)	830 ± 40.00	770 ± 0.00	800 ± 10.00
Av. final body weight (g)	1980 ± 0.08	2010 ± 0.07	1970 ± 0.02
Av. body weight gain (g)	1150±1.20	1240±70.00	1165.5±25.00
Av. daily feed intake (g)	126.25±4.65^{b}	140.00±1.60^{a}	116.60±0.70^{b}
Av. daily body wt. gain (g)	41.10 ± 4.30	44.30 ± 2.50	41.60 ± 0.90
Feed conversion ratio	3.12 ± 0.44	3.17 ± 0.14	2.81 ± 0.45
Protein efficiency ratio	1.63 ± 0.23	1.58 ± 0.07	1.78 ± 0.03

a,b; Means with different superscripts on the same row are significantly different (P<0.05), D/E = day and evening feeders, DY = day feeders, NG = night feeders.

Table 3: Economic implications of feeding broiler chickens at different period (finisher phase)

Parameters	D/E feeders	DY feeders	NG feeders
Feed cost per kg (₦/kg)	97	97	97
Total feed consumed (kg)	3.54 ± 0.13^{b}	3.93 ± 0.45^{a}	3.27 ± 0.02^{b}
Cost of feed consumed (₦)	343.38 ±12.61^{b}	381.21 ± 4.37^{a}	317.19 ± 1.94^{b}
Total weight gain (kg)	1.98 ± 0.04	2.01 ± 0.07	1.97 ± 0.05
Cost of Chicken/Kg (₦)	700	700	700
Revenue per bird (₦)	1386.00±32.00	1407.00 ± 53.00	1375.00 ± 43.00
Gross margin (₦)	1042.62± 32.02	1025.79 ± 48.85	1057.81 ± 47.21

a,b; Means with different superscripts on the same row are significantly different (P<0.05), Revenue = cost of chicken/Kg (₦) x total weight gain (Kg), Gross margin = Revenue – cost of feed consumed, D/E = day and evening feeders, DY = day feeders, NG = night feeders.

Effect of treatments on average daily gain showed that the average daily body weight gain recorded no significant ($P > 0.05$) difference among the treatments. The value for Treatment 2 (day feeder) which consumed significantly higher amount of feed when compared to other treatments are consistent with the observation which states that increased feed consumption leads to increased weight gain (Nir *et al.*, 1978; Shapira *et al.*, 1978; Cahaner *et al.*, 1993).

The various feeding times exerted influence on the efficiency of feed use. The result showed that birds which had access to feed at night was encouraging in efficiency of feed use, although significant differences was not observed across the treatment. The higher growth experienced in Treatment 3 is indicated by its higher value of protein efficiency (1.78) and lower value of feed conversion ratio (2.81). The birds on treatment 3 were more efficient in converting feed to gain (2.81). Feed to gain ratio (3.17) of Treatment 2 was poorer than birds fed on the other feeding regimens.

CONCLUSION AND RECOMMENDATION

It is thus envisaged that if feeding times could be adjusted more accurately, improved efficiency of dietary nutrient use at a reduced cost may be attainable. Feed restriction of broilers is beneficial as it reduces production cost and produces a uniform body weight gain. Birds which had access to feed during the day significantly ($P<0.05$) consumed more feed with concomitant increase in cost of feed compared with those on the other treatments. Total feed and cost of feed consumed was encouraging in T1 and T3 unlike T2 which incurred more cost on feeding.

This study, therefore, recommends the feeding of broiler chickens using either night or day and evening feeding regime program at 4 weeks aged finishing phase.

CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest as regards the research data in this manuscript.

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