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Effect of phase feeding on performance and economy of production of heavy broiler chickens

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***Target Audience**: Broiler producers and researchers.*

Abstract

A high –low – high phase feeding was used to determine the performance and economy of producing heavy broilers (Roasters of 12 weeks of age). One hundred and twenty (120) finisher broiler chickens were selected after brooding and allotted to four experimental units. The feeding trial comprised; a starter phase (0-4 weeks), a grower phase (4-8 weeks) and a finisher phase (8-12 weeks) on broiler finisher rations of varying crude protein levels which represented the treatments. The treatments include; T1 (Control) no restriction – commercial finisher ration 4-12 weeks after brooding. T_2 (Four weeks restriction after brooding and 18%crude protein dietre-feeding 8-12 weeks).T_3 (Four weeks restriction after brooding and 19% crude protein dietre-feeding (8-12) weeks. T_4(Four weeks restriction after brooding and 20% crude protein diet re-feeding 8-12 weeks). Each treatment was replicated three times in a completely randomized design. T_2 on 18% CP re-feeding had significant ($p<0.05$) lower body weight (3.02kg) than the control (3.41kg), whileT_3 and T_4 groups on 19% and 20% crude protein re-feeding had 3.23 and 3.22kg body weights respectively and did not differ significantly ($p>0.05$) from the control. Feed intake was significantly ($p<0.05$) higher for all the restricted groups than the control. Mortality was zero percent for the nutrient restricted groups and 4% for the control. Cost of feed per kilogram weight gain was about 25% higher for the control than the nutrient restricted groups. Extending the growing period of the broiler using a high-low-high phasing of nutrient intake resulted in the production of heavy broilers (roasters) that achieved identical body weight with the control at twelve weeks of age, with lower cost of feed per kilogram gain than the control.

***Key words:** Heavy broilers, Roasters, Phasing of nutrient intake, Body weight.*

Description of Problem

The growing successes in the broiler industry in the past decades had led to marked changes in food preferences of consumers worldwide. In Nigeria for example, there is generally preference for meat with longer chewing quality and hence high demand for spent layers, roosters or cock. (4) had reported that there is usually strong preference for meat of indigenous chicken in most places of the world especially in Africa and Asia because of the quality and unique flavour of the meat. The characteristic taste of the indigenous chicken is due to its age and not because it is a special breed. According to (4), slaughtering broilers too young because of improved growth rate is considered one of the reasons for this unsatisfactory consumer belief that the quality of the indigenous chicken is higher than that of the broiler. (9) had earlier reported that broiler meat consumption used to be very low in Western Germany because of slaughtering them too young. Therefore, there may be need for broiler producers to improve the meat quality of

the broiler in line with consumer preference by increasing the market age of the broiler.

Roasters are broilers of three to five months of age which are raised to heavier weights of more than 2.5kg (7). From Scientific research, it is known that heavier broilers yield more meat and are superior in meat quality (12). Under Nigerian Cultural context, they attract higher live bird prices especially during festive periods and when used for public relation. Most importantly, they are more efficient to process because of well-developed skeletal muscles. Roasters are specially raised as show -birds for exhibition in price winning fairs.

However, higher meat yield and better carcass quality are not the only consequences of extending the growing period of the broiler. Feed consumption per unit weight gain increases with age thereby raising cost per kilogram broiler meat for heavier birds. Again, unlike the turkeys, which can be slaughtered at 12-14 weeks of age without serious decline in feed efficiency, there is a serious decline in feed efficiency in broilers after the optimal finishing age of eight weeks. This is because, during the later stages of growth in broilers, the main component to be laid down is fat and in terms of feed conversion, this is the most expensive tissue to produce because, for a unit of gain of fat, it takes approximately four times the amount of feed per unit of muscle tissue gain (10).

Phase feeding can be used to delay maturity and increase the growing period. Phase feeding is a simple system where dietary protein and/or energy levels are reduced steadily over time (6). According to (6), Phase feeding reduces costs associated with excess protein or amino acids and improves growth. Phase feeding is also associated with compensatory growth. (3) and (13) had recommended consideration of strategies that promote compensatory growth because of the potential benefits which include feed savings and high efficiency of feed utilization.

The aim of this research was to address the problems associated with the production of heavy broilers (roasters) by extending the growing period of the bird above the optimal finishing age of eight weeks, up to twelve weeks using a high-low-high phase feeding. The objective was to determine the effect of this feeding system on performance of the experimental birds and the economics of producing heavy broilers using this system.

Materials and Methods

Experimental site

This research was carried out at the Poultry Unit of Cross River University of Technology Teaching and Research Farm, Obubra Campus, Cross River State, Nigeria.

Feeding Trials

The experiment comprised a high- low-high phase feeding which included:

1. Starter phase on commercial broiler starter ration (0 - 4 weeks)
2. Grower phase on grower ration (4 – 8 weeks)
3. Finisher phase on broiler finisher ration of varying crude protein levels which represented the treatments as described in Table 1 (8 – 12 weeks).

Experimental Treatments and Design

The treatments included:

T_1 – Commercial finisher ration from 4 – 12 weeks after brooding with commercial starter ration.

T_2 Four weeks restriction using Grower ration from 4 – 8 weeks and 18% CP finisher ration from 8 – 12 weeks.

T_3 Four weeks restriction – Grower ration from 4 – 8 weeks and 19% CP finisher ration from 8 – 12 weeks.

T_4 Four weeks restriction– Grower ration from 4 – 8 weeks and 20% CP finisher ration from 8 – 12 weeks.

Ration Formulation

The feed ingredients used for the rations were based on availability and cost. The cheapest and most available ingredients were used in formulation of the rations. They include; maize, local fishmeal, groundnut cake (GNC), palm kernel cake (PKC), bone meal, mineral/vitamin premix, synthetic lysine and methionine and common salt. The rations were formulated according to NRC 1994 specification.

The experimental rations and their chemical compositions are presented in tables 1 and 2. The chemical composition of the rations was obtained by calculation. The calculation was carried out using the spreadsheet method as described by (10).

Table 1: Ingredient Composition of Experimental Rations (Starter and Grower).

Ingredients (%)	Finisher*	Grower
Maize	-	24.78
G/nut cake	-	0.00
Fish meal	-	0.00
Palm kernel cake	-	71.22
Wheat offal	-	0.00
Bone meal	-	3.00
Salt	-	0.25
Lysine	-	0.20
Methionine	-	0.10
Min/ Vit. Premix**	-	0.45
Cost/kg of ration (₦)	76.00	31.42
Calculated chemical composition (% of DM)		
Crude protein %	20.00	15.00
Fat (%)	3.00	4.20
Crude fibre (%)	5.00	9.04
Calcium (%)	1.00	0.81
Phosphorus (%)	0.70	0.41
Lysine (%)	-	0.52
Methionine (%)	-	0.31
ME (Mcal/kg)	2.98	2.12

*Commercial ration (Top Feed) ®

** Each 2.5kg of premix contained: Vitamin A, 8,000,000 iu; Vitamin $D_{1,}$ 600,000 iu; Vitamin E, 20,000 iu; Vitamin K, 2,000mg; Vitamin $B_{1,}$ 1,5000mg; Vitamin $B_{2,}$ 4,000mg; Vitamin $B_{6,}$ 2,000mg; Vit. $B_{12,}$ 10mg; Niacin, 15,000mg; Panthotenic Acid, 5,000mg; Folic Acid, 500mg; Biotin, 20mg; Choline Chloride, 200,000mg Manganese, 80,000mg; Zinc, 50,000mg Iron, 20,000mg; Copper, 5,000mg; Iodine, 1,000mg; Selenium, 200mg; Cobalt, 500mg; Antioxidant, 120,000mg.

Table 2: Ingredient Composition of Experimental Finisher Rations.

Ingredients (%)	T_1(Control)*	T_2 18%CP	T_3 19% CP	T_4 20% CP
Maize	-	33.00	30.25	27.55
G/Nut cake	-	10.95	13.70	16.40
Fish meal	-	2.00	2.00	2.00
Palm kernel cake (PKC)	-	50.00	50.00	50.00
Wheat offal	-	0.00	0.00	0.00
Bone meal	-	3.00	3.00	3.00
Salt	-	0.25	0.25	0.25
Ly sine	-	0.20	0.20	0.20
Methionine	-	0.10	0.10	0.10
Min/Vit. Premix*	-	0.50	0050	0.50
Cost/kg of ration(₦)	76.0	41.00	41.00	41.00
Calculated chemical composition (% of dm)				
Crude protein %	20.00	18.00	19.00	20.00
Fat (%)	3.00	4.32	4.38	4.46
Crude fibre (%)	5.00	7.24	7.34	7.41
Calcium (%)	1.00	0.90	0.91	0.91
Phosphorus (%)	0.70	0.46	0.47	0.47
Lysine (%)	-	0.66	0.70	0.73
Methionine (%)	-	0.33	0.34	0.35
ME (Mcal/kg)	2.98	2.38	2.35	2.33
Energy/protein ratio	149/1	132/1	123.7/1	116/1

*Commercial finisher ration (Top Feed®)

** Each 2.5kg of premix contained: Vitamin A, 8,000,000 iu; Vitamin $D_{1,}$ 600,000 iu; Vitamin E, 20,000 iu; Vitamin K, 2,000mg; Vitamin $B_{1,}$ 1,5000mg; Vitamin $B_{2,}$ 4,000mg; Vitamin $B_{6,}$ 2,000mg; Vit. $B_{12,}$ 10mg; Niacin, 15,000mg; Panthotenic Acid, 5,000mg; Folic Acid, 500mg; Biotin, 20mg; Choline Chloride, 200,000mg Manganese, 80,000mg; Zinc, 50,000mg Iron, 20,000mg; Copper, 5,000mg; Iodine, 1,000mg; Selenium, 200mg; Cobalt, 500mg; Antioxidant, 120,000mg.

Management of Experimental Birds

Starter phase.

One hundred and thirty (130) day–old broiler chicks were purchased from a commercial distributor in Calabar. The birds were brooded in deep litter pen measuring 3 x $5m^2$ using standard practices for brooding broilers. Feed and water were given *ad-libitum*. They were fed on commercial starter ration (Top feed$^{(R)}$). All necessary vaccinations were administered. Other medications including coccidiostats were given when symptoms were observed. The starter phase lasted four weeks (day -1 to week four).

Grower phase

At the end of the starter phase, one hundred and twenty (120**)** birds were selected to tally with the experimental units. They were divided into four groups representing the experimental treatments. Each group of 30 birds was randomly assigned to a treatment group. The groups were tagged T_1 (control), T_2, T_3 and T_4. Grower ration was fed to the three experimental groups (T_2, T_3 and T_4) to induce growth retardation, while the control (T_1) was fed commercial finisher ration (Top feed$^{(R)}$). The grower phase lasted four weeks (5 – 8 weeks).

Finisher phase

At the end of the eight weeks, three finisher rations of varying crude protein levels (18%, 19% and 20% crude protein – Table 2) were introduced to T_2, T_3 and T_4 respectively. These were fed to the birds for the remaining four weeks (8 – 12 weeks).

Data collection and analysis

The birds were weighed at the start of the experiment to get their initial body weights. They were subsequently weighed on weekly basis for weekly body weights. Feeds offered daily were weighed and the left-over were weighed the following morning and subtracted from feed offered the previous day to get the feed intake. Weight gain and feed conversion ratio were deduced from the data obtained. Economics of production was obtained using cost of feed per kilogram weight gain which was calculated by multiplying cost/kg of feed by the amount of feed consumed per kilogram weight gain.

The data obtained were subjected to analysis of variance using statistical package for social sciences (SPSS) version 16.0 (student's version). Significant means ($P<0.05$) were separated using Duncan's Multiple Range Test of the same software.

Results and Discussion

Results:

The performance of the experimental birds are presented in Table 3.The birds had identical body weights at the end of the starter phase The nutrients restricted birds had significant ($p<0.05$) lower body weights than the control at the end of the four weeks restriction at eight weeks of age. The result at the end of the experiment at twelve weeks of age was startling. Apart from T_2 on 18% crude protein re-feeding which had significant lower ($p<0.05$) body weight than the control, T_3 and T_4groups on 19% and 20% crude protein re-feeding respectively did not differ significantly from the control. Weight gain, feed conversion ratio and feed efficiency followed the same trend as final body weight at twelve weeks of age. Feed intake was however significantly higher ($p<0.05$) for all the restricted groups. Mortality was zero for the nutrient restricted birds and 4% for the control.

Economics of production:

Cost of feed per kilogram weight gain was about 25% higher for the control than the nutrient restricted groups (18%, 19% and 20%).

Discussion

The significant ($P<0.05$) low body weights of the nutrient restricted birds (T_2, T_3 and T_4) at the end of the restriction period at eight weeks of age was due to growth retardation caused by the low nutrient content of the grower diet diets. This is supported by the fact that broilers have depressed body weight by all levels of feed restriction (1). The ability of the T_3 and T_4birds to achieve similar body weight significantly ($P<0.05$) with the control at twelve weeks of age after re-feeding could be due to growth compensation achieved by extending the growing period of the broilers. This is because the birds had enough period to refashion their growth curve. This result is in contrast with the results of previous studies with broilers on compensatory growth programme in which body weight of the restricted birds did not equal that of the control at market age of eight weeks (3; 13). These authors confirmed that broilers on compensatory growth programme might have problem achieving similar weight at market age as compared to birds on regular feeding programme due to their short growing period. (13) reported that turkeys on compensatory growth progamme showed better body weight than the control at twenty weeks of age because they have feeding periods extending into months. The significant low ($P<0.05$) performance of the restricted group on 18% crude protein re-feeding(T_2) in

comparison with the control was due to the low crude protein content of their finisher diet. This is because research has shown that broilers fed diet with lower crude protein level than expected presented inferior performance to birds fed higher crude protein levels even when the ratios between the essential amino acids are kept constant (1).

The significant higher (P<0.05) feed intake of the nutrient restricted birds in comparison with the control could be due to too much consumption of feed. (13) reported that due to small weight for age following restriction, broilers tend to over-consume feed in an attempt to "catch up" with normal body weight for age when normal nutrition is restored.

The zero percent mortality observed in the nutrient restricted birds against the 4% mortality in the control implies that the growth restriction method used in this research did not impose any serious stress to the birds (2). This was contrary to previous work by (5) where several indices of welfare were lower in feed restricted birds including higher mortality rate when compared to *ad-lib* fed birds. (2) reported that it is possible to reduce stress in feed restricted bird with feeding strategies that reduce nutrient content such diet dilution.

The low cost of feed / kg weight gain for the nutrient restricted birds despite their significant higher (P<0.05) feed intake was due to the low cost of grower and finisher diets used for these birds. This was in turn due to the cheap available feed ingredients used in their diets. This is supported by the report of (10) that the economic profitability of the concept of phasing of nutrient intake results from the fact that birds are kept in mild restriction using available cheap feedstuffs so that growth from relatively cheap nutrient sources are maximized.

Table 3: Performance response of the experimental birds (5-12weeks of age).

Treatments Parameters	T_1* (Control)	T_2 (18%CP)	T_3 (19% CP)	T_4 (20% CP)	SEM
Av bodywt.at 4wks (kg)	0.92	0.92	0.92	0.92	-
Av. body wt. at 8wks(kg)	2.41^{a}	1.60^{b}	1.60^{b}	1.60^{b}	0.52
Av.bodywt.at12wks(kg)	3.41^{a}	3.02^{b}	3.23^{ab}	3.22^{ab}	0.25
Growth rate (g/day)	43.75^{a}	38.00^{b}	41.43^{ab}	40.80^{ab}	3.67
Av. feed intake (g/day)	160.82	170.70	170.62	170.21	7.50ns
FCR (g feed/g gain)	3.66^{a}	4.50^{b}	4.10^{ab}	4.17^{ab}	0.60
FE (g gain/g feed)	0.28^{a}	0.23^{b}	0.25^{ab}	0.24^{ab}	0.04
Mortality (%)	4.00	-	-	-	-

^{ab}Means with different superscripts within the same row are significantly (P<0.05) different.
* Commercial finisher ration (Top feed®) - 20% CP
ns = not significant (P>0.05).

Table 4: Cost of feed per kilogramme weight gain for the production of heavy broilers using a high-low high phasing of nutrient intake

	Cost (Naira / Kg)			
Items	T_1 (control)	T_2 (18%cp	T_3 (19%cp)	T_4 (20%cp)
Experimental grower ration	-	31.42	31.42	31.42
Experimental finisher ration	-	41.00	41.00	41.00
Mean cost of experimental grower and finisher ration	-	36.21	36.21	36.21
Commercial finisher ratio	76.00	-	-	-
FCR (5-12 weeks)	3.66	4.50	4.10	4.17
Cost of feed/kg weight gain	278.16	162.45	148.46	151.00
Relative value for cost of feed/kg Weight gain (%)*	54.48	31.92	29.08	29.57

*Relative value was calculated as percentage of each treatment cost of feed/kg weight gain to the sum total of cost of feed/kg weight for all he treatment.

Conclusion and applications

Based on the results of this trial, it could be concluded that:

1. Extending the growing period of the broiler using a high-low-high phase feeding led to the production of roasters (heavy broilers) that achieved identical body weights with the control at 12 weeks of age, with zero mortality.
2. Re-feeding with less than 19% crude protein finisher diet presented inferior performance in nutrient restricted birds.
3. The nutrient restricted birds had about 25% lower cost of feed per kilogram weight gain than the control.
4. Broiler producers especially those in Nigeria can use a high- low- high phase feeding with 19% crude protein finisher diet to produce least-cost heavy broilers during festive periods.

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