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IMPACT OF PHASE-FEEDING PROGRAMS ON PERFORMANCE OF BROILER CHICKENS IN NIGERIA

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ABSTRACT: Phase-feeding is the feeding of several diets for a relatively short period of time to specifically meet an animal's nutrient requirements. The study evaluated the effect of different phase feeding methods on growth and carcass characteristics of broiler chickens. A total of 120-day-old chicks of the FIDAN strain were assigned to four dietary treatments of 30 birds each, 15 birds per replicate. Birds were fed at different phases: Phase 1 were fed broiler starter diet alone for 8 weeks; Phase 2 birds were fed starter diet from 0-4 weeks and 1st finisher diet from 5-8 weeks. Phase 3 birds were fed starter diet from 0-3 weeks, 1st finisher diet from 4-6 weeks and 2nd finisher diet from 6-8 weeks. Phase 4 birds were fed starter diet from 0-2 weeks, 1st finisher diet from 2-4 weeks, 2nd finisher diet from 4-6 weeks and 3rd finisher diet from 6-8 weeks of age. Result no significant differences ($p>0.05$) between the groups in body weight gain (2.91–2.47 kg/bird) and feed conversion ratio (2.03–2.34). Total feed intake was highest in phase 1 (6.70 kg/bird) followed by phase 2 birds (6.41 kg). Dressed weight in Phase 1 was significantly ($p<0.05$) higher than others, followed by Phase 2. Dressing percentage did not differ significantly ($p>0.05$) between the groups. Feed cost between treatments was however significantly ($p<0.05$) different, Phase 1 diet being costliest. Phase-feeding using phase 4 regime elicited reduced dietary cost without compromising optimal performance of the birds.

Keywords: Diet; Feed cost; Feed efficiency; Nutrition; Phase-feeding.

INTRODUCTION

Phase-feeding is a nutritional management strategy in which the ingredient and chemical composition of the diet is modified over time so that the nutrient composition of the diet more clearly meets the nutritional requirement of the animal (Warren and Emmert, 2000). It also describes the feeding of several diets for a relatively short period of time to more closely match an animal's nutrient requirements, minimizing over or under feeding of nutrients (Pope and Emmert, 2002; Moss et al., 2021). It is therefore an important part of establishing feed programs to meet animal performance and profitability goals.

The tremendous increase in grains costs over the years has increased focus on feed programs (Brown, 2019). Even small improvements in the feed programs used to produce meat or eggs can lead to substantial saving in feed costs and dramatically improve profitability. Pope and Emmert (2002) observed that weight gain and feed efficiency of broiler birds phase fed were greatly improved when compared with those fed NRC based diets. In another study (Tolimir et al., 2010) asserted that protein and amino acids requirements of broiler chickens change with age and feeding of one diet over a prolonged period of time give rise to shortfall or excess of nutrients in main part of the growth period. Restriction of feed in broiler chickens during the early stage of growth is reported to induce compensatory growth, improve feed efficiency and engenders reduced cost (Jalal and Zakaria, 2012; Bordin et al., 2021; Belaid-Gater et al., 2022).

Currently commercial feed companies produce different forms (mash, pellets or crumbles) of broilers feed in order to engender production performance (Saveewonlop et al., 2019). These forms affect directly the cost and efficiency of production as it impacts on the digestibility, conversion ratio and growth output. Mash is a feed form which is of fine texture and homogenous such that birds cannot easily separate out the composing ingredients while the pellets are compacted into hard dry pellets or grains (Saveewonlop et al., 2019). The authors observed that pellets offered many benefits including decreased feed wastage, reduced selective feeding among others. Crumbles are however prepared by firstly pelleting the mixed ingredients, then crushing the pellets into texture coarser than mash.

In order to derive maximum benefits from phase feeding, it is pertinent to establish diets and feed budget on the basis of actual animal performance and profitability or performance goals. Wenger Feeds (Wenger Feeds Co®. USA) assert that information from breeding companies can be useful in establishing expected outcome. Meremikwu and Obikaonu (2020) in their experiment where they fed a high – low – high nutrient phase diets to broilers reported a significantly

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higher feed intake by the nutrient restricted diet groups than the control group. The authors however observed a 25 % increase in cost of feed for the control diet above the nutrient restricted phase diets.

The study was conducted to evaluate the impact of feeding different planes of diets and at different periods of growth on performance and carcass characteristics of broiler chickens as well as to analyse the economics of production.

MATERIALS AND METHODS

Study which lasted for 8 weeks, between October and November, 2021, was carried out at the Poultry Unit of the Teaching and Research Farm, University of Calabar, Calabar, Nigeria. Feed ingredients were procured from local market in Calabar. African yam bean (*Sphenostylis stenocarpa*) seeds were processed by boiling in hot water at about 100˚C for one hour. It was then drained of water using aluminium basket, sundried and milled, as well as other feed ingredients. Four experimental diets were formulated as presented in Table 1.

One hundred and twenty day old chicks of the FIDAN strain were randomly assigned using Completely Randomized Design to four dietary treatments of 30 birds per treatment and 15 birds per replicate. Birds were fed at different phases: Phase 1 were fed broiler starter diet alone for 8 weeks; Phase 2 birds were fed starter diet from 0-4 weeks and first finisher diet from 5-8 weeks of age. Phase 3 birds were fed starter diet from 0-3 weeks, 1st finisher diet from 4-6 weeks and 2nd finisher diet from 6-8 weeks. Phase 4 birds were fed starter diet from 0-2 weeks, 1st finisher diet from 2-4 weeks, 2nd finisher diet from 4-6 weeks and lastly, 3rd finisher diet from 6-8 weeks of age. Birds were raised in deep litter system and fed *ad-libitum*. Data on feed intake, weight gain and feed conversion ratio were taken and recorded weekly.

Table 1 - Feed composition of experimental diets

Ingredient	Starter	1st finisher	2nd finisher	3rd finisher
Maize	50	53	54	55
African Yam Bean	5	6	6	6
Soya bean	30	27	25	23
Fish meal	4	2	2	1
Wheat offal	8	9	10	12
Bone meal	2	2	2	2
Salt	0.3	0.3	0.3	0.3
Vit/Min premix	0.3	0.4	0.4	0.4
Lysine	0.2	0.15	0.15	0.15
Methionine	0.2	0.15	0.15	0.15
Total	100	100	100	100
Cost per Kg diet ($)	0.900	0.202	0.178	0.175
Determined analysis				
CP (%)	29.31	27.12	25.37	23.62
CF (%)	5	6	7.75	8.25
ME (kcal/kg)	1705.6	1724	1772.9	1780.4

CP: crude protein, CF: Crude fibre, ME: Metabolizable energy

Carcass evaluation

At the end of the feeding trial, three birds per treatment were selected randomly and fasted for 24 hours in preparation for slaughtering and carcass evaluation. Each bird was weighed and slaughtered by severing the jugular vein. The feathers were plucked and primal cuts removed thereafter. All data collected was subjected to Analysis of Variance. Significant means were separated using Duncan Multiple Range Test.

Animal welfare and ethical approval

The ethical approval of university of Calabar Committee on Animal Welfare and Rights was obtained based on the Australian Code for the Care and Use of Animals for Scientific Purposes, 8th Edition of National Health and Medical Research Council - Canberra in 2013.

RESULTS AND DISCUSSION

The gross composition of experimental diets is presented in Table 1. Cost of each diet was also calculated. Table 2 shows the proximate composition of the experimental diets. Diet T_1 had the highest (29.31%) crude protein content as compared to 27.12 %, 25.37% and 23.625 for T_2, T_3 and T_4 respectively. Emmert and Baker (1997) remarked that levels of amino acid in diets could be gradually decreased in accordance with a bird's lysine, sulphur amino acid and threonine

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requirements without compromising its growth and carcass yield. The growth performance of the birds is presented in Table 3. Weight gain and feed conversion ratio were not significantly different ($p>0.05$) among the dietary groups. Feed intake was however significantly different ($p<0.05$), Phase1 and 2 birds being superior in this regard. The result of the present study is in consonance with the reports of Warren and Emmert (2000) as well as Pope and Emmert (2002) who established that multi- Phase-feeding had no significant effect on body mass of broiler chickens. The mean weekly weight of the experimental birds was not significantly different ($p>0.05$). However, Tolimir et al (2010) differed with this research finding. Previous authors (Farhart et al., 2002) reported improvement in body weight of birds fed starter diets from 0-14 days and those fed finisher diets from 16–35 days. Contrary to the present research finding, Gajana et al. (2011) observed that birds fed single diet performed better in terms of feed conversion ratio than those fed two diets. Zubair and Leeson (1994) remarked that under nutrition is more detrimental to animals during the early stages of life than later. When birds are subjected to early feed-restriction they exhibit slow growth followed by a period of rapid growth and weight gain as they approach market weight to compensate for the delayed growth during the early restriction period. Feed restriction in this study was in terms of quality at the different phases of feeding. Feed intake is an important factor and birds on Phase 3 diet consumed averagely lower quantity than other groups, it therefore portends to reduced body weight gain with a resultant effect of reduced maintenance requirements.

Table 2 - Performance of broiler chickens subjected to phase-feeding

Parameters	Phase 1	Phase 2	Phase 3	Phase 4	SEM	P-value
Initial Weight (kg)	0.04	0.04	0.04	0.05	0	NS
Final weight (kg)	2.95	2.78	2.67	2.51	0.17	NS
Total weight gain (kg)	2.91	2.74	2.81	2.47	0.17	NS
mean weekly wt. gain	0.37	0.36	0.36	0.33	0.07	NS
Mean weekly body wt.	1.12	1.11	1.06	1	0.04	NS
Total feed intake (g)	6695.4	6405.7	5711.6	5738.1	10.32	NS
Mean weekly feed intake	836.93^{a}	800.71^{a}	713.95^{b}	717.26^{b}	3.65	*
Feed conversion ratio	2.27	2.37	2.17	2.33	0.04	NS
Total feed cost/kg ($)	1.884^{a}	1.736^{ab}	1.536^{b}	1.507^{b}	0.16	*

^{a,b} Means on the same row with different superscripts are significantly different; SEM= standard error of mean; *p<0.05; NS: not significant

Table 3 - Carcass characteristics of broiler chickens subjected to phase-feeding

Parameters	Phase 1	Phase 2	Phase 3	Phase 4	SEM	P-value
Live weight	2950.03^{a}	2780^{b}	2670.62^{c}	2510.1^{c}	11.2	*
Carcass weight	2067.39^{a}	1935.45^{b}	1834.79^{c}	1824.25^{c}	10.12	*
Dressing %	70.08	69.62	68.7	72.67	3.3	NS
Head	55.78	50.14	60.74	60.12	1.03	NS
Neck	91.97^{a}	73.80^{ab}	69.12^{b}	71.92^{ab}	1.5	*
Wings	216.6^{ab}	211.2^{ab}	210.08^{ab}	220.3^{a}	1.02	*
Thighs	274.76^{ab}	282.33^{a}	229.04^{c}	261.82^{b}	2.26	*
Drumstick	214.51^{a}	194.13^{ab}	200.91^{a}	185.34^{b}	1.63	*
Back	265.63^{a}	212.29^{ab}	192.52^{b}	200.46^{ab}	2.67	*
Breast	516.67^{a}	516.67^{a}	466.67^{b}	416.67^{c}	3.22	*
Shank	73.07	71.64	83.47	80.6	1.11	NS
Gizzard	38.03	36.03	35.21	33.68	0.31	NS
Abdominal fat	37.97	33.05	20.86	27.84	1.26	NS

^{a,b} Means on the same row with different superscripts are significantly different; SEM= standard error of mean; *p<0.05; NS: not significant

The cost per kg of the diets differed significantly ($p<0.05$). Feed cost per bird was higher ($p<0.05$) in the birds on single diet (phase 1) $0.900 than in others. Lowest feed cost per kilogram diet ($0.175) was recorded on the four-phase diet. This finding is at variance with report of Henry and Ammerman (1995) that single diet feeding programme may save merit in broiler production by saving on feeding cost. In line with result of this research, Meremikwu and Obikaonu (2020) affirms that the cost per kilogram ($0.42) of feed of broiler birds on the control (regular feed) was significantly ($p<0.05$) higher than the cost ($0.21 – 0.23) of nutrient restricted diets. It goes to confirm that it is more cost effective to feed broiler birds using different Phase- feeding regimes than the conventional diets.

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Result of carcass evaluation is presented in Table 4. Live and dressed carcass weights of birds on single diet were significantly ($p<0.05$) higher than those on 2, 3 and 4 phase diets. Similarly, birds on phase 2 phase diet were significantly ($p<0.05$) superior than those on 3 and 4 phase diets live and dressed carcass weights. Dressing percentage however, did not differ ($p>0.05$) significantly among the diet phases, values recorded ranged between 68.70 and 72.67%. The dressing percentage values obtained in this study fall within the range (68.66 – 70.30) reported by Jalal and Zakaria (2012) who fed broiler chickens at 100, 80, 65 and 50% feed intake respectively. Significance varied among traits and dietary phases. This result is at variance with the report of Farhart et al. (2002) that carcass weight was lower in the single diet group than those fed three phases. Abdelraheem et al. (2019) asserted that "carcass weight of broiler chickens can be controlled using different options of feed restriction programs according to the need of the market and the producer situation with special consideration to the economic return". Previous researches have lent credence to the fact that nutrition plays important role in broiler performance as feeding factors impact considerably on carcass composition of the birds (Abdelraheem et al., 2019; Banaszak et al., 2021). Abdelraheem et al. (2019) reported dressing percentage values of 72 – 75% for broiler birds fed 120g of feed per bird per day slaughtered at 32 days of age. Milczarek et al. (2022) similarly reported dressing percentage ranging between 75 and 78.5% for broiler chickens fed graded levels of guar meal diets. Differences between the findings of the present research and reports of previous authors could be attributed to genetic, nutritional and management variations among the studies.

CONCLUSION AND RECOMMENDATIONS

The study established that none of the Phase-feeding regimes engendered a significant performance among the bird, since total weight gain, feed conversion ratio and dressing percentage did not differ significantly among the feeding groups. It is recommended therefore that phase-feeding of broiler chickens using phase 4 feeding regime, (that is starter, first finisher, second finisher and third finisher diets) be embraced by poultry farmers as it would elicit reduced dietary cost without compromising optimum performance of the birds.

DECLARATIONS

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Consent to publish
Not applicable

Authors' contributions
V.N. Ebegbulem: conceptualization, research methodology and writing of the first draft of the article;
E.E. Archibong: methodology, statistical analyses;
T.N. Kperun and M. Udayi: feeding trial, data collection;
E.D. Izuki: literature review, editing the manuscript and references.

Competing interest
There is no competing interest to this research and publication.

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