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# Growth Indices and Economy of Feed Intake of Broiler Chickens Fed Changing Commercial Feed Brands at Starter and Finisher Phases

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**Abstract:** Growth and feed intake data obtained from broiler chickens were analyzed to determine the effect of changing commercial feed brands on broiler performance. Mean total weight gain, specific growth rate (SGR) and growth efficiency (GE) were influenced by treatment at both starter and finisher phases with birds receiving changing feed brands having higher values. Economics of feed intake showed that feed cost/kg, feed cost/bird and feed cost/kg gain were higher for birds fed changing commercial feed brands at both phases. However, feed to gain ratio was better for birds fed treatment 1 at starter phase and treatment 2 at finisher phase with value of 2.52 and 3.11 respectively. Highest revenue was obtained from birds in treatment 3 and 2 at the starter and finisher phases respectively. Results of growth curve parameter estimates showed that the asymptotic weight of birds increased with the length of frequency of change of feed with a difference of 155g between the control and other treatments. Farmers can therefore use other feed brands once a week as such practice will in no way be detrimental to growth but rather slightly increase growth of the birds.

**Key words:** Growth indices, economics, feed intake, broiler, commercial feed brands

## Introduction

The level and efficiency of production of any animal depends on the provision of adequate protein, energy, vitamins and minerals in the right proportions in their diets. In broiler nutrition, energy and protein levels are of great significance. Presently, poultry occupies a unique position in the livestock sector of Nigeria (Obioha, 1992). Expansion of the industry depends to a large extent on the manipulation of growth of the birds and availability of good quality feed at affordable price. This is particularly true of the intensive poultry enterprise whose performance depends almost entirely on the use of balanced rations.

An overview of the poultry industry shows that majority of the producers are small-scale holder farmers that rely on commercial feed millers for the supply of feed. Knowledge of the growth response of the birds will provide an insight into the efficient use of feed. Growth can be defined as the increase in size and changes in functional capabilities of the various tissues and organs of animals that occurs from conception through maturity. The lifetime interrelation between an individual's inherent impulses to grow and mature in all body parts and the environment in which the impulses are expressed can be expressed with growth models. The fitting of growth which is a nonlinear function offers an opportunity to summarize information contained in the entire sequence of size age points into a small set of parameters that can be interpreted biologically and used to derive other relevant growth traits (Fitzhugh, 1976; Perotto *et al*., 1992).

In order to model animal growth, a wide range of equations has been proposed in the literature. Mechanistic models have been used to describe the growth response of broilers (Aerts *et al*., 2003). Such models have helped in gaining in-sight, transfer of scientific knowledge and for simulation of processes. Beside these mechanistic models, many empirical models which are mainly the result of non linear regression analysis are applied to growth data (Von Bertalanffi, 1938; Brody, 1945; Fitzhugh, 1976). Such regression models have the advantage that they are accurate and do not have complex structure. It is therefore the objective of this study to model growth of broiler chicken fed changing commercial feed brands using the non linear model.

## Materials and Methods

**Site of study:** The data used in this study were obtained from the research conducted at the poultry unit of the Teaching and Research Farm of the University of Benin, Benin City, Nigeria. Benin City is located between latitudes 6° and 6°30'N of the equator and longitudes 5° 40' and 6°E of the Green wish Meridian. It has an annual rainfall of 2162mm, mean temperature of 27.6°C and mean relative humidity of 72.5%.

**Experimental animals and management:** A total of 144 day-old Anak broiler chicks were purchased from Otta Hatchery, Ogun State, Nigeria. The birds were reared in deep litter in a standard tropical open sided poultry building divided into 12 pens. The experiment lasted 10 weeks from June to August 2005.

The chicks were brooded during the first 4 weeks during which each pen was provided with electric bulbs and the open sides of the pen covered with polythene sheet to provide warmth. The birds were vaccinated according to schedule against Newcastle and Gumboro diseases. Other medications applied included antibiotics, Coccidiostats and vitamins. Feed and water were provided ad libitum.

**Experimental design:** 144 day-old Anak broiler chicks of both sexes were randomly assigned to 4 treatments over the experimental period. Each treatment had 3 replicates of 12 experimental units each assigned into a completely randomized design (CRD).

**Experimental diets:** Four commercial brands of broiler feed namely: Guinea feed (A), Pfizer feed (B), Jachem feed (C) and Top feed (D) were used. These feed were combined to give 4 treatments based on the frequency of change from one feed to the other. In treatment 1, only feed A was given. Treatment 2 consist of changing all feed brands weekly, changing at interval of every 4 days (treatment 3) and at an interval of every 2 days (treatment 4). The starter and finisher commercial feed brands energy and crude protein composition are presented in Table 1. The day old chicks were placed on feed A for one week to stabilize them. Three replicates were assigned to each of the treatments with treatment 1 acting as the control.

The experiment consists of two phases: the starter and the finisher phases. Because the energy and protein requirements of the birds are different at both phases, commercial feed millers compound feed to meet such requirements which however vary with feed brands depending on the feedstuffs. Presented in Table 1 are the energy and protein levels of the feed brands.

Table 1: Energy and protein levels of the different commercial feed brands at the starter and finisher phases

| | Feed brands | | | |
|---|---|---|---|---|
| Nutrients | A | B | C | D |
| Starter phase | | | | |
| ME( kcal/kg) | 2500.00 | 2987.60 | 2700.00 | 2850.00 |
| CP (%) | 19.00 | 24.00 | 21.00 | 22.40 |
| Finisher phase | | | | |
| ME (kcal/kg) | 2850.00 | 2987.60 | 2700.00 | 2850.00 |
| CP (%) | 19.00 | 20.00 | 18.00 | 19.40 |

ME= metabolizable energy, CP= crude protein

**Data collection and statistical analysis:** Data on weekly body weight (BWT) and feed intake (FDIN) of the birds using a weighing scale were collected. The growth response of the birds were model using Gompertz model which has been found to be most useful in describing growth in broiler (Tzeng and Becker, 1981) depicted as $W = A_e^{\,b\text{-}kt}$ (Fitzhugh, 1976).

Where W is the weight at time t (kg); A is the mature weight (kg); e is base of natural logarithm; b is a scaling parameter; k is a function of the ratio of maximum growth rate to mature size(l /d); t is time (d). The parameters of the Gompertz equation were estimated based on all weight data of the experimental period.

The model describes animal growth as a function of time (age) by making use of non-linear regression equation (Fitzhugh, 1976). Growth performance was determined using live weight and growth rate parameters such as

$$WG = \frac{LW_1 - LW_{11}}{t_1 - t_{11}}$$

where: WG = weight gain; $LW_1$= weight at particular week = $t_1$; $LW_{11}$ = weight for the previous period $t_{11}$

$$SGR(\%) = \frac{\ln(LW_1) - \ln(LW_{11})}{t_1 - t_{11}} \times 100$$

Where: SGR is specific growth rate

In $LW_1$ is natural log of live weight at week $t_1$

In$LW_{11}$ is natural log of live weight at $t_{11}$

$$GE = \frac{WG}{LW}$$

Where: GE is growth efficiency for time period

WG is weight gain for specific time period

LW is initial weight as a covariate

**Economic evaluation of feed:** Feed cost was calculated by multiplying total feed intake by price per kg feed.

Revenue was calculated by multiplying weight at end of both phases by prevailing market price of N500/kg (Market survey, October 2005) given dressing percentage of 65 (Olomu, 1995).

## Results

Mean growth performance of broiler chickens fed changing different commercial feed brands at the starter and finisher phases are shown in Table 2. Initial body weights of birds differ significantly in all the treatments ($P<0.05$) except at the end of starter phase. Total weight gain (TWG) showed no significant difference with changing of feed. Specific growth (SGR) rate and growth efficiency (GE) showed no trend pattern. However, birds in treatment A with the least specific growth rate value also had the least growth efficiency.

At the finisher phase, birds fed treatments 1 and 4 that hitherto had lower values for SGR and GE at the starter phase had higher values. Final body weight of birds differed significantly between sole feeding and changing feed brands.

Presented in Table 3 are the mean values obtained for feed intake and economic evaluation of feed intake. The

Table 2: Mean value for growth traits of broiler chicken fed changing commercial feed brands at starter and finisher phases

| | Treatments | | | | |
|---|---|---|---|---|---|
| Variables | 1 | 2 | 3 | 4 | SEM |
| Starter phase | (1-5weeks) | | | | |
| Initial wt, g | 147.75[b] | 135.00[d] | 145.00[c] | 150.00[a] | 0.18 |
| Final wt, g | 1063.33[a] | 1183.33[a] | 1200.00[a] | 1109.72[a] | 116.07 |
| TWG, g | 915.58[b] | 1048.33[a] | 1055.00[a] | 926.39[b] | 113.22 |
| SGR (%) | 49.50 | 54.15 | 52.75 | 50.05 | |
| GE | 1.55 | 1.94 | 1.82 | 1.60 | |
| Finisher phase | (5-9wks) | | | | |
| Initial wt, g | 1063.33[a] | 1183.33[a] | 1200.00[a] | 1109.72[a] | 116.07 |
| Final wt, g | 2855.00[b] | 3112.50[a] | 3008.33[a] | 3105.56[a] | 116.32 |
| TWG | 1786.67[b] | 1929.17[ab] | 1850.00[ab] | 1995.84[a] | 193.33 |
| SGR | 24.67 | 24.08 | 22.98 | 25.77 | |
| GE | 0.42 | 0.41 | 0.38 | 0.44 | |

Means on the same row with different superscripts are significantly different (p<0.05)

TWG = total weight gain, SGR = specific growth rate, GE = growth efficiency

obtained values differed significantly at both the starter and finisher phases. Birds with the least feed intake at the starter phase had similar intake with those in treatment 2 at the finisher phase. Feed cost/kg diet dropped at the finisher phase for birds fed changing feed brands. Feed cost/bird and feed cost/kg gain showed significant difference (P<0.05) at both phases while feed to gain ratio only showed significant difference (P<0.05) at the starter phase. Revenue at market weight was about 2.6 the value at the end of starter phase. Birds on treatment 2 gave the highest revenue of N1,011.56 with an average 9 weeks body weight of 3.1125kg.

Results of curve parameter estimates of the birds are presented in Table 4. The asymptotic weight A, increased with the frequency of change of feed brands recording a difference of about 155g between the control and when feed was changed every two days. Other curve parameters also change in similar manner.

## Discussion

**Growth traits:** An initial average difference of 15g that existed in the initial body weight of the birds could not be sustained by the birds that exhibited it as the highest absolute final body weight was obtained in birds in treatment 2 thus suggesting that initial body weight do not influence growth of birds. Rather, how well the feed is utilized will determine final body weight. However, birds that received treatments with changing feed brands (2, 3 and 4) had similar final body weight value. The total weight gain value obtained for the birds at the starter and finisher phases when converted to daily weight gain gave values that were similar to those reported in the literature for broiler chicken fed different commercial premixes at two developmental stages (Ayanwale *et al.,* 1999). The non significant influence of the treatments on total weight gain of the birds despite the wide range of the dietary energy content of the feed (Table 1) can be attributed to the seeming ability of the birds to adjust feed intake according to energy levels of diets (Angulo *et al.*, 1993; Olomu, 1995) which thus reflected in the significant difference observed in feed intake. The higher the frequency of change the more feed that was consumed because feed with lower energy level will be given more frequently also. The least weight gain observed in the control treatment at both phases might be explained on account of significant reduction in feed intake. This observation is in line with the findings of Salami (1999) who reported reduced feed intake and poor growth rate in weanling rabbits fed diets containing abnormal energy protein ratio.

Specific growth rate and growth efficiency values were higher at the starter phase thus suggesting that the birds will show more sensitivity to poor feeding hence treatment A with the lower energy and protein values had the least value for these variables. The poor use of changing feed brands thus accounted for higher values obtained. However, least GE obtained for treatment A coupled with the better feed efficiency of the feed at this stage therefore suggest that specific feed brand be given at this phase for maximum utilization of feed.

**Feed efficiency:** Feed efficiency has been used to measure the potentials of birds or feeding programme (Stewart *et al.,* 1980). The results obtained from this study showed that changing feed brands at every 4 days interval (Trt 3) gave the best feeding programme at the starter phase and at weekly interval (Trt 2) at the finisher phase. Feed to gain ratio deteriorated with the frequency of change of fed at the starter phase. Similar observation was noted by Adeniji (2005).

Birds given changing feed brands consumed more feed per kg gain than the control treatment. This indicated that birds in the control were more efficient converters of feed for growth. The lower value obtained at the finisher phase was expected since birds were less efficient in feed efficiency. However, the no significant difference observed at the finisher phase may have resulted from

Table 3: Mean value obtained for feed intake and economic evaluation of feed intake of birds fed changing commercial feed brands

| | Treatments | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | SEM |
| Starter phase | (1-5weeks) | | | | |
| Total feed intake | 2265.00[c] | 3295.92[ab] | 3454.67[a] | 3181.94[b] | 88.63 |
| Feed cost/kg diet | 52.00 | 53.00 | 53.00 | 53.00 | |
| Feed cost/bird | 117.78 | 174.68 | 183.16 | 168.64 | 4.67 |
| Feed cost/kg gain | 131.56[b] | 169.07[a] | 176.14[a] | 182.67[a] | 19.33 |
| Feed to gain ratio | 2.53[b] | 3.19[ab] | 3.32[ab] | 3.45[a] | 0.37 |
| Revenue | 346.66 | 384.58 | 390.00 | 360.66 | |
| Finisher phase | (5-9wks) | | | | |
| Total feed intake | 5794.17[b] | 5892.92[b] | 6305.00[a] | 6352.22[a] | 345.09 |
| Fed cost/kg diet | 52.00 | 50.00 | 50.00 | 50.00 | |
| Feed cost/bird | 301.30[ab] | 294.65[b] | 315.25[a] | 317.61[a] | 17.62 |
| Feed cost/kg gain | 169.87[a] | 155.67[b] | 170.67[a] | 169.67[a] | 15.21 |
| Feed to gain ratio | 3.27 | 3.11 | 3.41 | 3.39 | 0.36 |
| Revenue | 927.87 | 1011.56 | 977.71 | 1009.31 | |

Means on the same row with different superscripts are significantly different ($p<0.05$)

Table 4: Growth curve parameter estimates of broiler fed changing commercial feed brands from week 1 to 9

| | | Parameter | Estimates | |
|---|---|---|---|---|
| Tr. | A | b | K | $R^2$ (%) |
| 1 | 1192.2±349.3 | 21.27 | 181.8±2.64 | 96.9 |
| 2 | 1315.2±406.0 | 15.97 | 226.0±2.09 | 97.5 |
| 3 | 1327.0±398.4 | 17.77 | 218.7±3.61 | 97.7 |
| 4 | 1347.3±409.7 | 17.99 | 223.4±3.67 | 97.4 |

Tr.: Treatments

the seemingly similar energy and protein value of the feed brands.

The significant difference in feed efficiency obtained in this study at the starter phase can be attributed to the energy level of the feed which has also been implicated as a major factor affecting FE of broilers (Zubair and Leeson, 1996). However, the lowest FE may not always be the most economical because economics may dictate optimum use of low rather than high diet energy levels. In line with this assertion at the finisher phase the lowest FE did not give the least feed cost/kg diet.

**Growth curve parameter estimates:** The modeling of growth by differential equations allows a large collection of data to be parsimoniously summarized by a few parameters, the coefficient of a curve. The value obtained for the curve parameter for the asymptotic weight A, increased with the frequency of change of feed recording a difference of about 155g between the control and when feed was changed every two days. Therefore, changing feed brands is advantageous since birds fed changing feed brands had higher A value than the control.

The value obtained for b ranged from 15.97 to 21.27 while k value which is an indication of the rate of maturing, varied between control and other treatment groups with birds in treatment 2 having the highest value (Table 4). Comparing the k values against their respective A value, birds in treatment 2 with the highest value recorded the least A value. This result is at variance with that of Brown *et al.* (1976) who reported that large estimates of A were generally more associated with smaller estimates of k thus indicating that early maturing birds tend to grow to smaller matured weight. In this study, birds with least estimate of A also had the least k estimate. However, among treatments with changing feed the above assertion of Brown *et al.* (1976) holds.

Examining the $R^2$ values which were generally high an very close thus suggest that sole feeding or changing feed brands will in no way be detrimental to the growth of broiler chickens. Rather, changing feed brands will slightly increase their growth since it better explained the proportion of variation in growth of the birds. The high $R^2$ value obtained also indicates a good overall measure of fitness as was also reported by Lopez *et al.* (2000).

**Conclusion:** Results of this study revealed that feeding broiler chickens with one feed brand though had better efficiency of feed use at the starter phase could not be sustained to the finisher phase. Therefore, farmers can use other feed brands when the particular brand they have being using is not readily available or intentionally introduce other feed brands occasionally for better performance.

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