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On the Performance of the Profile Analysis on Different Brands of Feeds for Broiler Chickens in Nigeria

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Abstract: ***This paper assessed the performance of the Profile analysis on four different brands of feeds for broiler chickens in Anambra State, Nigeria. The specific objectives of this study includes: To determine whether the profiles are parallel, whether the profiles have equal levels, ascertain whether the profiles are flat and finally to determine the best among the feeds for the broiler chickens in Anambra, State. The data for the study is primary sourced from Legacy Farm Nteje, Anambra. A total of 120 broiler chickens with 30 chickens per feed were fed on Hybrid, Vital, Top and Animal Care Feeds for the period of eight weeks and weights of the broilers were collected for the period under same ration of feed and good healthy environment to ensure accurate results. The data obtained for the study were tested for multivariate normality using multivariate normality test based on skewness and kurtosis .The R-software is used for the data analysis. The results obtained showed that the data is multivariate normal. The results of the analysis revealed that the profiles are not parallel since the p-values were all 0.00 which falls under the rejection region of the hypothesis assuming 95% confidence level inferring that mean weight yields on broilers on consumption of different brands of feeds are not equal. The Result of Wilk's Lambda for n-group multiple pair wise comparison showed equally that the profiles are not parallel having Wilk's value of 0.017and p-value of 0.00 which falls on the rejection region of the hypothesis .Also, observed that the profiles do not have equal levels since F-value of 28.43 and p-value 0.00 falls under the rejection region of the hypothesis assuming 95% confidence level showing that brands of feed does not give equal mean weight yields on the broilers on a particular observation level. Further findings equally showed that the profiles are not flat having F-value of 1255.245 and p-value 0.00 which falls under the rejection region of the hypothesis assuming 95% confidence level indicating that mean weight yields are not equal to the same constant in all brands of feeds under consideration. More so, from the line graph Top feed showed significantly better than all other feeds. Again, the result of the sample estimates showed that Top feed is the best having recorded the highest mean estimate of 1.80. The result of the multiple pairwise comparison test validated that only the comparison between T4 and T3 was significant with p-value of 0.02581. This is attributed to the Top feed recording the highest sample estimates. From the results of the findings, Top feed proved to be the best feed for the broilers in Anambra State, Nigeria.***

Keywords: Feed**,** Broiler chicken, Profile Analysis, Parallelism test, Multiple comparison test

1. Introduction

Poultry farming is one of the most lucrative business ventures that can be undertaken if properly managed. Poultry management targets the production of healthy and weighty birds to maximize profit. Chicken meat is known to be consumed by most people irrespective of tribe, race or religion. Also, the most widely consumed breed of chicken is commonly known as broilers, which are raised specifically for food.

However, the poultry industry in Nigeria has suffered a lot of losses, which affects poultry farmers as well as consumers. Challenges facing poultry production comprises of high cost of feeds and disease. A single attack can wipe out thousands of birds or even the whole farmed birds, which is why vigilance accounts are required in the formulation of feed. The feed ingredients for the poultry diet are selected for the nutrients to be consumed by the poultry animal. To actualize this, there is need to adopt the best feed which poultry chickens can feed on to gain weight thereby maximizing profit. Hence, the need to use profile analysis to select the best feed required for poultry in the state of Anambra is essence of this study.

2. Review of Literature

Kaplan and Gürcan (2018) examined the performance of the Gompertz, Logistic, VonBertalanffy, Richards, Levakovich and Janoschek growth models in estimating the weight of the Japanese quail. The study adopted weekly live-weight data obtained from 372 females and 339 males. The live weight of females was found to be greater than that of males, and the first divergence in growth of female and male birds occurred in 21-28 days, and it survived until experience.T he coefficient of determination (R^2), adjusted coefficient of determination (adj. R^2), mean square error (MSE), Akaike's information criteria (AIC) and Bayesian information criterion (BIC) were used to determine the best growth model. R^2 and adjusted R^2 values of the growth models were similar and close to 1, indicating that all models perform well in describing age-related changes in live weight in quail. Based on the MSE, AIC and BIC values, Richards model was determined to be the best fitting model to the growth data of both sexes. Therefore, it has been found that the Richards function which has a flexible structure in terms of inflection point is the most suitable growth function for female and male birds.

Olumide et al. (2018) examined the effect of different levels of supplementations (0, 100, 200, 300 and 400 g per 100 kg) of Ocimumgratissimum leaf meal on the performance, haematology and serum biochemical profile of broiler chicken. The birds were divided into five dietary treatments. Each treatment was replicated trice with thirty birds per treatment in a completely randomized design. Data were obtained on the performance parameters such as body weight, feed intake, while feed conversion ratio and livability was calculated. Blood samples were collected for hematology and serum biochemistry. The result of the performance characteristics showed that there were significant differences in the body weight and average feed intake of the birds. The feed conversion ratio value ranged from 2.17 – 2.36. The result obtained for livability showed that there was significant difference in the livability of birds on the control diet (80%) and those fed diet containing 400 g Ocimumgratissimum (100%). Significant differences were found in the values of packed cell volume (PCV), red blood cells (RBCs), white blood cells (WBCs), heterocytes, hemoglobin, cholesterol, glucose, aspartate transaminase and alanine transaminase. Hence inclusion of Ocimumgratissimum in broilers diet at 300 gm/100 kg of feed in broilers gave the best result in terms of broilers health. It was concluded that the inclusion of Ocimumgratissimum in the diets of broiler chicken has no detrimental effect on performance characteristics but improved the livability of the birds.

Askri et al. (2019) investigated the effect of inclusion of a prebiotic “AVIATOR®” (Arm and Hammer) based on yeast culture and enzymatically hydrolyzed yeast products (Saccharomyces cerevisiae) as a potential substitute of antibiotics growth promoters (AGPs) in poultry industry. Average weight (AW), Daily Weight Gain (DWG), FI (Feed Intake), Feed Conversion Ratio (FCR), Mortality Rate (MR) was measured. The study considered hot and cold carcass weight, hot and cold carcass yield and muscles weights. Meat quality was evaluated by determining pH and color values of CIE Lab Color System of meat. The statistical tool employed for analyzing the data includes the GLM-general factorial ANOVA procedure, the statistical assumption of residual normality was evaluated using the Shapiro- Wilk while Levene’s test was used for homogeneity of variances. Results showed no significant difference on growth performance between control and experimental groups. Similar results were observed regarding pH 30 min and pH ultime. However, a significant difference occurred on meat color CIE Lab. Thus, meat quality showed no alteration when the control group was compared to birds fed with prebiotic during starter period.

Aronu et al. (2013) used the Mantel test analysis to examine the relationship in weight of two group of broiler. The study noted that feeding in the production of broilers remains a major element in determining the weight and profitability of broilers. The choice of feed type often depends on the farmer's target; because it is believed that broilers need energy for tissue growth, maintenance and activity, which varieties of feed may or may not have the capacity to provide such nutritional value. Secondary data obtained from Ekeukwu Farms, Anambra State, Nigeria for an eight-week period was adopted for the study. Sixty birds were divided into two groups, a group labeled A was fed with the first feed while group B was fed with another type of feed. Bird weights were recorded weekly for an eight week period. The results of the study revealed a significant weak positive relationship between the weights of group A broilers and group B broilers with an association of 35.72% and a P value of 0.0002.

Alinaitwe et al. (2019) examined the nutritive and economic value of hydroponic barley fodder produced using locally available materials on the growth rate of Kuroiler chicken in Kampala, Uganda. One-day old male chicks were brooded together, given basal feed and vaccinated. At three weeks age, a completely randomized design was used to assign chicks to 5 study groups each with three replicates running for 9 weeks. Group 1 (control) was fed on 100% basal feed; groups 2, 3, 4, & 5 were fed on 25% hydroponic barley fodder (HBF) +75% basal; 50% HBF+50% basal; 75% HBF+25% basal and 100% HBF respectively. Nutritional profile of barley grain and fodder were analyzed using proximate analysis. The analysis of variance was carried out using SPSS version 24, the differences between the means were determined using the post hoc Tukey test and the LSD test setting alpha at 0.05. Second degree polynomial regression was used to predict the precise percentage of HBF inclusion for the maximum growth rate. Group 2 achieved the highest average live weight of 3.349 ± 0.039 kg. The optimal inclusion percentage was 23% while the cost of producing HBF decreased by 63%; however, group 4 achieved the highest gross margin of 50% and the cost-benefit ratio of 2.0.

Oloruntola (2019) considered the use of phytogenic feed supplement in broiler production for enhancing their performance and health status. The study adopted a 42-day feeding trial, were the effects of a diet supplemented with pawpaw leaf and seed meal composite mix (PCM) on hematological indices, carcass, internal organs weights, and histology of the liver and testis of broiler chickens was assessed. The White blood cell (WBC) counts of birds fed PCM supplemented diets were similar to that of the birds fed the control diet; however, the highest counts were recorded in birds fed diets 2 and 6. The hemoglobin concentration (Hbc) and packed cell volume (PCV) of birds fed PCM supplemented diets were similar to those fed the control diet, except for those fed diet 6 had significantly lower Hbc and PCV. The carcass and relative weight of the internal organs of broilers were not affected by the PCM supplementation. Food supplementation with PCM has produced a marked proliferation of polymorphonuclear and mononuclear cells, activation of the hepatic macrophage system and Kupffer cells in the liver of birds. Spermatogenic activities were also reduced in the seminiferous tubules, the congestion of the seminiferous tubules, the tunica albugina and the medial hypertrophy of the blood vessels in the birds fed with a food supplemented from 0.4 to 1.0% of PCM. The results of the study reveal that food supplementation with PCM supports normal hemapoietic processes and the normal development of carcasses and internal organs.

Tóthová et al. (2019) evaluated the protein profile in broiler chickens extended by the concentrations of serum protein fractions at different periods of fattening. Descriptive statistical tool was used to calculate arithmetic means (x) and standard errors of means for each variable and sample

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collection time, the Kolmogorov–Smirnov test for normality was used for analysis of the distribution of data, and the analysis of variance test was applied to examine the changes in the concentrations of evaluated parameters during the fattening period. Also, the significance of differences in values between the sample collections was evaluated by Tukey's multiple comparisons test. The findings of the study revealed various significant changes in the proportion of the individual protein fractions during the observed period except for the beta-globulins in all protein fractions and the albumin/globulin (A/G) ratio. The values of pre-albumin fraction were found as a small band preceding the albumin fraction differed significantly between the different age groups of chickens. The total serum protein concentrations showed higher values in older broilers and the significantly highest mean value was recorded on day 32 of fattening. Hence, the findings indicates that fattening and age of broilers influences not only the production patterns, metabolic processes, and lipid and mineral profile but also the parameters of protein profile.

3. Material and Methodology

3.1 Method of Data collection

The primary source of data was adopted for this study. Data includes the weight of one hundred and twenty broiler chickens fed with four different types of feeds in a pair of 30 chickens per feed at Legacy farm Nteje, Oyi Local Government Area, Anambra State, Nigeria between July and September, 2019. The broiler chickens were weighed weekly for a period of eight weeks in kilogram.

3.2 Methodology

3.2.1 Profile Analysis

Profile analysis is a multivariate technique that measures the shape (profile) of variables across groups (Onyeagu, 2003). A profile analysis can be referred as a broken line that graphically joins interdependent observations which are measured on the same experimental units. Often, repeated measurements are made on the same subjects over time. For instance which is our interest is that of broiler chickens on a particular brand of feed being observed weekly. Profile analysis is most commonly used in two cases:

1) Comparing the same dependent variables between groups over several time-points.
2) When there are several measures of the same dependent variable.

3.2.2 The three Parts of Profile Analysis

1) Test of Parallelism:
2) Test of Levels (Separation)
3) Test of Flatness

1) Test of Parallelism

In profile analysis, parallelism is usually the main test of interest because the test examines whether each segment is the same across all individuals or groups. A segment in this context is simply the difference in the response between time points or variables. Parallelism is assessed using a multivariate test which compares the multiple segments of the profile. A one-way MANOVA can be used to test whether there is evidence for significant non-parallelism between the groups. The within-group variance comes from subtracting the segment matrix for each individual in the group from the group mean. The between-group variance is obtained by subtracting each group mean segment matrix from the grand mean segment matrix. If the null hypothesis of parallelism is rejected, there is a significant inter-action between group membership and the measured variables or group membership and the time points.

The Hotelling's T^2 for independent samples is used to test for parallelism in profile analysis. The test statistics is expressed as

$$T^2 = \left(\bar{X}_1 - \bar{X}_2\right)' C' \left[\left(\frac{1}{n_1} + \frac{1}{n_2}\right) C S_{pool} C'\right]^{-1} C\left(\bar{X}_1 - \bar{X}_2\right) > c^2 \quad (3.0)$$

$$c^2 = \frac{(n_1 + n_2 - 2)(p-1)}{n_1 + n_2 - p} F_{(p-1),(n_1+n_2-p)}(\alpha) \quad (3.1)$$

Where,

C is the linearly transforming of original p variables into (p −1) new variables.

$$C_{(p-1)\times p} = \begin{bmatrix} -1 & 1 & 0 & 0 & \cdots & 0 & 0 \\ 0 & -1 & 1 & 0 & \cdots & 0 & 0 \\ \vdots & \vdots & \vdots & \vdots & \ddots & \cdots & \cdots \\ 0 & 0 & 0 & 0 & \cdots & -1 & 1 \end{bmatrix} \quad (3.2)$$

$$S_{pool} = \frac{(n_1 - 1)S_1 + (n_2 - 1)S_2}{(n_1 + n_2 - 2)} \quad (3.3)$$

2) Test of Levels (Separation)

This test examines whether the profiles coincide if profiles are pairwise parallel. The test is basically used for determining whether one group scores higher on average across all the variables (e.g., domains or subtests) or time points. To evaluate this, the grand mean of all time points or variables is calculated for each group. Mathematically, the test simply measures the relative contributions of between-group and within-group variations to the total sum of squared errors.

$$\sum_i \sum_j \left(X_{ij} - GM\right)^2 = np \sum_j \left(\bar{X}_j - GM\right)^2 + p \sum_i \sum_j \left(X_{ij} - \bar{X}_j\right)^2 \quad (3.4)$$

Where GM is the grand mean, n is the sample size of each group, p is the number of groups. Based on this test, if the groups "Levels" are significantly different, then the null hypothesis (Ho) of the equal level is rejected.

3) Test of Flatness

Flatness like parallelism is a multivariate test which compares the multiple segments of the profile. The flatness null hypothesis is that the segments are 0, i.e. the slope of each line segment is zero and the profile is flat. This is evaluated independently for each group, making this a within-subjects test. If the line is not flat (any of the segments vary significantly from 0 then there is a within groups main effect of time-point, dependent variable, measure, etc. MANOVA is used to test the difference of the zero-matrix and the segmented data for each group. Usually Hotelling's T^2 is used here

$$T^2 = N(GM)^I (S_{wg})^{-I} (GM) \quad (3.5)$$

Where *GM* is the grand mean, N is the number of segments, and S_{wg} is the within-group variance-covariance matrix.

Wilks λ can then be calculated from the T^2 statistics using the equation

$$\lambda = \frac{1}{1+T^2} \quad (3.6)$$

3.2.3 Assumptions of Profile Analysis

There are several statistical assumptions in profile analysis. Firstly, the test scores should have a multivariate normal distribution. This assumption usually holds if there are more subjects in the smallest cell of the data than the number of variables and if the sample sizes are equal across the variables. This assumption can be assessed by checking skewness and kurtosis of the variables. If a variable is not normally distributed marginally, then transformations (e.g., log or square-root transformations) may be considered.

Multivariate skewness and kurtosis measures the same shape characteristics as in the univariate case. However, instead of comparing the distribution of a variable against a univariate normal distribution, they compare the joint distribution of several variables against a multivariate normal distribution (Mardia, 1970). Cain et al. (2017) stated that the multivariate skewness and kurtosis can be defined respectively, as

$$b_{1,p} = \frac{1}{n^2} \sum_{i=1}^{n} \sum_{j=1}^{n} \left[(X_i - \bar{X})' S^{-1} (X_j - \bar{X}) \right]^3 \quad (3.7)$$

$$b_{2,p} = \frac{1}{n} \sum_{i=1}^{n} \left[(X_i - \bar{X})' S^{-1} (X_i - \bar{X}) \right]^2 \quad (3.8)$$

Where, X is a p ×1 vector of random variables and S is the sample covariance matrix of X defined as

$$S = \frac{1}{n} \sum_{i=1}^{n} \left[(X_i - \bar{X})(X_i - \bar{X})' \right] \quad (3.9)$$

Both measures have a p subscript, so they are specific to a set of p variables. The expected Mardia's skewness is 0 for a multivariate normal distribution and higher values indicate a more severe departure from normality. The expected Mardia's kurtosis is p(p + 2) for a multivariate normal distribution of p variables.

4. Results of Data Analysis

4.1 Multivariate normality test based on Skewness and Kurtosis

Table 4.1: Multivariate Normality Test Based on Skewness with Transformed Data

Feeds	U test value	df	p-value	Remark
LOG(Hybrid Feed)	10.0334	8	0.0685	Multivariate Normal
LOG(Vital Feed)	9.9691	8	0.08903	Multivariate Normal
LOG(Top Feed)	14.6355	8	0.06663	Multivariate Normal
LOG(Animal Care Feed)	14.8829	8	0.064652	Multivariate Normal

The result of transformed data showed that data were multivariate normally distributed with U values of 10.0334, 9.9691, 14.6355 and 14.8829 for hybrid feed, vital feed, top feed and animal care feed respectively with corresponding p-values which were found to be greater than significant value of α= 0.05.

Table 4.2: Multivariate Normality Test Based on Kurtosis with Transformed data

Feeds	W test Value	df1	df2	w1	w2	p-value	Remark
LOG(Hybrid Feed)	20.6254	35	1	0.48	0.80	0.08869	Multivariate normal
LOG(Vital Feed)	22.6506	35	1	0.48	0.80	0.06221	Multivariate normal
Log(Top Feed)	22.3564	35	1	0.48	0.80	0.06305	Multivariate normal
LOG(Animal Care Feed)	23.0212	35	1	0.48	0.80	0.0622	Multivariate normal

The result of transformed data showed that data were multivariate normally distributed with W values of 20.6254, 22.6506, 22.3564 and 23.0212for hybrid feed, vital feed, top feed and animal care feed respectively with corresponding p-values which were found to be greater than significant value of α= 0.05.

Table 4.3: Result of Profile Analysis for testing whether the profiles are parallel

	Multivariate.Test	Statistic	Approx.F	num.df	den.df	p.value
1	Wilks	0.02523	39.2059	21	316.411	0.00***
2	Pillai	1.98553	31.3151	21	336	0.00***
3	Hotelling-Lawley	8.97144	46.4236	21	326	0.00***
4	Roy	6.08595	97.3752	7	112	0.00***

Signif.codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

The result obtained in table 4 .3 showed that the profiles are not parallel since the p-values for the test statistics were all 0.00 which falls under the rejection region of the hypothesis assuming 95% confidence level was obtained. This implies that each segment is not the same across all groups of broilers.

Table 4.4: Result of Wilk's Lambda for testing multiple pairwise comparisons

Wilks' Lambda	Chi2-Value	DF	p-value
0.017144	459.47	24.00	0.00**

This result of Wilk's Lambda for n-group multiple pair wise comparison showed equally that the profiles are not parallel having Wilk's value of 0.017and p-value of 0.00 which falls on the rejection region of the hypothesis as well.

Table 4.5: Result of Profile Analysis for testing whether the profiles have equal levels

Source of Variation	Df	Sum of Squares	Mean Squares	F-value	Pr(>F)
Group	3	3.891	1.2971	28.43	0.00***
Residuals	116	5.291	0.0456		

Signif.codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

The result obtained in table 4.5 found that the profiles does not have equal levels, since F-value of 28.43 and p-value 0.00 which falls under the rejection region of the hypothesis assuming 95% confidence level was obtained. This result implies that at least one type of feed performed better on the average across all measures.

Table 4 6: Result of Profile Analysis for testing whether the profiles are flat

F-value	df1	df2	p-value
1255.245	7	110	0.00***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

The result obtained in table 4. 6 found that the profiles are not flat having F-value of 1255.245 and p-value 0.00 which falls under the rejection region of the hypothesis assuming 95% confidence level. This result implies that there is significant difference within the group of broiler chickens across the study period.

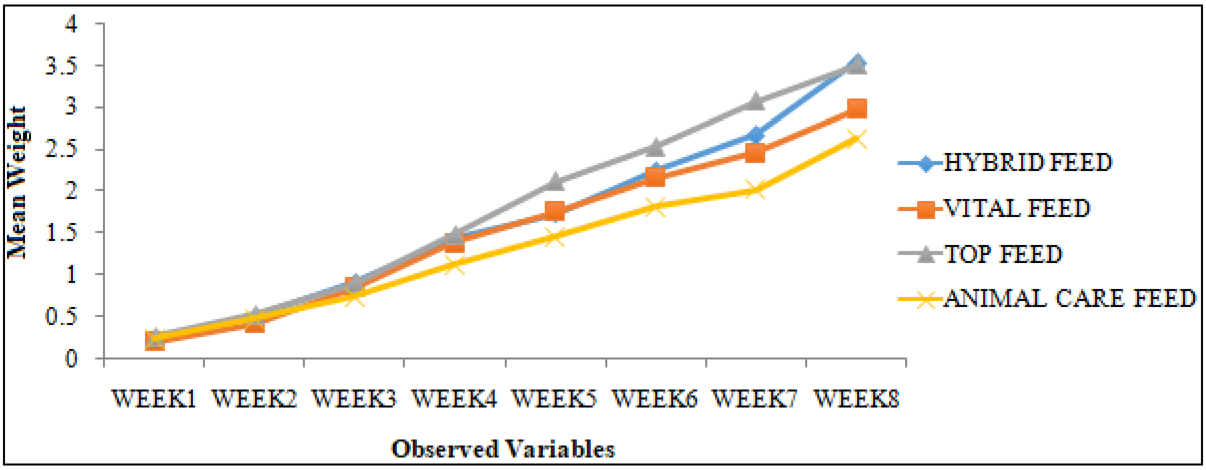

Figure 1: Line Graph showing the distribution of Weekly mean Weight of broiler chickens for the various Feed

Table 4.7: Result of Sample estimates for testing multiple pairwise comparisons

Feed	WEEK1	WEEK2	WEEK3	WEEK4	WEEK5	WEEK6	WEEK7	WEEK8	MEAN
Hybrid Feed	0.21966	0.4950	0.9076	1.4316	1.7300	2.2483	2.6733	3.5416	1.65591
Vital Feed	0.20566	0.4300	0.8440	1.3916	1.7700	2.1616	2.4683	2.9816	1.53162
Top Feed	0.26333	0.5230	0.8966	1.4800	2.1166	2.5366	3.0783	3.5066	1.80016
Animal Care Feed	0.23466	0.4676	0.7366	1.1133	1.4569	1.8133	2.0166	2.6363	1.30933

The result of the sample estimates obtained in table 4.7 showed that Top feed recorded the highest mean estimate of 1.80, following Hybrid feed which is 1.66, and then Vital feed with 1.53 and Animal care feed recorded the least value of 1.31.

Table 4.8: Result of Multiple pairwise comparison tests

Pairs	1st Pair	2nd Pair	3rd Pair	4th Pair	5th Pair	6th Pair
	T2 – T1	T3 – T1	T4 – T1	T3 – T2	T4 – T2	T4 – T3
Sig.	0.521366	0.278875	0.344827	0.418669	0.349173	0.02581

The result of the multiple pairwise comparison test obtained in table 4.8 found that only the comparison between T4 and T3 was significant with p-value of 0.02581. This is attributed to Top feed recording the highest sample estimates.

5. Conclusion

This study assessed the performance of the Profile analysis on four groups of broiler chickens with four different brands of feeds in Anambra State, Nigeria. The feeds considered in the study include hybrid feed, vital feed, top feed and animal care feed. The data obtained for the study were tested for multivariate normality using multivariate normality test based on skewness and kurtosis and the results obtained showed that data is multivariate normal with transformed data. The findings of the study revealed that the profiles are not parallel which implies that each segment is not the same across all groups of broilers under study. Also, it was found that the profiles do not have equal levels which imply that at least one type of feed performed better on the average across all measures under study. Further findings showed that the profiles are not flat which indicated that there is significant difference within the group of broiler chickens across the study period. Top feed perform better that all other feeds from the result of line graph. Additional findings showed that Top feed recorded the highest mean estimate of 1.80 followed by Hybrid feed with mean values of 1.66 while Vital feed recorded 1.53 and Animal care feed recorded the least value of 1.31. The multiple pair wise comparison test validated the results. Hence, Top feed proved to be the best feed for the broilers in Anambra State, Nigeria. This study recommends that managers of poultry farms should be advised to use Top feed for better production and maximization of profit. Again, government should adopt the document for policy making ensuring that is implemented accordingly for greater outputs for the state in general.

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