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Original Research Article

# Performance of three strains of broiler chickens fed with straight diet

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## ABSTRACT

One hundred and twenty (120) day-old broiler chickens of three different strains fed with straight diet were used in this study which lasted for 49 days. A single straight diet containing 2844.25kcal/kg of M.E and crude protein of 21.04% was formulated for the study. Each strain of the broiler namely Cobb, Ross and Abor acre formed the three treatments of 40 birds per treatment which were replicated four times with 10 birds per replicate using Completely Randomized Design. The data collected were subjected to ANOVA, where means were different, Duncan Multiple Range Test was used to separate the means. The result of the final weight, weight gained, average daily weight gained, total feed intake, average daily feed intake, live weight and dressed weight had the same level of significances where Cobb and Ross were not significantly (P>0.05) different from each other but they were significantly (P<0.05) higher than Arbor acre. The organ yield showed no significant difference (P>0.05) across the treatments. The proximate composition of meat did not show any particular pattern. Cobb strain of broiler had the best gross margin (₦2345.16) though not significantly (P<0.0.5) different from Ross (₦2326.66). From the fore going, it can be concluded and recommended that Cobb and Ross strains of broiler are best raised for performance traits and maximum gain for farmers feeding straight diet.

Key words: Broiler strains, performance, straight diet.

## INTRODUCTION

The development of suitable strains of broiler chickens for the tropical environment is a research interest which has engaged the attention of a number of poultry geneticists for the past two decades (Nargish *et al*., 2010). Improvement of poultry birds by genetic principle is one of the most important aspects in developing the poultry industry. Growth is the most important trait for evaluating different livestock species especially in meat producing animals and birds.

Growth traits such as body weight gain are affected by genetic and non-genetic factors that include nutrition, environment, health and phenomenon of growth is usually measured by observing differences in body weight recorded at different ages and or body weight gain obtained during different growth periods (Udeh & Ogbu, 2011). Taha *et al.* (2010) reported the significant effect of chicken strain on growth rate and body weight at different ages. Body weight and linear body parameters of broilers are dependent on their genotypes (Atansuyi *et al.*, 2017).

The genetic engineering of broiler chicken breeding programs has achieved levels never reached by any other animal species, making the chicken meat sector efficient in producing protein of high biological value. Selecting characteristics for better performance, resulted in improvement in feed efficiency and weight gain, modifying the growth curve and the nutritional requirement of the broiler strains (Udeh, 2015). The mastery and advancement of the genetic improvement of broiler strains generated a competitive and qualified chicken meat genetic market, in which each breeding company has its selection criteria providing strains that, although similar, have particularities of their own. Genetic companies sell their brands evidencing their strain and highlighting characteristics such as differentiated cuts, resistance to diseases, higher weight gain and better feed conversion. Researches show that there is a difference in the carcass yield of strains, while some have a higher breast yield, others have a higher yield of drumstick and thigh (Udeh, 2015).



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Tests with commercial strains of broiler chicken become fundamental since characteristics of economic importance and of market preferences may be different between genetic ones. Based on the above, there are differences among strains of broiler chicken available in the market. Straight diet is a single diet that is in between the starter and finisher diets but all the nutritional requirements of the birds are met. Hence the aim of this present study is to evaluate the effect of straight diet on three different broiler strains, namely; Ross, Abor Acre and Cobb.

## MATERIALS AND METHODS

### The Study Area

The study which lasted for 7 weeks from 7th of May, 2021 to 26th of June, 2021 was conducted in the poultry unit of the Teaching and Research Farm, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria. Umudike is located in the South Eastern part of Nigerian on latitude 05º 29' North and longitude 07º 33º East, in the Rain Forest Zone of Nigerian.

The climate of the region is characterized by a mean daily temperature of between 27°C and 35°C, all through the year. Average rainfall is about 2200mm per annum with a double maxima pattern (NRCRI, 2021).

### EXPERIMENTAL BIRDS AND MANAGEMENT

One hundred and twenty (120) day-old broiler chicks of different strains namely Cobb (strain A), Ross (strain B) and Arbor acre (strain C) were purchased from reputable hatcheries and raised on deep litter in 12 separate units for 49 days, with four replicates, each having ten birds per replicate. The chicks were brooded using coal pot and electric bulbs alternatively to supply heat for the first two weeks of life. Standard management procedures for raising broilers were strictly followed. The birds were given water and feed *ad libitum.*

### EXPERIMENTAL DIET

A single straight diet was formulated for the experiment such that the energy was 2844.25kcal/kg of M.E, while the crude protein was 21.04%. The composition of the diet used and calculated analysis are as shown in Table I.

**Table I: Percentage composition of Experimental Diet**

| Ingredients | Percentage |
|---|---|
| Maize | 58.25 |
| Soybean meal | 30.6 |
| Fish meal (72%) | 5.5 |
| Palm kernel cake | 2 |
| Bone meal | 3 |
| Salt | 0.2 |
| Lysine | 0.1 |
| Methaionine | 0.1 |
| Vitamin and mineral premix | 0.25 |
| Total | 100 |
| Calculated composition | |
| M.E (kcal/kg) | 2844.25 |
| Crude Protein (%) | 21.04 |
| Crude Fibre (%) | 4.05 |
| Calcium (%) | 1.37 |
| Phosphorus (%) | 0.92 |

### DATA COLLECTION

### GROWTH PERFORMANCE

Growth performance was estimated using the feed intake, daily weight gain and feed conversion ratio.

Initial body weight (2 decimal places in grammes) of the chicks was assessed by weighing the birds at the beginning of the study using single pan electronic balance (Scientech Inc. USA).

Final body weight (kg) was assessed by weighing the birds at the end of the experimental period using triple beam balance (Ohaus, New Jersey).

$$\text{Feed intake/bird/day (g)} = \frac{\text{Quantity of feed given} - \text{Quantity not eaten}}{\text{No. of birds} \times 49 \text{ days}}$$

$$\text{Daily weight gain/bird (g)} = \frac{\text{Final live weight} - \text{Initial weight}}{\text{No. of birds} \times 49 \text{ days}}$$

$$\text{Feed conversion ratio} = \frac{\text{Quantity of feed consumed}}{\text{Weight gain}}$$

$$\text{\% Mortality} = \frac{\text{Number died}}{\text{No. Stocked}} \times 100$$

### PROXIMATE ANALYSIS OF MEAT

Four birds per strain of broiler were slaughtered, processed and their meat taken to the laboratory for proximate analysis. Proximate analysis to determine the chemical composition of samples was done using the official methods of analysis (AOAC, 2000).

### CARCASS CHARACTERISTICS AND ORGAN YIELD

The carcass characteristics and organ yield were determined by slaughtering four birds per treatment at the end of the feeding trial. The birds slaughtered were fasted for 24 hours

to empty the digestive tract but water was supplied *ad-libitum*. Slaughtering was done by a clean cut across the jugular vein and the birds were allowed to bleed for at least three minutes. The birds were de-feathered by dipping into hot water of about 70$^{o}$C for one and a half minutes and then the feathers were removed. The carcass was cut into parts and the organs separated according to the procedure described by Ojewola & Longe (1999). All parts (breast, drumstick, thigh, wings and backcut) were weighed and expressed as percentage dressed weight. Organs like liver, heart, gizzard, kidneys were also weighed and expressed as percentage of live weight.

**ECONOMICS OF PRODUCTION**

Economy of production was estimated according to the earlier method described by Ojewola *et al.* (2005).

$$\text{Cost/kg of feed} = \frac{\text{total cost of producing 100kg of feed}}{100}$$

Cost of feed consumed (₦) = cost/kg of feed × total feed consumed (Kg)

$$\text{Cost/kg weight gain (₦/g)} = \frac{\text{Cost of feed consumed}}{\text{Total weight gain}}$$

Cost of production (₦) = cost/kg weight gain × mean weight gain

Revenue (₦) = Price of 1kg of meat (₦) × mean weight gain (g)

Gross margin (₦) = Revenue (₦) – Cost of production (₦)

**EXPERIMENTAL DESIGN AND MODEL**

The experimental design was Completely Randomized Design with three treatments and four replicates having ten birds per replicate. The statistical model was thus:

$$Y_{ij} = \mu + T_i + e_{ij}$$

Where, $Y_{ij}$ = single observation

$\mu$ = overall mean

$T_i$ = effect of treatment

$e_{ij}$ = the random error

iind $(0,\sigma^2)$

**DATA ANALYSIS**

Data collected were expressed as mean ± SEM and subjected to analysis of variance (ANOVA) in a Completely Randomized Design and significant means were separated using Duncan's multiple range test (Duncan, 1955).

**RESULTS AND DISCUSSION**

**GROWTH PERFORMANCE OF COBB, ROSS AND ARBOR ACRE FED STRAIGHT DIET**

Table II showed the growth performance of three different strains of broiler chickens fed straight diet. The result of the final weight, weight gained, average daily weight gained, total feed intake and average daily feed intake showed the same level of significance where Cobb and Ross were not significantly (P>0.05) different from each other but they were significantly (P<0.05) different from Arbor acre. The result of the feed conversion ratio showed that there was no significant (P>0.05) difference across the treatment groups.

**Table II**: Growth performance of three different strains of broiler chickens fed straight diet.

| Parameters | T1(Cobb) | T2(Ross) | T3(Arbor acre) | SEM |
|---|---|---|---|---|
| Initial weight (g/bird) | 440.00 | 450.00 | 485.00 | 5.88 |
| Final weight (g/bird) | 2489.09$^{a}$ | 2538.19$^{a}$ | 1950.05$^{b}$ | 87.59 |
| Weight gained (g/bird) | 2049.09$^{a}$ | 2088.19$^{a}$ | 1465.05$^{b}$ | 92.84 |
| ADWG (g/bird) | 73.18$^{a}$ | 74.67$^{a}$ | 52.33$^{b}$ | 3.33 |
| TFI (g/bird) | 3681.38$^{a}$ | 3923.49$^{a}$ | 2759.34$^{b}$ | 170.39 |
| ADFI (g/bird) | 131.48$^{a}$ | 140.13$^{a}$ | 98.55$^{b}$ | 6.09 |
| FCR | 1.80 | 1.88 | 1.86 | 0.04 |

$^{a \text{ and } b}$ Means across rows with different superscripts differ significantly at P<0.05; ADFI: Average Daily Feed Intake: ADWG: Average Daily Weight Gain: FCR: Feed conversion Ratio: TFI: Total Feed Intake: SEM: Standard Error of Mean.

**CARCASS ANALYSIS OF THREE DIFFERENT STRAINS OF BROILER CHICKENS FED STRAIGHT DIET**

Table III showed the carcass analysis of three different strains of broiler chickens fed straight diet. The result of the live weight and dressed weight had the same level of significances where Cobb and Ross were not significantly (P>0.05) different from each other but they were significantly (P<0.05) higher than Arbor acre, while the result of dressing percentage, breast cut, thigh, drumstick, wings and backcut showed that there was no significant (P>0.05) differences across the treatment groups.

**Table III: Carcass analysis of three different strains of broiler chickens fed straight diet**

| **Parameters** | **T1(Cobb)** | **T2(Ross)** | **T3(Arbor acre)** | **SEM** |
|---|---|---|---|---|
| Live weight | 2675.00$^{a}$ | 2700.00$^{a}$ | 2312.50$^{b}$ | 64.29 |
| Dressed weight | 2075.00$^{a}$ | 2075.00$^{a}$ | 1800.00$^{b}$ | 44.95 |
| Dressing % | 77.67 | 76.89 | 77.88 | 0.61 |
| Breast cut | 36.90 | 34.97 | 34.22 | 0.78 |
| Thigh | 14.31 | 14.32 | 13.39 | 0.35 |
| Drumstick | 13.85 | 13.34 | 13.51 | 0.37 |
| Wings | 10.43 | 10.60 | 10.15 | 0.17 |
| Backcut | 16.68 | 16.87 | 18.78 | 0.48 |

$^{a \text{ and } b}$ Means across rows with different superscripts differ

significantly at P<0.05; S.E.M: Standard Error of the Mean

**ORGAN YIELD OF THREE DIFFERENT STRAINS OF BROILER CHICKENS FED STRAIGHT DIET**

Table IV showed the organ yield of three different strains of broiler chickens fed straight diet. The result of gizzard, heart, proventiculus, liver, lungs, abdominal fat, pancrease and spleen showed that there was no significant (P>0.05) differences across the treatment groups.

**Table IV: Organ yield of three different strains of broiler chickens fed straight diet**

| Parameters % | T1(Cobb) | T2(Ross) | T3(Arbor acre) | SEM |
|---|---|---|---|---|
| Gizzard | 1.68 | 1.75 | 1.83 | 0.05 |
| Heart | 0.47 | 0.44 | 0.48 | 0.02 |
| Proventiculus | 0.35 | 0.31 | 0.35 | 0.01 |
| Liver | 1.92 | 2.09 | 1.96 | 0.07 |
| Lungs | 0.45 | 0.48 | 0.54 | 0.02 |
| Abdominal fat | 0.28 | 0.34 | 0.40 | 0.07 |
| Pancrease | 0.21 | 0.27 | 0.27 | 0.02 |
| Spleen | 0.11 | 0.11 | 0.11 | 0.01 |

S.E.M: Standard Error of the Mean.

Table V showed the proximate composition of meat of three different strains of broiler chickens fed straight diet. The result of dry matter showed that Ross was significantly (P<0.05) higher than Arbor acre but they were not significantly (P>0.05) different from Cobb. The result of ether extract showed that cobb and arbor acre were not significantly (P>0.05) different from each other but they were significantly (P<0.05) higher than Ross, while the result of crude fibre showed that Arbor acre was significantly (P<0.05) higher than Cobb but they were not significantly (P>0.05) different from Ross while the result of crude protein, nitrogen free extract ash and metabolizable energy showed that there was no significant (P>0.05) difference across the treatment groups.

**Table V: Proximate composition of meat of three different strains of broiler chickens fed straight diet.**

| Parameters | T1(Cobb) | T2(Ross) | T3(Arbor acre) | SEM |
|---|---|---|---|---|
| Dry matter | 92.48$^{ab}$ | 92.93$^{a}$ | 92.41$^{b}$ | 0.11 |
| Crude protein | 63.31 | 66.82 | 63.31 | 1.47 |
| Ether extract | 7.15$^{a}$ | 6.52$^{b}$ | 7.01$^{a}$ | 0.10 |
| Crude fibre | 0.98$^{b}$ | 1.16$^{ab}$ | 1.29$^{a}$ | 0.06 |
| NFE | 9.05 | 6.63 | 4.68 | 1.57 |
| Ash | 12.00 | 11.81 | 13.28 | 0.40 |
| Metabolizable energy kcal/kg | 3801.09 | 3829.99 | 3785.69 | 17.90 |

$^{a\ and\ b,}$Means across rows with different superscripts differ significantly at P<0.05; S.E.M: Standard Error of the Mean

**ECONOMICS OF PRODUCTION OF COBB, ROSS AND ARBOR ACRE FED STRAIGHT DIET**

Table VI showed the economics of production of three different strains of broiler chickens fed straight diet. The result of cost/kg feed showed that there was no significant (P>0.05) differences across the treatment groups, while the result of cost of feed consumed, cost/kg weight gained, cost of production, revenue and gross margin showed the same level of significances where Cobb and Ross were not significantly (P>0.05) different from each other but they were significantly (P<0.05) different from Arbor acre. The Ross strain performed best (₦3758.74) in the revenue/bird, though it was not significantly (P>0.05) different from the Cobb (₦3688.35).

**Table VI: Economics of production of three different strains of broiler chickens fed straight diet.**

| Parameters | T1(Cobb) | T2(Ross) | T3(Arbor acre) | SEM |
|---|---|---|---|---|
| Cost/kg feed | 365.00 | 365.00 | 365.00 | 0.00 |
| Cost of feed consumed | 1343.20$^{a}$ | 1432.08$^{a}$ | 1007.16$^{b}$ | 62.15 |
| Cost/kg weight gained | 747.92$^{a}$ | 762.19$^{a}$ | 534.74$^{b}$ | 33.89 |
| Cost of production | 1343.20$^{a}$ | 1432.08$^{a}$ | 1007.16$^{b}$ | 62.14 |
| Revenue | 3688.35$^{a}$ | 3758.74$^{a}$ | 2637.08$^{b}$ | 167.10 |
| Gross margin | 2345.16$^{a}$ | 2326.66$^{a}$ | 1629.92$^{b}$ | 115.75 |

$^{a\ and\ b,}$Means across rows with different superscripts differ significantly at P<0.05; S.E.M: Standard Error of the Mean.

**DISCUSSION**

The significant difference (P<0.05) in final weight of Arbor acre to both Ross and Cobb disagreed with the report of Olawumi *et al*. (2012a) who found no significant effect on body weight at 5 and 7 weeks of age, but agreed with those of Enaiat *et al*. (2010) and Razuki *et al*. (2011), who obtained significant strain differences in live weight of broiler chicken slaughtered for carcass at 8-12 weeks. The result of this work is in consonance with results of Fadare *et al*. (2020) who got the highest weight gained for Cobb compared to other strains used in their study.

The result obtained in this work are in line with the report of Fadare *et al*. (2020) who discovered that Marshall strain had the highest pre-slaughter weight (2215.00±18.50g) followed by cobb (2048.88 ± 10.30 g) while the least pre-slaughter weight was recorded in Arbor acre strain (1937.50 ± 12.40 g). Marshall strain also had the highest slaughter weight of

2130.00±15.25g while the least value of 1937.50±12.40g were recorded in Arbor acre strain. Cobb strain gave the highest dressed weight though not significantly (P>0.05) different from Marshall strain but with both being significantly (P<0.05) higher than Arbor acre strain. Cobb strain had higher dressed weight than Arbor acre strain (Zaman *et al*., 2015). However, the difference in the live weight and dressed weight of the broiler strains may be explained by different factors, such as, genotype, feed, sex, strains, and environmental conditions. So it is assumed that more weight of Cobb and Ross broiler strains might arise from the genetic make-up during the embryonic stages, which can lead to having a superior growth potential than Arbor acre strain and it may be possible owing to strain effect and some other factors.

Also, the higher weight obtained by Cobb and Ross broiler strains showed a higher potential of weight when compared to Arbor acre birds. This presents a great potential for lean tissue deposition in the carcass, which gives it a higher weight being used in breeding programs for broiler chickens while broiler strain with a lower degree of breeding for meat production, such as Arbor acre tends to show a less development of noble parts of the carcass (Albino *et al*., 2014).

Similar views were shared by Ojedapo *et al*. (2015), they reported that Cobb and Marshall strains of broiler had similar (P>0.05) liver and gizzard weights. The study conducted by Akporhuarho & Unukevwere (2015), reported that statistically similar (P>0.05) heart, liver, intestine and lung weights were found in Arbor acre and Marshall strains. This suggests that the diet did not alter any of the organ part in all the treatment groups. In contrast to the present study, the internal organs of Marshall, Arbor Acre and Cobb broilers as reported by Fadare *et al.* (2020) showed significant (P<0.05) broiler strain effect on the weights of lung, liver, full gizzard, empty gizzard. The highest weight and relative percentage of lung was found in Marshall strain while Cobb and Arbor acre strains had similar lung weight and relative percentage. The relative percentage of full gizzard was similar in Cobb and Arbor acre strain. However, regardless of genetic improvements performed by breeders, broiler strains still differ with regard to their efficiency due to the specific selection practices (Emmerson, 1997). Hence the evaluation of promising strains selected for high carcass traits would highly contribute to the high efficiency of broiler chicken produce. The aforementioned traits depend on numerous factors, including the genotype, age, environmental factors and the gender. The marketing of poultry has been greatly diversified with a significant increase in cut-up (parts) and processed products (Le Bihan-Duval *et al.*, 2001). Demand for high quality parts and further-processed products have driven the poultry industry to change its marketing practices by breeding broiler strain with high characteristics (Wats and Kennet, 1995).

Studies have attributed variations in nutrient composition to climatic conditions, edaphic factors as well as methods of processing and laboratory analysis (Taiwo *et al*., 2005). Thus, this single straight diet from this work is good enough to give an improved dressed carcass weight within a short period of time.

This result therefore, showed that it is more economical to raise and sell the Cobb and Ross strains than the Arbor acre strain. Ijaiya *et al*. (2009) stated that diets are formulated to promote the desired intake of all nutrients and to improve the growth rate at reasonable cost. Although cost of production seemed the same, the results indicated that there were more returns on investment with Cobb and Ross broilers than the Arbor acre.

## CONCLUSION

From the results of the study, it could be concluded that Cobb and Ross strains of broiler birds can be raised profitably because of the higher returns on investment compared to Arbor acre. This is attributable to the superior results that were gotten for the growth performance, the carcass quality, the meat proximate and the economics of production. Hence, Cobb and Ross strains are recommended for production considering their performance and profitability.

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