PRODUCTION TRAITS OF BROILER CHICKEN STRAINS FED *AD LIBITUM* AND RAISED ON DEEP LITTER SYSTEM IN THE HUMID TROPICS

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ABSTRACT

This study was conducted to evaluate the effects of strain and age on production traits of commercial broiler chickens reared on full-feeding, and under the same housing, feeding regime, agro-climatic zone and management practices. A total number of 150 broiler day-old chicks, that, is 50 chicks each of Arbor Acres (strain A), Hubbard (strain B) and Marshall (strain C) were purchased from local hatcheries, and raised on deep litter in separate pens for 49 days (7 weeks). Data collected include live body weight, body length, breast girth, shank length and thigh length. In addition, data on feed intake, feed conversion ratio and feed efficiency at two weeks interval beginning from 1st week were taken. Analyzed results showed that genotype and age of birds had highly significant (P<0.01) effects on all the performance traits of broiler chickens. Strains A and B appeared superior to strain C in body weight, but the latter was better (P<0.01) in shank length and breast girth than the former. As regards feed conversion, strain C was the poorest, intermediate in strain B, and strain A the best. The feed efficiency and feed conversion ratio were related but in a reverse manner. Strain A was adjudged good and profitable because the strain had the highest mean values in body weight and feed efficiency coupled with the lowest feed conversion ratio at maturity, and could be recommended to poultry farmers in this zone for increased productivity, income generation and maximum profit.

Keywords: Poultry, Broiler, Strain, Traits, Body weight, Feed efficiency, Feed conversion, Feed efficiency

INTRODUCTION

Poultry products such as meat and eggs are excellent sources of animal proteins necessary to meet protein requirements of both infants and vulnerable people. Globally, in order to meet the increasing demand for poultry products, new strains of both broilers and layers are being bred and developed with fastest growth rate and improved carcass quality with less abdominal fat. For breeding programmes to be successful, a breeder must take into consideration the interrelationships between body weight and other body conformation traits. Such conformation traits include shank length, thigh length, breast girth and body length, and according to Ibe (1989), some of these conformation traits are good indicators of body weight and market value in broilers. Previous study had reported that the relationships between body weight and conformation traits are direct and positive (Okon *et al.,* 1997). In addition, Kabir *et al.* (2008) found that the exact time to slaughter a mature broiler depends on its body weight and general development. It was reported in the literature that researchers and local farmers make use of body weight and body dimensions as parameters for selection in order to improve the productivity of their breeds (Fitzburgh, 1976). In most places, and especially in the villages where scales are not readily available, prediction equations according to Ozoge and Herbert (1997) and Nesamvuni *et al.* (2000) may be derived from body measurements, and used to predict body weight of animals. There are genetic differences in growth rate between strains, and the changes in weight ranking may be critical in the age range between 8 – 12 weeks (Deeb and Lamont, 2002). Body weight according to Chambers (1990) is the most frequently used indicator of growth. Body weight is a qualitative trait, controlled by few pairs of genes, highly heritable and influenced also by the environment. Previous investigators had posited that differences in growth pattern are under genetic control, and that variations exist within species (Lilja *et al.,* 1985; Carborg *et al.,* 2003). Growth rates in birds have been categorized into two levels, that is, low and high growth rates (Lilja 1983). The researcher indicated that a high growth capacity is characterized by a rapid early development of the digestive organs and the liver whereas; a low growth rate is characterized by a rapid early development of the pectorals and feathers. In a study, Reddish and Lilburn (2004) observed that selection for breast muscle yield and body weight in commercial broilers has resulted in genotypes far different from broilers processed in the past. Furthermore, Ajayi and Ejiofor (2009) found significant differences between strains and sexes in body weight and body dimensions. The authors' findings are consistent with other studies reported in literature (Razuki, 2002; Razuki *et al.,* 2007; Razuki *et al.,* 2011). Significant strain effects on feed consumption and feed conversion have been reported (Berrong and Washburn, 1998; Razuki, 2002; Razuki and Al-Rawi, 2007). Furthermore, Adebambo *et al.* (2008), Olawumi (2011) and Olawumi and Dudusola (2011) observed significant effect of breed on feed efficiency in commercial layer strains. In view of the importance of broiler chickens to the socio-economic wellbeing of our people, and the desire to guide local farmers on the choice of broiler strain to procure for increased meat production and optimum profit, this present investigation was conducted to assess the genetic differences in production traits of three strains of commercial broilers. The objectives of this study include: (a) determination of strain(s) with superior growth rates, and recommending same to local farmers and (b) identification of feed efficient strain(s) to be recommended to poultry farmers.

MATERIALS AND METHODS

Study Location: The study was carried out at the Animal Breeding Unit, Teaching and Research Farm, Ekiti State University, Ado-Ekiti, between September, 2010 and December, 2010. Ado-Ekiti is situated along latitude $7^0 31^1$ and $7^0 49^1$ North of the Equator and longitude $5^0 71^1$and $5^0 27^1$East of the Greenwich Meridian. The city falls under Derived Savannah zone. The city enjoys two separate seasonal periods namely, Rainy (May-October) and Dry (November-April) seasons.

Management and Experimental Birds: A total number of 150 broiler day-old chicks, that, is 50 chicks each of Arbor Acres (strain A), Hubbard (strain B) and Marshall (strain C) were purchased from local hatcheries, and raised on deep litter in separate pens for 49 days (7 weeks). The chicks were brooded using coal pot to supply heat for the first three weeks of life. Antibiotics and vitamins were administered as and when due. Also, vaccines against infectious Bursae and Newcastle diseases were given at specified age intervals. Their beddings are made up of dry wood shavings to prevent coccidiosis outbreak, and high level of hygiene was maintained throughout the experimental period to ensure favourable and conducive environment for growth, and to prevent disease outbreak. The birds were fed *ad libitum* with starter mash (1 – 4 weeks) containing 3000Kcal/KgME, 22% CP and finisher feed (5 – 8 weeks) containing 3100Kcal//KgMe, 21% CP.

Data Collection: Ten birds per strain taken at random were starved overnight and weighed from the pen each time the exercise was carried out. The birds were weighed at 7th day (week 1), and subsequently at two weeks interval up to 7 weeks of age, that is, 1st, 3rd, 5th and 7th week. Other linear measurements taken were body length, breast girth, shank length and thigh length. In addition, data were taken on feed intake, feed conversion ratio and feed efficiency at two weeks interval beginning from 1st week. Live body weights were weighed using sensitive scale (gm), while other parts were measured with tailor's tape rule in centimetre (cm).

Feed conversion ratio was computed for each breed. It refers to the ratio of feed (g) consumed/bird to average body weight on strain basis. Feed conversion ratio (FCR) = feeds (g)/bird/week ÷ average body weight (g)/bird/week. Feed efficiency also refers to the ratio of average body weight to feed (g) consumed, was calculated thus: Feed efficiency (FE) = average body weight (g)/bird/week ÷ feeds (g)/bird/week

Statistical Analysis: Data collected were subjected to analysis of variance, and the differences between means for breed and age were separated using Duncan new multiple range test (SAS, 2001). The appropriate statistical model used was: $Y_{ijk} = \mu + G_j + A_i + (GA)_{ij} + \varepsilon_{ijk}$, Y_{ijk}= observation of the k^{th} population, of the j^{th} genotype and i^{th} age, μ= common mean, G_j= fixed effect of j^{th} genotype (j=3), A_i = fixed effect of i^{th} age (i=4), $(GS)_{ij=}$ fixed genotype x age interaction effects and ε_{ijk}= random error.

RESULTS

Strain Effects on Body Weight and Linear Measurements: Body weights of broilers at the 3rd week had significant ($P<0.01$) differences among the strains. Strains A and B recorded the highest mean values, while the lowest body weight was recorded for strain C. There was significant ($P<0.05$) strain differences in body weight and thigh length at the 3rd week of age. Strains A and B still maintained the lead, and recorded the highest mean values, while the lowest body weight was recorded for strain C at the 3rd week (Table 1).

There was no significant ($P>0.05$) effect of strain on body weight, body length and thigh length at the 5th and 7th week. The only two traits that were significantly ($P<0.01$) affected by genotype were shank length and breast girth. For shank length, strain C recorded highest mean value, while strains A and B were similar. As regards breast girth, strain C had the highest mean value, and the lowest was recorded for strains A and B in the 7th week (Table 1).

Strain Effects on Feed Intake and Feed Conversion Ratio: Strain A recorded the highest mean values at 1st and 3rd week of age. In the 1st week, strain A had the highest mean value of feed intake, followed by strains B and C. A similar pattern occurred for feed intake in 3rd week; however, strain C was superior to other strains in feed intake at 5th and 7th week of age. In the 5th week, strain C recorded the highest mean value of feed intake, followed by strains A and B, respectively. The 7th week mean values of feed intake showed the superiority of strain C followed by strains B and A, respectively (Table 1).

There were significant ($P<0.01$) differences among different strains for feed conversion ratio. Strain C recorded the highest mean values in almost all the age sub-divisions, intermediate in strain B, and strain A had the lowest (Table 1).

Strain Effects on Feed Efficiency: There were significant ($P<0.01$) effect of strains on feed efficiency. Strain A recorded highest mean values in all the weeks, followed by strains B and C, respectively (Table 2).

DISCUSSION

The significant differences observed in growth rate in these strains at two weeks interval was an indication that these strains have different genetic potentials for growth, and that the three strains studied have different ancestors.

Table 1: Breed differences in body weight and linear measurements of varied strains of broiler chicks raised in deep litre at 1, 3, 5 and 7 weeks

Traits		Week 1			Week 3	
	Strain A	Strain B	Strain C	Strain A	Strain B	Strain C
Body weight (g)	122.60±4.42[a]	114.80±4.42[a]	97.60±4.42[b]	530±17.8[a]	500±17.8[ab]	460±17.8[b]
Body length (cm)	13.44±0.28	12.8±0.28	13.12±0.28	19.28±0.31	18.92±0.31	18.52±0.31
Thigh length (cm)	5.60±0.12[a]	4.54±0.12[b]	5.46±0.12[a]	7.14±0.31[a]	6.06±0.31[b]	6.06±0.31[b]
Shank length (cm)	2.72±0.13	2.54±0.13	2.50±0.13	3.56±0.13	3.64±0.13	3.74±0.13
Breast girth (cm)	6.32±0.22	6.52±0.22	6.16±0.22	8.20±0.13	8.46±13	8.32±0.13
Traits		**Week 5**			**Week 7**	
Body weight (g)	1104±69.25	1060±69.25	1110±69.25	1775±22.17	1732±22.17	1732±22.17
Body length (cm)	26.04±0.62	26.14±0.62	24.68±0.62	29.15±1.10	29.62±1.10	27.49±1.10
Thigh length (cm)	10.54±0.31	9.68±0.31	9.84±0.31	13.47±0.17	13.17±0.17	13.55±0.17
Shank length (cm)	5.32±0.16[b]	5.38±0.16[b]	5.92±0.16[a]	5.87±0.10	5.87±0.10	5.89±0.10
Breast girth (cm)	12.04±0.20[b]	12.12±0.20[b]	16.46±0.20[a]	13.70±1.52	17.37±1.52	13.69±1.52

[ab] means along rows with different superscripts are significantly different; Strain A: Arbor Acre Strain B: Hubbard, Strain C: Marshall

Table 3: Breed differences in feed intake, feed conversion and feed efficiency of varied strains of broiler chicks raised in deep litre at 1, 3, 5 and 7 weeks

Week	Strains	Production Parameters		
		Feed intake	Feed conversion	Feed efficiency
1.	A	290[a] ± 0.00	2.36[c]±0.00	0.42[a] ± 0.00
	B	278.6[b] ± 0.00	2.43[b]±0.00	0.41[b] ± 0.00
	C	278.5[c] ± 0.00	2.85[a]±0.00	0.36[c] ± 0.00
3.	A	1150[a] ± 0.00	2.17[c]±0.00	0.46[a] ± 0.00
	B	1148[b] ± 0.00	2.30[b]±0.00	0.44[b] ± 0.00
	C	1144[c] ± 0.00	2.49[a]±0.00	0.42[c] ± 0.00
5.	A	1721[b] ± 0.00	1.56[b]±0.00	0.64[a] ± 0.00
	B	1696[c] ± 0.00	1.61[a]±0.00	0.63[b] ± 0.00
	C	1729[a] ± 0.00	1.56[b]±0.00	0.64[a] ± 0.00
7	A	2200[c] ± 0.00	1.24[b]±0.00	0.807[a] ± 0.00
	B	2201[b] ± 0.00	1.27[a]±0.00	0.787[b] ± 0.00
	C	2203[a] ± 0.00	1.27[a]±0.00	0.786[c] ± 0.00

[abc] means along columns with different superscripts are significantly different, Strain A: Arbor Acre, Strain B: Hubbard, Strain C: Marshall

This result agreed with those obtained in the previous studies (Leeson *et al.,* 1997; Faran *et al.,* 2000a; Faran *et al.,* 2000b) who reported marked strain differences for body weight in chickens. There were also significant (P<0.01) strain differences in thigh length of broiler chickens in the present study. Strains A and C were similar in thigh length, but higher than strain B. Strain differences in body length, shank length and breast girth were however not significant (P>0.05) in the first week of birds' age. At 3rd week, strains A and C still maintained their superiority in body weight despite the fact that they were all given the same treatment in terms of feed quality and quantity. In agreement with the present study, Deep and Lamont (2002), Rondelli *et al.* (2003), Zhao *et al.* (2009) and Taha *et al.* (2010) observed that strains differed in growth rate and weight gain at different ages. Their findings also corroborate those of Pingel *et al.* (1990) who reported that age was the major determinant of growth and physiological development in chicks. The other traits, that is, body length, shank length and breast girth measured at 3rd week were not significantly (P>0.05) affected by genotype.

The raised chicken, strain C, at maturity had broader chest and longer shank than strains A and B. This singular attribute could be used to differentiate between the various strains at matured weight. This result was comparable to the findings of Ajayi and Ejiofor (2009) who reported significant effect of genotype on breast girth and shank length. The non-significant effect of strain on other traits at 5th and 7th week of age implies that the three strains were at par in terms of body weight, body length and thigh length. Our data on body weight at maturity were inconsistent with those of Ajayi and Ejiofor (2009) and Razuki *et al.* (2011). Significant effect of strains on body weight was observed between 6th and 7th week of age. The observed differences between the present study and those of Ajayi and Ejiofor (2009) and Razuki *et al.* (2011) might be as a result of differences in genetic constitution of the birds used, health status and management practices. The differences in genetic make-up coupled with the bird's inherent abilities to adjust and adapt to fluctuating weather conditions are the major factors determining the reproductive performance of any breed of chickens reared in any production environment. Regardless of strain, there was an increase in body weight and all other linear measurements as the birds advanced in age.

With regard to feed intake, there was an increase in feed consumption as the birds advanced in age, and this increment occurred across the strains. Between 1st and 3rd week, strain A consumed more feed than strains B and C, and this might be the reason why the former recorded superior body weight during this period. The result agreed with those of Leeson *et al.* (1997), Rondelli *et al.* (2003) and Taha *et al.* (2010) who found significant differences in feed intake among strains of chickens. Feed intake between 5th and 7th week showed that strain C had the highest mean values, intermediate in strain B, and strain A, being the lowest. This implies that at maturity, strain C consumed more feed than the rest, but the excess feed consumed was not translated to more meat because the strain performed poorly in feed efficiency. It was this same strain C that had the highest feed conversion ratio. This is an indication that the strain was a poor converter of feed to flesh, and at maturity will not generate good returns or dividends when compared with strains A and B. Generally, Strain A was superior in terms of feed efficiency from 1st to 7th week, strain B has intermediate mean values, and strain C the least.

Our data on feed conversion were consistent with previous studies in literature (Rondelli *et al.*, 2003; Taha *et al.,* 2010). The researchers found significant strain differences in feed conversion among chicken breeds. Strain A with the highest feed efficiency and lowest feed conversion ratio at maturity (7th week) will be preferable to other strains for increased meat production and maximum profit. Regardless of strain, it was indicated in this study that feed conversion ratios decreased with advancing age of the birds. On the contrary however, mean values for feed efficiency increased as the birds grew in age across the strains.

In this study, it was observed that the strain with the highest feed conversion ratio recorded the lowest mean value in feed efficiency while, the strain with the lowest feed conversion had the superior mean value for feed efficiency. Strain C was a poor feed converter, and the least in feed efficiency, while strain A with lowest feed conversion ratio recorded the highest mean value in feed efficiency, and therefore, the preferred one among the three genotypes. It infers that a good and feed efficient strain must have the least feed conversion ratio for the sustainability of poultry farming. The result of this study corroborates the findings of Adebambo *et al.* (2008) and Olawumi and Dudusola (2011) who reported significant breed differences in feed efficiency among different strains of chickens. In general terms, there was consistent increase in body weight and linear measurements with advancing age of the birds regardless of bird's genotype. In addition, feed conversion ratio and feed efficiency were related but in a reverse manner. As one increases with the advancing age of the birds, the other one decreases in mean value under normal circumstances.

Conclusions: (i) Genotype of birds had significant (P<0.01) effect on all the performance traits of broiler chicken breeds. (ii) Strains A and B appeared superior to strain C in body weight, but the latter was better (P < 0.01) in shank length and breast girth than the former. (iii) As regards feed conversion, strain C was the poorest while strain A was the best. (iv) The feed efficiency and feed conversion ratio are related but in a reverse manner, that is, one (feed efficiency) increases with advancing age of the birds while the other (feed conversion) decreases in value simultaneously. (v) Therefore, strain A with the highest mean values for body weight and feed efficiency coupled with the lowest feed conversion ratio is recommended to researchers and poultry farmers in this zone for increased productivity and maximum profit.

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