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Comparison of the Growth Performance of Three Commercial Hybrid Chicken Varieties Using Grain Based Feeds

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

In poultry, feed costs represent a major part of total production costs. Accordingly, improvement of feed conversion ratio; feed intake: weight gain should be a major objective in most breeding programmes. Growth performance of three commercial broiler hybrids in Nigeria were investigated using a total of 60 unsexed day old chicks consisting of 15 each of Rhode Island White, Plymouth Rock and Rhode Island Red; and 15 of the purebred, the Nigerian Southern light ecotype used as control. The breeds were maintained separately in wooden cages of dimension 120cm × 80cm × 40cm at stocking density of 15 birds per m^2 and fed for six weeks using broiler starter feed for first four weeks and finisher feed for next two weeks. The broiler starter feed was composed of broiler concentrate (energy Keauka) 2950Kcal, crude protein 2.1%, crude fibre 4.0%, calcium 1.0%, Available phosphorus 0.48%, cysine 1.2% and methionine 0.5%. The finisher's diet consisted of 1:1.8 mixtures of broiler concentrate and maize meal. No medication was provided during the study. The result showed Rhode Island White had highest maximum weight gain (2874.43% initial

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weight), Plymouth Rock (1053.14% initial weight) intermediate and Rhode Island Red (986.12% initial weight) lowest. The pure breed weight gain (441.50% initial weight) was lower than the hybrids. Average feed conversion ratio was highest for Rhode Island White (0.394±0.0047), intermediate for Plymouth Rock (0.373± 0.0051) and Rhode Island Red (0.366± 0.0048) next. The difference was significant (P< 0.05). The purebred had the lowest feed conversion ratio (0.346± 0.0047). Rhode Island Red had the lowest mortality (0%), Rhode Island White (6.67%) intermediate and Plymouth Rock next (20%). The purebred had the highest mortality (33.33%). The study showed Rhode Island White was the most economically viable breed due to its higher growth rate, feed conversion ratio and low mortality rate.

Keywords: Chicken varieties; feed; growth and grain based feed.

1. INTRODUCTION

Due to their rapid growth, hybrid chickens are more economical to rear than heritage poultry [1] With increased demand for meat in the developing world due to rising population, increased wages and urbanization, hybrid chicken have become high in demand by shops and food processing industries [2].

Important economic traits in hybrid broilers are growth rate, feed conversion ratio, mortality and carcass quality. The most important of these traits in broilers is the growth rate and genetics have been shown to have a major impact on the growth rate of broilers chicken [3]. The heritability of growth rate is about 4% and body weight gain is negatively correlated with reproductive performance [4]. Feed conversation efficiency which is the total efficiency with which all the nutrients are utilized, is economically important to broiler producers. Breeders of commercial broilers began to select for feed efficiency during the 1980s [5]. Many factors such as genetics, sex, lighting, temperature, and ventilation, feed and water quality have influence on feed conversion [6].

The level of food consumption is a basic and important factor that determines the rate of growth and body composition achieved by animals throughout their life cycle [7]. It is important to consider whether selection for improved commercial trait must lead to increase in mortality [8].

This paper compares the growth rate, average body weight, total food consumed, feed conversion rate and mortality percentage among three commercial broiler hybrids in Nigeria (Rhode Island White, Plymouth Rock and Rhode Island Red) with the purebred local chicken, the Nigerian Southern light ecotype.

2. MATERIALS AND METHODS

2.1 Study Area

The experiment was conducted in the laboratory of the department of Zoology, Paul University Awka Nigeria. It falls within the humid area, high rainfall and short period of dry season.

2.2 Study Animal and Management

The experimental animals consisted of three hybrid chicken breeds; the Rhode Island White, the Plymouth Rock and the Rhode Island Red chicken breed obtained from a commercial hatchery, Aroma farms Awka, Anambra State Nigeria. The local chicken breed, the southern light ecotype used as control was purchased from the local market, the Eke-Awka, market Awka. 60 one day old chicks consisting of 15 of each of the three hybrid chickens and 15 of the pure breed chicken were used in the study.

The birds of each breed were housed in separate wooden cages at a stocking density of 15 birds per m^2 [9].Each cage was equipped with feed dispenser and water; and heating was provided for the birds during the brooding period in first two weeks of growth using oil powered lamps. Broiler starter feeds and water was supplied to the chicks from 0 to 28 day while finisher's diet was provided for the next two weeks.

2.3 Animal Feed Formulation and Feeding

The feeds were formulated to meet the nutritional requirement of [10]. The broiler starter feed mixture comprised broiler concentrate (energy Keauka) 2950Kcal, crude protein 2.1%, crude fiber 4.0%, calcium 1.0%, available phosphorus 0.48%, cysine 1.2% and

methionine 0.5%; while the finishers diet consisted of 1:1.8 mixture of broiler concentrate and maize meal. No medication in form of antibiotic was provided to the bird during the research daily.

2.4 Data Collection

The following data were collected: daily food intake, weekly weight gain, percentage weight gain, specific growth rate and food conversion ratio.

Weekly weight gain= weekly final mean weight (g) - weekly initial mean weight (g)

$$\mathrm{PWG} = \frac{\text{Mean final weight} - \text{mean initial weight}}{\text{mean initial weight}} \times \frac{100}{1}$$

$$\mathrm{SGR} = \frac{\log w^2{}_e - \log w^1{}_e}{T_2 - T_1} \times \frac{100}{1}$$

Where; $w_{1=}$initial mean weight
$w_2 =$ Final mean weight
$T_1 =$ Initial time
$T_2 =$ Final time
$\log =$ logarithm.

$$\mathrm{FCR} = \frac{\text{Food consumed by Birds(g)}}{\text{Mean weight gain by Birds (g)}}$$

2.5 Statistical Analysis

The data obtained from the indices of growth and feed utilization were subjected to Analysis of variance (ANOVA).

3. RESULTS

The feed utilization indices and growth performance results of three commercial hybrid chicken birds are presented in the Tables below respectively (daily feed intake, weekly weight gain, percentage weight gain, specific growth rate, food conversion ratio,).

The highest average weight of birds after six weeks was recorded for the Rhode Island White (1073.77±35.48g), Rhode Island Red was intermediate (359.18±5.91g) and Plymouth Rock (321.15±16.13g) was lowest among the hybrids. The average weight of the pure breed, the Southern Light Ecotype after six weeks was lower than all of the hybrids (145.50±23.77g). Rhode Island White had the highest percentage weight gain (2874.43% initial weight) after six weeks. Plymouth Rock (1053.14% initial weight) was intermediate and Rhode Island Red (986.12% initial weight) was lowest among the hybrids. The weight gain for the pure breed Southern Light Ecotype was lower than the hybrids (441.50% initial weight).The feed conversion ratio of the different chicken breeds studied per week is shown in Fig. 1. The highest average feed conversion ratio was recorded for Rhode Island White (Average = 0.394±0.0047), Plymouth Rock (Average = 0.373± 0.0051) was intermediate and Rhode Island Red (Average = 0.366± 0.0048) was lowest among the hybrids. The purebred Southern light ecotype (Average = 0.346± 0.0047) had a lower feed conversion ratio than the hybrids. The difference was significant (ANOVA, $F_{3, 20} = 19.53$, $P<0.05$).

The weekly mortality rates of the different chicken breeds studied is shown in Fig. 2. The highest mortality rate after six weeks was recorded the purebred, the Southern Light Ecotype (33.3%); followed by Plymouth Rock (20.0%), Rhode Island White (6.67%) and Rhode Island Red (0% mortality). The difference in mortality was not significant (ANOVA, $F_{3, 20} =0.9547$, $P>0.05$).

There was significant positive linear correlation between average body weight and food consumed per week for all the chicken breeds. For Rhode Island White (n=6, r=0.999996, critical value=±0.811) (Fig. 3), for Plymouth Rock (n=6, r=0.983363, critical value=±0.811) (Fig. 4), for Rhode Island Red (n=6, r=0.967425, critical value=±0.811) (Fig. 5), for Southern Light Ecotype (n=6, r=0.971113, critical value=±0.811) (Fig. 6). There was negative linear correlation between food conversion ratio and average body weight for all the chicken breeds. It was not significant.

4. DISCUSSION

The study showed differences in average weight of day old chicks of the different breeds. This could be due to differences in genetic composition [11] reported that maternal genes were involved in determining egg weight, yolk weight, albumen weight, and percentage of albumen dry matter and that this greatly affected chick body weight at hatch [12] in turn reported difference in day old chick weight in Rhode Island Red, Fayoumi chickens and local Tanzanian chickens.

Table 1. Average weight of chicken per week

Weeks	Treatment 1 Rhode Island White	Treatment 2 Plymouth Rocks	Treatments 3 Rhode Island Red	Treatment 4 Southern light ecotype
Week 1	360.96	270.85	330.07	260.87
Week 2	106.65	350.18	390.40	320.37
Week 3	255.22	126.55	109.27	357.98
Week 4	561.16	167.39	185.27	365.19
Week 5				
Week 6	776.69	221.93	227.86	111.27
	856.81	269.72	314.69	128.39

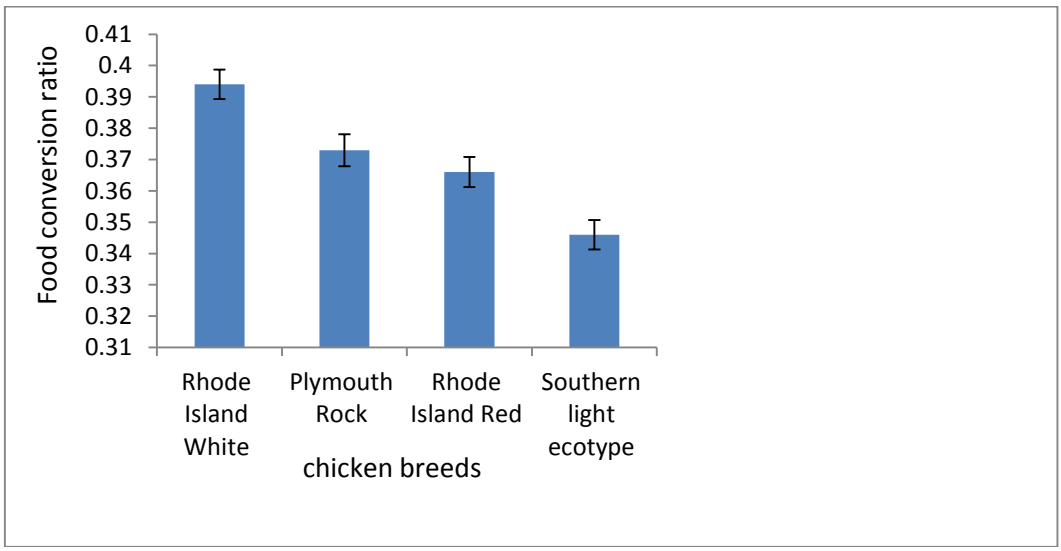

Fig. 1. Average food conversion ratio of the chicken breeds

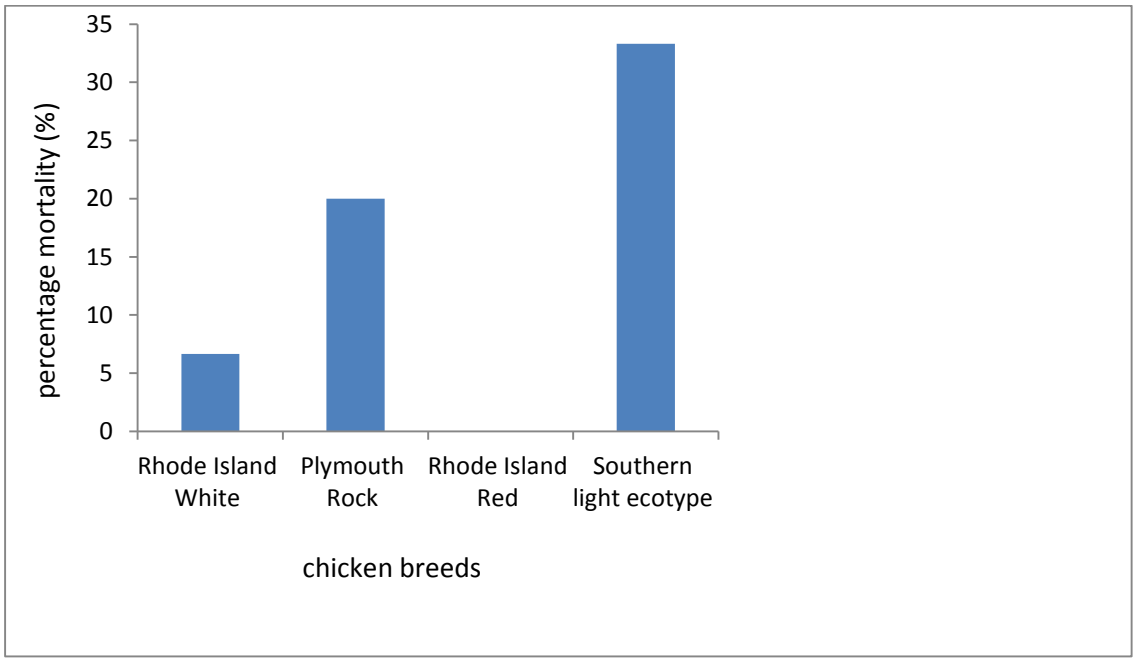

Fig. 2. Percentage Mortality of the chicken breeds

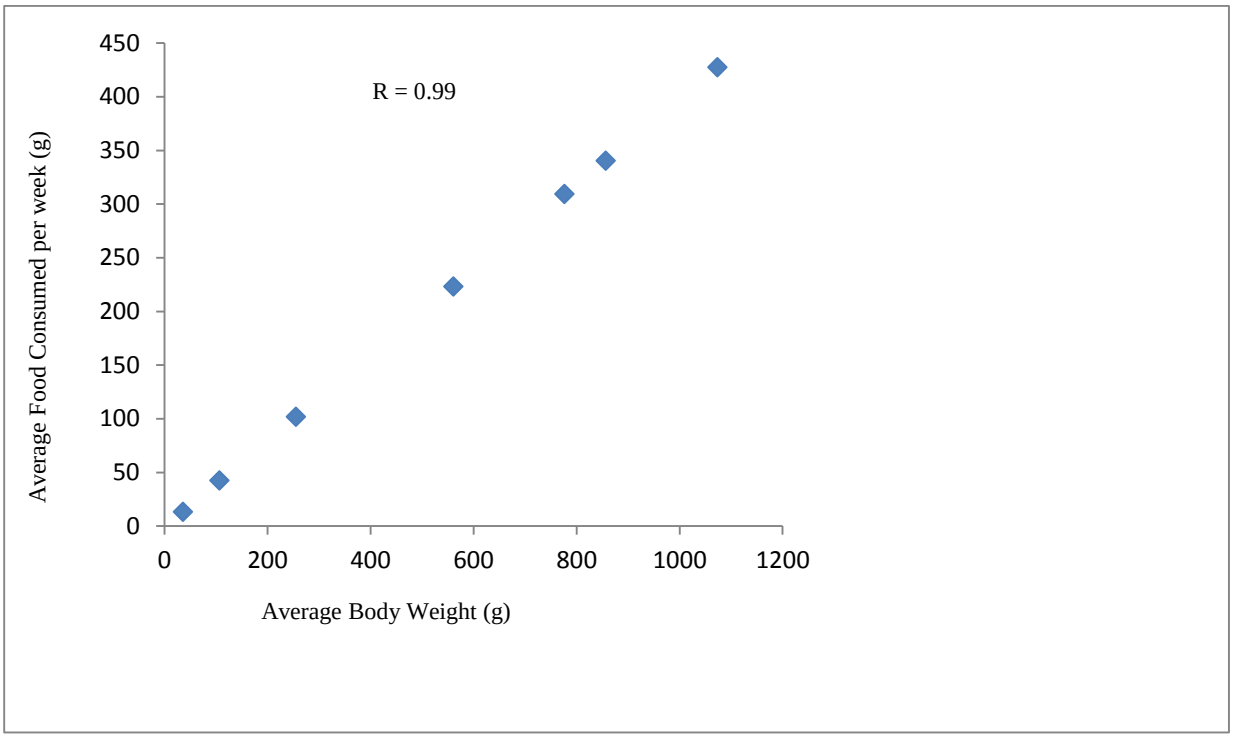

Fig. 3. Correlation between average food consumed and body weight for Rhode Island White

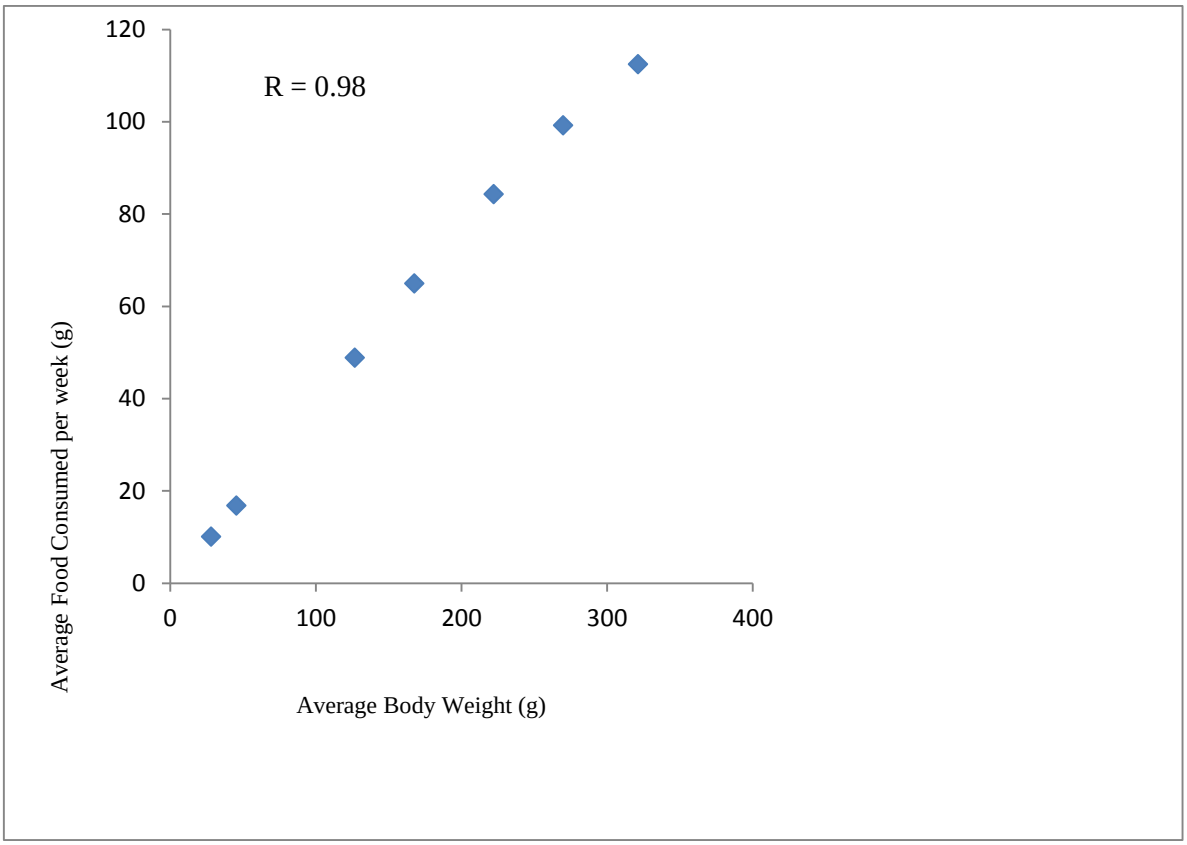

Fig. 4. Correlation between average food consume and body weight for Plymouth Rock

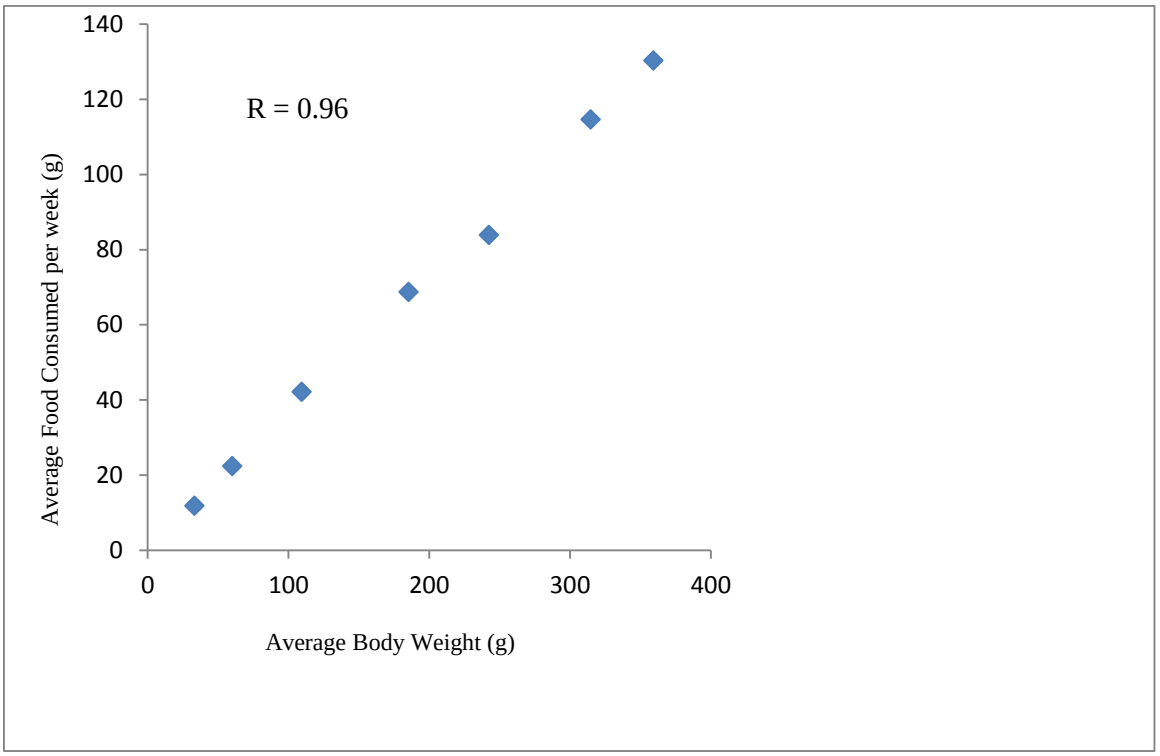

Fig. 5. Correlation between average food consume and body weight for Rhode Island red

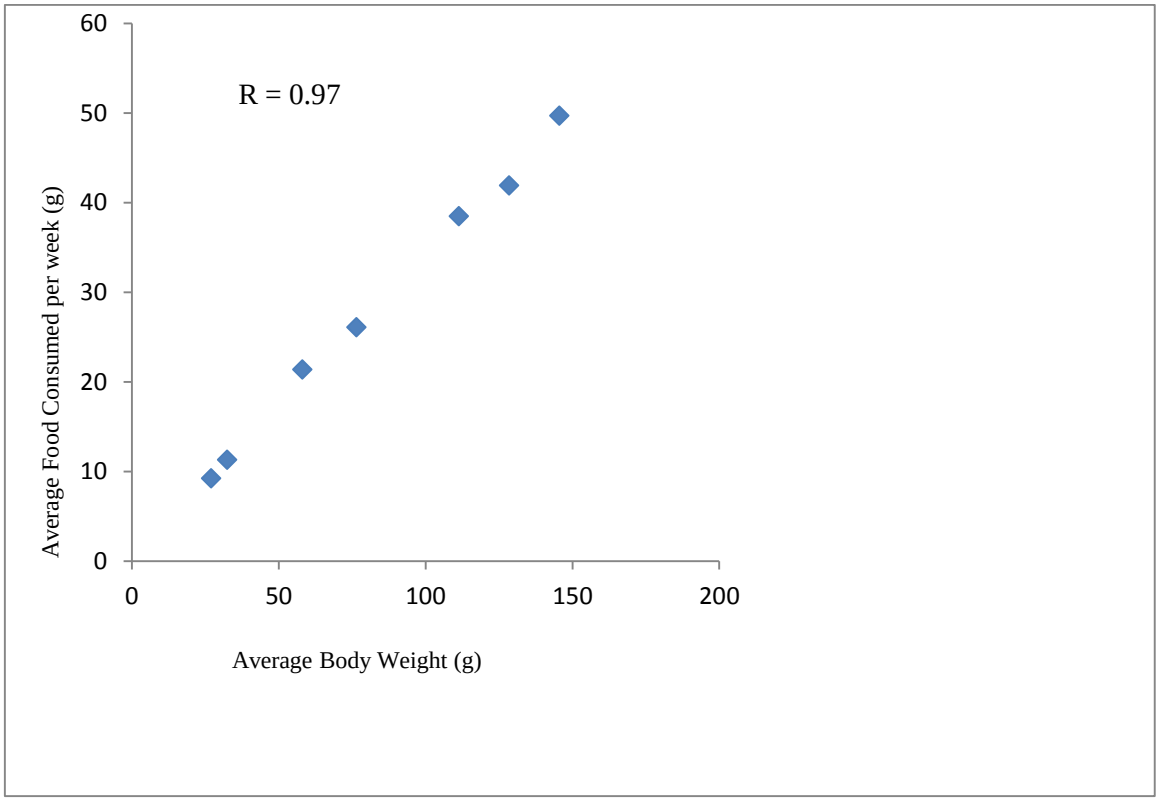

Fig. 6. Correlation between average food consumed and body weight for Southern light ecotype

The study showed differences in the growth rate of the different chicken breeds which could be attributed to differences in food intake and genetic composition [13] reported that chicken growth hormone (cGH) gene play a crucial role in controlling growth and metabolism, [14] observed marked strain and breed differences for body weight while [15] observed that Rhode Island Red × Fayoumi crossbred chickens performed better in terms of growth performances compared to pure breed Fayoumi [16] reported that growth rate and efficiency were linked to the ability to consume, digest, absorb and metabolize dietary nutrients. The poor growth rate of the pure breed Southern Light Ecotype could be attributed to lower feed intake, genetic composition and lower weight of newborn chick which could affect the weight of their broiler chicks to market age. The study showed differences in the growth rates at different ages, with fastest growth in first two weeks of life. A possible explanation will be that food conversion efficiency decreased with age due to stress and other environmental factors arising from growth. The findings are consistent with those of [17] who reported higher weight and growth rates in the first eight weeks of growth.

The study showed difference in food consumed by the different breeds. The difference in food intake could be genetic arising from improved nutrition and genetic selection and increased body need, gut volume and absorption capacity [18] found significant effect of strains on feed consumption and feed conversion ratio between broiler chicken breeds.

The study showed differences in the food conversion ratio with Rhode Island White chicken having the highest among the breeds [19] reported differences in feed efficiency of various breeds [20] also observed differences in feed conversion ratio. The difference and higher values for the hybrid could be explained by genetic variation and improvement through intensive breeding.

The study showed a strong positive correlation between mean weight of chicken and amount of food consumed per week for all the breeds. The result suggests that food consumption increases with increase in body weight [15] explained that bodily weight gain was mainly related to feed consumption and feed conversion efficiency, both of which depends on the physiological condition of the birds, climatic condition and other factors. Furthermore there was no correlation between feed conversion ratio and body weight [21] reported a negative correlation between weight gain and food conversion ratio in turkey (*Meleagris gallopavo*). The result could be due to a diversion of a greater amount of nutrient to maintenance than to growth as the chicken grows older. The findings are consistent with those of [22]. The lower mortality of the hybrids could be explained by differences in genetic composition and disease resistance, and by the ability to adapt to the surrounding and housing management system used. The results are consistent with those of [23] who reported that cross-breeding improved chick viability. The mortality during the rearing period was higher than for the growing period for all the breeds suggesting that the birds were yet to build up their immunity to meet the challenges of their environment.

Njenga [24] recorded different mortality and reported that crossbred offspring of Rhode Island Red and Fayoumi had the low mortality among four different breeds reared under semi-scavenging system. The high mortality of the pure breed Southern light ecotype could be due to their being unaccustomed to confinement and to diseases common under confined conditions [25] observed high incidences of mortality among indigenous birds when kept under confinement. The immunity of purebreds under intensive rearing has also been known to deceases.

Overall, the study showed that among the chicken breeds studied leghorn white had the best growth rate, food consumption and food conversion rate, while Rhode Island Red chicken had the least mortality rate. Further studies to explore the role of immunity, adaptability to stress and harsh environment and other factors are warranted.

5. CONCLUSION

The result of the study, suggest that Rhode Island White was the best hybrid chicken in terms of growth in body weight, among the breeds of chicken studied, while Rhode Island Red was the best breed in terms of survival rate for the the breeds of chicken kept under intensive management.

ETHICAL APPROVAL

All authors hereby declare that "Principles of laboratory animal care" (NIH publication No. 85-

23, revised 1985) were followed, as well as specific national laws where applicable. All experiments have been examined and approved by the appropriate ethics committee.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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