Growth Performance and Sexual Maturity of Two Exotic Chicken Breeds

Kasaye Assefa Balcha

School of Animal and Range Sciences, Haramaya University, P.O. Box 138, Dire Dawa, Ethiopia

Abstract

Introduction: Chicken rearing is an important source of income and nutrition in Ethiopia. However, the country's poultry producers could not satisfy the expected human food consumption mainly because of the low productivity and chickens are not as productive as expected in rural area. Several programmes, in Ethiopia and elsewhere, have attempted to improve chicken production as a means to reduce poverty. Therefore, this study was proposed to evaluate the growth performance and age at sexual maturity White Leghorn and Fayoumi breeds from day old up to 28 weeks of age.

Materials and Methods: At the age of 34 weeks, White Leghorn and Fayoumi chicken breeds (88 from each breed) were selected randomly as a parent stock from Haramaya University's poultry farm. Age at sexual maturity, body weight at sexual maturity, and egg weight at first egg were taken when the chickens laid eggs and reached 5% of egg production. The results obtained from this study were analyzed by SAS 2008.

Results: The mean egg weight ranged between 42.87 to 51.12 g for Fayoumi and White Leghorn, respectively. Fayoumi breed had higher fertility (91.25%) as compared to White Leghorn, which had 71.42% of fertility. In addition, higher feed consumption (33.33%), better-feed conversion ratio (0.57 g), higher average body weight gain (31.09 g), better average body weight (124.99 g), and egg weight at first egg (41.67 g) were observed for the White Leghorn whereas Fayoumi breed was better in fertility, hatchability, and yolk color.

Conclusions: It is concluded that the White Leghorn breed is suitable for rising considering its heavier body weight, egg weight, better egg quality whereas Fayoumi breed was better in fertility, hatchability and yolk color. There was non-significant result in age at first egg laying as both attain in 167 days. The age at sexual maturity is an important economic trait due to its effect on egg production, so the age at sexual maturity must be adjusted at a suitable age for production.

Keywords: Body weight gain; Egg yolk color; Feed consumption; Feed conversion ratio; fertility, Hatchability

1. Introduction

Poultry production has a main role in the economy of developing countries and contributes significantly to the exertions made to ease poverty through income generation and enhancing household food security (Abdelqader *et al*., 2007; Abubakar e*t al*., 2007). In Ethiopia, the total chicken populations are predictable to be about 56.9 million, from which 78.85% indigenous, 12.03% hybrid and 9.11% are exotic breeds (CSA, 2021). In Ethiopia, the performance of chicken production is rundown due to small egg weight, retard growth rate, late maturity and high mortality of chicks (Aberra Melese, 2000; Solomon Demeke, 2003). To overcome these problems village chicken improvement is attempted through the introduction of the exotic chickens (Solomon Demeke, 2008). In 1996, the Ethiopian Ministry of Agriculture developed a poultry extension package for rural farmers, which involved training a member of the household in various aspects of poultry management, and providing a nucleus flock of Rhode Island Red chickens (Tadelle Dessie and Yilma Jobre, 2004). Different stakeholders such as higher learning institutions, research organizations, Ministry of Agriculture and non-governmental organizations have been importing and disseminating exotic chicken breeds to rural farmers and urban-based small-scale poultry producers (Solomon Demeke, 2008).

Higher yielding exotic chicken breeds such as White Leghorn, Brown Leghorn, New Hampshire, Light Sussex, Barred Rock, Rhode Island Red, and Fayoumi were imported to the country in large quantities (Alemu Wami and Tadelle Dessie, 1998; Tadelle Dessie *et al*., 2003; Solomon Demeke, 2004; Wilson, 2010). The main purposes of presenting these breeds were to increase the output of the local chickens (Abraham Lemlem and

*Corresponding Author: assefakasaye2019@gmail.com

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Yayneshet Tesfay, 2010). Those introduced chickens are not extensively fit the initial programme objective as the exotic birds showed a deprived tolerance to the local conditions, and farmers have criticized that this distribution of exotic cocks, pullets and fertile inversely affected the homegrown poultry's brooding ability and adaptation to low-input feeding systems (Hunduma Dinka *et al*., 2010).

However, the White leghorn and Fayoumi breeds are extensively available and raised by smallholder farmers in Eastern Ethiopia. Some restricted studies were conducted for evaluating the breeds' productivity and reproductive performance in diverse parts of Ethiopia (Abebe Hassen, 1992; Solomon Demeke, 2004). Dual-purpose chicken breeds such as Fayoumi are favorite due to their higher egg and meat production potential as well as their disease resistance and better performance in village poultry production systems (Melkamu Bezabih, 2016; Dawud Ibrahim *et al*., 2019). Fayoumi layers are identified to produce about 250 eggs per annum on a low nutrition supply. Due to its non-broodiness character and strong immunity against common diseases, farmers keep this breed in their homes and farms (Rajput *et al*., 2005). Agreeing to Halima Hassen *et al*. (2006) found that Fayoumi attain 'age of sexually mature' at 22 weeks and weighed between 1.43 kg. This breed is adapted for sub-optimal and severe environmental conditions of the unrestricted system and small-scale farming.

On the contrary, White Leghorn has potential for a higher economic return as layers (Javed *et al*., 2003) and fast growers which weigh 33.46, 243.01, and 359.78 g at day old, 8 weeks and 12 weeks age, respectively (Ewonetu Kebede, 2017). The study conducted by Solomon Demeke (2004) at Jimma College of Agriculture typified the White leghorn breed during the brooding (60 days) and reported 34 g, 5.2 g, 5.8, 8.1% for daily feed intake, daily weight gain, feed conversion efficiency, and mortality, respectively. Whereas during the growing period (90 days) the author reported 109 g, 11.4 g, 8.9, 6.5% for daily feed intake, daily weight gain, and feed conversion efficiency, respectively. The bodyweight of the breed at 6 months ranged from 1300 to 1660 g at Haramaya University (Abebe Hassen, 1992).

Study on the reproductive performance of chicken is needed to know economically importance of reproductive traits, which were stated by Ghayas *et al*. (2021). Among these traits, age at first egg laying, body weight at first egg laying, hatchability, and fertility are the major ones according to Aman *et al*. (2017). The fertility and hatchability of the eggs of the chicks are required to produce large numbers of chickens. Fertility refers to the proportion of incubated eggs that become fertile while hatchability is the proportion of fertile eggs that hatched into chicks (Wondmeneh *et al*., 2006; Kingori, 2011). Hatchability being a function of the number of chicks hatched is affected by numerous factors such as genetic factors (Liptoi and Hidas, 2006), the season of the year (Jayarajan, 1992), fertility, health, nutrition (Alemayehu Bezabih *et al*., 2015). Egg fertility under broody hens is only about 55% and hatchability about 75% as reported by Tadele Dessie and Ogle (2001) as well as Tadelle Dessie *et al*. (2003). The yolk is the most concentrated source of nutrients in the egg containing about 50% water and high fat content. The albumen is mainly protein and water with a small amount of carbohydrates. So far, these breeds are not extensively evaluated on growth performance, fertility and hatchability, age at sexual maturity, body and egg weight at first egg laying, and egg quality analysis. Therefore, this study is projected to evaluate the growth performance and sexual maturity of two exotic chicken breeds from day-old up to 28 weeks of age.

2. Materials and Methods

2.1. Description of the Study Site

This study was conducted at Haramaya University poultry farm, which is located at a distance of 505 km east of Addis Ababa. The site is situated at an altitude of 2006 meters above sea level, 9°26' N latitude, and 42°3' E longitude. The area has an average annual rainfall of 741.6 mm. The mean annual minimum and maximum temperatures are 8.25 °C and 23.4 °C, respectively (Ewonetu, 2017).

2.2. Experimental Animals and their Management

At age of 34 weeks of White Leghorn and Fayoumi, chicken breeds (88 from each breed) were randomly selected as a parent stock from the two genotypes. Line breeding was conducted within the breed in the sex ratio of one cock to ten hens to produce fertile eggs. A total of 500 eggs (250 from each breed) were selected and incubated at 37.5°C and 55% relative humidity. On the 18th day of incubation, the incubated eggs were candled to detect fertility, after twenty-one days' of incubation chicks were hatched.

Table 1. The line breeding design of the study.

Breeding design	Number of chicken		
	Male	Female	Total
Fayoumi (male) × Fayoumi (female)	8	80	88
White Leghorn (male) × White Leghorn (female)	8	80	88
Total	16	160	176

2.3. Managing the Experimental Chicks

Experimental pens were cleaned, washed, disinfected, and left empty for a week, to kill some microorganisms that could be the cause of diseases. All drinkers and feeders were made ready for the parental stocks, which consisted of White leghorn and Fayoumi breeds. Electric bulbs were installed to meet 16 hours of light in a day. Three hundred day old chicks (150 from each breed) were randomly distributed into three replicates and fifty chicks per replication. Body weight was taken at day old and each chick was wing-banded then recorded. Chicks were vaccinated against Marek disease, Infectious Brusal disease and Newcastle disease.

The chicks were brooded for eight consecutive weeks and reared on deep litter in a conventional open-sided house and a starter diet with 20% CP and 2600 kcal ME/kg were prepared and fed to the chicks' *adlibitum*. Clean and fresh water was provided at *adlibitum*. The chick fed on rations that were formulated for respective ages from different ingredients Table 2. The diets formulated were to meet the nutrients requirements of 2800 Kcal ME/kg DM for both age groups while 20 and 16% CP of chicks and greater for layers (NCR,1994).

Table 2. Feed ingredients and nutrient composition of (% for DM).

Feeding ingredients (%)	Management stage of chickens		Mean nutrient composition(% for DM)					ME (Kcal kg^{-1})
	Stage I(0–8) weeks	Stage II(9–28) weeks	DM	CP	EE	Ash	CF	
Ground corn	55.00	45.15	89.00	7.10	5.30	2.30	8.00	3436.88
Soybean meal	12.00	15.00	93.20	38.50	8.90	8.00	9.00	3310.46
Peanut meal	9.00	13.00	94.70	37.30	9.60	6.200	12.00	3155.88
Wheat short	20.00	25.00	90.30	12.00	3.30	6.80	6.20	3303.14
Limestone	3.15	1.00	–	–	–	–	–	–
Vitamin premix	0.50	0.50	–	–	–	–	–	–
Salt	0.35	0.35	–	–	–	–	–	–
Average			91.80	6.78	23.73	5.83	8.80	3301.34

Note: *DM = Dry Matter; CP = Crude Protein; EE = Ether Extract; and ME = Metabolizable Energy.*

2.4. Data Collection

Individual body weight was taken at day old, 4, 8, 12, 16, 20, 24, and 28 weeks using a digital electronic balance nearest to 1.0g accuracy. The body weight gain was calculated by subtracting the initial body weight from the final body weight on that period. Data on the growth performance (body weight, feed conversion, feed consumption, sexual maturity, and body and egg weight at sexual maturity) were recorded for up to 28 weeks. Feed consumption (g/day) was calculated by subtracting feed refused from offer and divided by total number of chickens per replication. Feed conversion was calculated as the ratio of grams of feed consumed to grams of weight gain. Hatchability and fertility percentage of the breeds were calculated by application of the following formula Adedeji *et al.* (2015). Hatchability was calculated for the total eggs set and fertile eggs for each genotype.

$$\text{Fertility (\%)} = \frac{\text{Number of eggs fertile}}{\text{Total egg set}} \text{ x } 100$$

$$\text{Hatchability \% on fertile egg set} = \frac{\text{Total number of chicks hatched out}}{\text{Total number of fertile eggs after candled}} \text{ x } 100$$

A total of 120 eggs (60 from each breed) were collected from similar aged pullets for the analysis of the egg quality at Haramaya University poultry laboratory. Eggs were weighed using digital balance, with an error margin of $\pm$0.01g and broken carefully on a glass sheet, and the parameter like yolk and albumen height; yolk colour were taken. Eggshell thickness was measured at the middle, large and broad end as suggested by Aberra Melese *et al.* (2012) and a tripod micrometer was used to measure yolk and albumen height. Yolk color was measured by using the Roche color fan, which ranges from 1–15.

2.5. Data Analysis

Data collected on various parameters were subjected to statistical analysis using (SAS, 2008) version 9.2.1. When the analysis of variance indicated the existence of a significant effect, then Fisher's test method was used to locate the means that are significantly different from each other at 95%. The following statistical model was used:

$Y_{ik} = \mu + G_i + e_{ik}$

Where, Y_{ik} = the observed value of i^{th} genotype; μ = overall mean; G_i = effect of the i^{th} genotype (I = White leghorn, Fayoumi); and e_{ik} = random error.

3. Results and Discussion

The current study was conducted to evaluate the growth performance of White Leghorn and Fayoumi breeds in a deep litter system from day old to age of 28 weeks. This study was designed to evaluate the growth performance, age at sexual maturity and egg quality. The significance level of the study was determined based on the probability value and indicated in each table result.

3.1. Parental Egg Weight

The mean of egg weight of this study was significant at ($P < 0.05$) and ranged from 42.87 to 51.12g (Table 3). The variation for the average egg weight was due to breed and body weight differences. Fayoumi chicken laid smaller eggs possibly due to their small body size and had the lowest egg weight.

3.2. Egg Weight at First Egg Laying

Egg weight at first egg was significantly ($P < 0.05$) between the two chicken breeds (Table 3). Fayoumi breed laid eggs with lower weights at first egg laying than the eggs laid by pure lines of Leghorn. The variation in egg weight is attributed to differences in breed, maternal effect, and body weight. This finding is supported by the results of Fathi *et al.* (2013) who stated egg weight might be affected by the breed and body weight of chickens. Egg weight at first egg of this study ranged from 33.67 to 41.67 g. However, Ndofor *et al.* (2015) found that the mean egg weights of Fayoumi and White Leghorn at first egg for Fayoumi and White Leghorn were ranged from 38.64 g to 60.0 g. Thus, the White Leghorn could be used for its heavier egg weight at first egg laying. This finding revealed that the lightest egg weight for the Fayoumi breed is in line with the results of Hammershøj and Steenfeldt (2015), who observed that Lohmann Silver hens laid heavier eggs than New Hampshire hens, and attributed this difference genotype.

Table 3. Performance of White leghorn and Fayoumi chicken breeds.

Parameters	Breeds		P–value	SL
	White leghorn	Fayoumi		
Parental egg weight(g)	51.12[a]	42.87[b]	0.0004	***
EWFEL (g)	41.67[a]	33.67[b]	0.0001	***
Fertility (%)	71.42[b]	91.25[a]	0.0001	***
Hatchability (%)	75.00[b]	80.00[a]	0.0001	***
Shell weight(g)	5.74[a]	3.57[b]	0.0001	***
Albumen weight (g)	27.34[a]	22.77[b]	0.0001	***
Yolk weight (g)	18.02[a]	16.47[a]	0.1780	NS
Albumen height (mm)	4.98[a]	4.36[a]	0.1476	NS
Yolk height (mm)	11.46[a]	9.38[a]	0.1421	NS
Shell thickness (mm)	0.30[a]	0.28[a]	0.1051	NS
Yolk color	4.67[b]	5.64[a]	0.0001	***

Note: *Means of the same letter across the rows are non-significant at P < 0.05; SL = Significant level; NS = Non–significant at P < 0.05; EWFEL = Egg weight at first egg laying.*

The results of this study obtained on parental egg weight are lower than those reported by Basant *et al.* (2013) who found that the average egg weight of Fayoumi breed was 39.38 g. This result is in contrast to that of Zaman *et al.* (2004) who reported that the egg weight of RIR × Fayoumi was 47.5 g, whereas that of Fayoumi × RIR was 47 g (Abraham Lemlem and Yayneshet Tesfay, 2010; Khawaja *et al.*, 2013). Moreover, Ndofor *et al.* (2015) also found that mean egg weights ranged from 38.64 to 60.00 g for exotic chickens. The current result indicated that White leghorn is preferred for its larger egg weight to Fayoumi.

3.3. Fertility and Hatchability

3.3.1. Fertility

The result indicated that Fayoumi breed had a higher fertility percentage (91.25%) than White Leghorn (71.42%) breed. The variation in fertility percentage might be attributed to breed, and mating ability of the cock. It was comparable with the results of Emad (2015) who noted that the fertility of a local strain named Mandarah (MM) and one exotic parental commercial meat type strains named Italian (II) was 90.60 and 91.70%, respectively. This study are consistent with the reports of Kirby *et al.* (1998) who stated that the duration of sperm fertilizing ability varied widely among individuals within specific commercial parent male lines and within the lines used for their study. Similarly, Lalev *et al.* (2014) who reported that the fertility of White Plymouth Rock lines (LxL) was 74.95%.

However, the results of this study is at variance with those of Beaumont *et al.* (1992), Brillard (1993), the results of this study are not in agreement with those of Ewonetu Kebede (2017) who found that the overall hatchability rate was lower for Fayoumi than Leghorn and varied significantly. This variation might be attributed to several factors such as egg weight, turning of eggs, storage, humidity, shell strength, egg size. Similarly, Kamble *et al.* (1996) reported that the fertility percent for Indian full-feathered and Nana chickens was 85% and 66%, respectively. Fayoumi pure lines could be used for its better egg fertility and hatchability that can be needed in the area where large numbers of chicks are produced.

3.3.2. Hatchability

The hatchability of Fayoumi breed was higher than that of the White Leghorn chicken breed (Table 3) and the variation might be associated with the breed, egg weight, and egg quality. The results of this study are in line with the report of King'ori (2011) who stated that hatchability was influenced by nutrition, the genetic constitution of the embryo, disease, egg size, and age and shell quality. Moreover, Zaky (2005) also found that hatchability percent ranged from 61.2 to 86.7%. However, Ewonetu Kebede (2017) reported findings that contrast with hatchability obtained in this study in which he reported a hatchability of 61.01 for Fayoumi and 70.32% for White leghorn. However, Malago and Baitilwake (2009) found a lower hatchability percent for exotic chickens (52.2%). Similarly, the study conducted on Fayoumi breed at Adami Tulu Research Center and Northern part of Ethiopia by Yayneshet Tesfay *et al.* (2013) and Abrahm Lemlem (2010) showed that lower hatchability percentage which was 63.5% and 67.9%, respectively. This study found to favor Fayoumi for better hatchability than White leghorn.

3.4. External and Internal Egg Quality

White Leghorn was significantly superior in average egg weight and yolk height at age at first egg laying than Fayoumi, which had the least in average egg weight, shell weight, albumen weight, and yolk height (Table 3). Both White Leghorn and Fayoumi breeds were not statistically different in yolk weight, albumen height, and shell thickness. This study is in line with the study of Hocking *et al.* (2003) who reported that there is no difference in eggshell thickness of commercial chickens. However, Mohammed *et al.* (2005) observed significant differences in the average eggshell thickness among Sudanese breeds. Nebiyu (2016) reported that the higher albumen height for the Bovans brown was (7.1 mm ± 0.08) under the urban production system in Addis Ababa. Desalew Tadesse (2012) found that the difference in albumen height estimation for Isa brown, Bovans brown and Koekoek chicken were (6.30 mm ± 1.85, 6.92 mm ± 1.62 and 5.64 mm ± 1.55), respectively.

3.5. Body Weight and Body Weight Gain

Body weight

Chicken weight at the age of day old was significantly ($P < 0.05$) different between studied breeds (Table 4). This difference might be attributed due to egg size, breed, and body weight. The results of this study are in agreement with resulted reported by different researchers (Devi and Reddy, 2005; Adedeji *et al.*, 2006; Chatterjee *et al.*, 2007; Peters, 2008) who also found that significant effect of genetic group on body weights of chicks. Besides, Woanski *et al.* (2006) also reported that heavier egg weights contained more nutrients than small or medium-sized eggs and as a result, chickens from heavier eggs tended to have more yolk attachment at hatching.

Fayoumi breed produced a lower day old weight that is consistent with the study of Malago and Baitilwake (2009), who reported that the mean weight of day-old was recorded as 28.54 g. Similarly, Tyasis *et al.* (2019) also reported for Ovambo x Venda, Koekoek x Ovambo and Venda x Koekoek were 28.80, 27.60 and 28 g, respectively. White Leghorn was produced a better day old weight in this study which was confirmed by Tyasis *et*

al. (2019) who found that Koekoek and Ovambo, Venda x Ovambo produced one-day-old chicks that weighed 30 and 29.60 g, respectively. The current chick's day old weight ranged from 28.81 to 30.15 g, which is in agreement with the findings of Oke (2011) who reported hatched chicks ranging in weight from 22.3 to 30.90 g for frizzle chickens of Nigeria. However, Solomon Demeke (2004) found 42 g hatch weight of White Leghorn chicken breed. The significantly higher day-old body weight in White leghorn suggests that the gene may have the potential for rapid growth.

White Leghorn breed had better body weight throughout the study period. This result revealed an increase in body weight as the age of chicken is increased except for the age of 12 and 28 weeks. The variation in body weight might be attributed to the genetic superiority of the White Leghorn in body weight to Fayoumi breed in the study. Wondmeneh Esatu (2011) also reported that the difference in live body weight might be due to strain or breed differences in body weight. Moreover, Mohammed *et al.* (2005) and Adedeji *et al.* (2006) found significant genotypic differences in body weight between the chicken, which is highly influenced by genetic factors.

Table 4. Body weight performance of breeds.

Age (weeks)	Breeds		P–value	SL
	White leghorn	Fayoumi		
BW0	30.15[a]	28.81[b]	0.0001	***
BW4	74.67[a]	51.75[b]	0.0001	***
BW8	466.67[a]	451.67[b]	0.0001	***
BW12	413.33[a]	386.67[b]	0.0001	***
BW16	897.08[a]	868.80[b]	0.0001	***
BW20	963.29[a]	943.89[b]	0.0001	***
BW24	1283.43[a]	1175.05[b]	0.0001	***
BW28	1495.94[a]	1320.90[b]	0.0125	*
AFEL (days)	167.00[a]	167.00[a]	0.2749	NS
BWAFEL(g)	1257.22[a]	1178.36[b]	0.0001	****

Note: *Means of the same letter across the rows are non-significant at P < 0.05; BW = Body weight at day old, 4, 8, 12, 16, 20, 24, 28; SL = Significant level; NS = Non-significant at P < 0.05;* AFEL = Age at first egg laying; and BWAFEL = Body weight at age at first egg laying.

3.6. Age at Sexual Maturity

There was no significant difference in age at sexual maturity between the breeds and a comparable result was found on age at first egg laying with Solomon Demeke (2004) who found that the age at first egg laying for White Leghorn was five months. On the other hand, Daselew Tadesse *et al.* (2013) also found that the mean age at first laying were 160.5 ± 13.5, 165.5 ±13.2 days for Issa Brown and Bovan Brown, respectively. The variation in sexual maturity of the hens may also be associated with live body weight, high feed efficiency, and fast growth. Moreover, consistent results were reported by Ewonetu Kebede and Kasaye Assefa (2018) who reported age of sexual maturity was reached at 165 days for White Leghorn in the same study area. Furthermore, results of the present study is comparable with that of Khalil *et al. (*2004) who reported almost the same days (167.6 ± 9.1) of age at first egg laying for a pure Baladi Saudi chicken. However, different authors found earlier ages at first egg laying were reported for WLH (153.25 ± 3.09) days (Waleed *et al*., 2011) and Fayoumi breed (144.29 days) (Shafik *et al.,* 2013). However, Abraham Lemlem and Yayneshet Tesfay (2010) and Khawaja *et al.* (2013) found that the later age at first egg laying is achieved at 231 days for Fayoumi under the traditional management system. However, there was no difference in age at sexual maturity between White Leghorn and Fayoumi breeds in this study.

3.7. Body Weight at Age at First Egg Laying

The body weight at first egg laying of White Leghorn breed was heavier than that of Fayoumi breed (Table 4). In a similar earlier study, Abebe Hassen (1992) found the mean body weight of White Leghorn chicken at 6 months of age ranged from 1.3 kg at Haramaya University. In addition, Oke *et al.* (2004) found average body weight at first egg laying was 1163 ± 85.02 g and the average matured body weight of the current study was close to the value of the same variety reported by Oguntona (1982), but higher than 1106 g (exotic), and 1052 g (pearl) in the sub-humid tropics as reported by Ayorinde and Ayeni (1983). This difference in body weight at first egg laying is attributed to genetic constitution, body size, feed intake

difference, and feed conversion efficiency. Chineke (2001) also confirmed that the chickens could vary in body weight at sexual maturity by breed, strain or variety; individual variations in performance.

Body weight gain

Heavier body weight was recorded for White Leghorn at day old, 8, 12, and 28 weeks and better body weight gain was obtained for Fayoumi at four and six weeks of age. Both breeds exhibited non-significant body weight at 20 and 24 weeks of age. Fayoumi pure lines had lower body weight gain at all stages, this result was due to smaller body size and genetic variation. Both Breeds exhibited a declining body weight gain from 4–8 and 24–28 weeks (Table 5). This was associated with less body weight recorded during those periods by both breeds. This study suggests that White leghorn breed could be used for better weight gain.

Table 5. Body gain performance of two exotic chicken breeds at different age.

Age(wee)	Breeds		P–value	SL
	White Leghorn	Fayoumi		
BGW0	44.51[a]	22.94[b]	0.0001	***
BGW0–4	392.00[b]	399.92[a]	0.0001	***
BGW4–8	–53.34[a]	–64.99[b]	0.0001	***
BGW8–12	483.75[a]	482.13[b]	0.0001	***
BGW12–16	66.21[b]	75.09[a]	0.0001	***
BGW16–20	320.14[a]	231.16[a]	0.1280	NS
BGW20–24	212.51[a]	145.86[a]	0.2721	NS
BGW24–28	–66.76[a]	–100.06[b]	0.0901	*

Note: *Means of the same letter across the letter is non-significant at P < 0.05; BWG = Body weight gain at day old, 4–8, 8–12, 12–16, 16–20, 20–24, 24–28; SL = Significant level; and NS = Non–significant at P < 0.05.*

3.8. Feed Consumption

The results of this study revealed that feed consumption capacity of the two studied breeds and the White Leghorn breed was superior in feed consumption to that of the Fayoumi breed throughout the study period.

This study exhibited that as the age of chickens increased; the ability to consume feed increased (Table 6). This result is supported by the findings of Abiola *et al.* (2008) who observed that daily feed intake of chickens increased with the increase in the weight of chicks and varied from breed to breed. Furthermore, Tadelle Dessie *et al.* (2003), Reta *et al.* (2012) and Wondmeneh Esatu (2015) found the amount of feed consumed in chickens increased as the age of chickens advanced. In agreement with this result, Nwachukwu *et al.* (2006) also indicated more feed consumption in heavier birds than lighter ones. The variation in feed consumption in this experiment was associated with genetic differences and body size. Ferket and Gernat (2006) reported feed consumption could be affected by many factors like weather including the temperature and breed effect. Fayoumi breed could be utilized for its lower feed consumption. The variations in feed intake could be associated with the differences in layers' body weight.

Table 6. Feed consumption of two exotic chicken breeds at different ages.

Age (weeks)	Breeds		P–value	SL
	White leghorn	Fayoumi		
FCW0–4	18.71[a]	16.98[b]	0.0001	***
FCW4–8	30.23[a]	24.82[b]	0.0001	***
FCW8–12	42.06[a]	39.82[b]	0.0001	***
FCW12–16	47.25[a]	46.52[b]	0.0001	***
FCW16–20	66.91[a]	62.38[b]	0.0001	***
FCW20–24	105.08[a]	99.01[b]	0.0016	**
FCW24–28	114.58[a]	107.98[b]	0.0042	**

Note: *Means of the same letter across the rows are non-significant at P < 0.05; FCW = Feed consumption at weeks 0–4, 4–8, 8–12, 12–16, 16–20, 20–24, 24–28; SL = Significant level; and NS = Non–significant at P < 0.05.*

3.9. Feed Conversion Ratio

Feed conversion ratios of the two breeds were non-significantly ($P < 0.05$) different and ranged from 0–4 to 12, and up to 16 at 24–28 weeks. The feed conversion ratio for White leghorn was lower except at 16–20 weeks (Table 7). The difference in feed conversion ratio might be due to breed and body size. The observed breed effects in affecting feed conversion ratio were in agreement with the reports of Udeh *et al.* (2015). This result is in the same line with Khawaja *et al.* (2013) who found that Fayoumi pure brewed chickens had poorer feed utilization. Better FCR was noted for White Leghorn while the poorest was recorded for Fayoumi

Table 7. Feed conversion ratio of two exotic chicken breeds at different age.

Age (weeks)	Breeds		P–value	SL
	White leghorn	Fayoumi		
FCRW0–4	0.42[a]	0.74[a]	0.4101	NS
FCRW4–8	0.07[a]	0.06[a]	0.1451	NS
FCRW8–12	–0.79[a]	–0.61[a]	0.1241	NS
FCRW12–16	0.09[a]	1.00[a]	0.7580	NS
FCRW16–20	1.01[a]	0.83[b]	0.0001	***
FCRW20–24	0.33[b]	0.46[a]	0.0373	**
FCRW24–28	0.58[a]	0.87[a]	0.3901	NS

Note: *Means of the same letter across the rows are non-significant at $P < 0.05$; FCRW = Feed conversion ratio at weeks of 0–4, 4–8, 8–12, 12–16, 16–20, 20–24, 24–28; NS = Non-significant at $P < 0.05$; and SL = Significant level.*

Adebambo *et al.* (2008) and Olawumi and Dudusola (2011) verified the finding of this study as they reported significant breed differences in feed efficiency of various breeds. The strain differences for feed conversion obtained in this study are consistent with the results found in the literature (Rondelli *et al.*, 2003; Taha *et al.*, 2010).

4. Conclusions

In this study, higher feed consumption, better-feed conversion, higher body weight and gain, better body weight and egg weight at first egg laying were observed for a pure line of White Leghorn due to its better body weight. White Leghorn was higher feed consumption (33.33%), better-feed conversion ratio (0.57 g), higher average body weight gain (31.09 g), better body weight (124.99 g), and egg weight at first egg (41.67 g) However, Fayoumi breed was better in fertility, hatchability and yolk color. There was non-significant result in age at first egg laying as both attain in 167 days. The age at sexual maturity is an important economic trait due to its effect on egg production, so the age at sexual maturity must be adjusted at a suitable age for production. This study suggests that White Leghorn could be used for its heavier body weight, egg weight, better egg quality and Fayoumi for its better fertility, hatchability and yolk color. Further research is required to evaluate performance of hen housed and hen day egg production potential and survivability of these breeds particularly in the eastern part of the country.

This study forwarded the following recommendations; High cost of commercial poultry rations was one of the major problem encounters that affect chicken production performance of exotic chicken. Consequently, a ration should be ready from homegrown concentrate feed ingredients and used for feeding chicken. Additionally, locally available alternative poultry feed resources should be identified, verified and utilized. The main opportunity to increase chicken production and productivity is recurrent selection of exotic chicken and by hybridizing local hens with exotic males. In urban poultry production, the cage system is vital instead of back yard production to yield more in small space. In addition, it could progress hygienic condition of the flock since it supports to inhibit diseases. One of the limits in extension service distribution and alertness of the target households on exotic chicken supervision were problems that affect chicken production performance. Thus, applied oriented training should be organized on exotic chicken management practices for farmers and development agents.

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