# Growth Performance and Rearing Costs of Fayoumi and White Leghorn Chicken Breeds

**Ewonetu Kebede Senbeta**

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

**Abstract:** In Eastern Ethiopia, small scale poultry farmers desire Fayoumi and White leghorn breeds for their active and efficient foragers, better productivity and adaptation to the environment. However, there is no extensively studied research work on their growth performance and rearing cost. Therefore, an experiment was conducted to evaluate the growth performance of Fayoumi and leghorn chicken breeds. A total of 1152 intermediate size eggs from Fayoumi and White leghorn strains of nearly similar average age were selected and randomly arranged into three replicates each constituted 192 eggs in a CRD. Eggs were incubated on the same day and the chicks hatched on the same day (21 days) were individually counted and weighed to determine hatchling weight and hatchability. The birds were intensively raised on deep litter system for 12 weeks, but kept separately according to the initial treatment of eggs to determine their relative subsequent growth performances. In this study, White leghorn brooders were better in growth rate and survival whereas Fayoumi brooders were outperformed in terms of good feed conversion ratio and economic profits under the same conditions. There were significant ($P< 0.0001$) differences in total feed consumed, cost of feed consumed, and total rearing cost and profits. The maximum cost was incurred on raising in White leghorn breed while minimum cost was incurred on raising the Fayoumi breed. The total profit obtained from the sale of a Fayoumi breed was higher by 4.68 Birr as compared to a leghorn counterpart. It can, thus, be concluded that the Fayoumi breed can be selected for its better feed conversion to gain the same weight, lower rearing cost and better economic returns while the white leghorn breed can be selected for their superior survival and growth rate traits.

**Keywords:** Breed; Brooders; Fayoumi; Performance; White leghorn

## 1. Introduction

Various strains of poultry have been developed in the past with a view to obtain maximum eggs and meat production. Because of low performance of indigenous chicken breed of Ethiopia, different exotic chicken breeds (White Leghorn, Brown Leghorn, New Hampshire, Light Sussex, Barred Rock, Rhode Island Red, and Fayoumi) have been introduced to the country (Alemu and Tadelle, 1998; Tadelle *et al.,* 2003; Demeke, 2004; Wilson, 2010). Fayoumi chicken breed has been imported with the expectation of better productivity, adaptation and disease resistance. They are originated in Egypt, reported to be a hardy breed and particularly well suited to hot climates (Heinrichs, 2007). They are also very good foragers, and on a free range basis they can fend for themselves in a nearly feral manner. Fayoumi hens are good layers of small white eggs. The breed is fast to mature, with hens laying in about four and half months after hatching (Ekarius, 2007). Fayoumi layers are known to produce about 250 eggs per annum on low nutrition supply (Akhtar, 2007). 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). It has been introduced to Haramaya University teaching and research poultry farm in Ethiopia to develop a breed that could survive and perform well under severe climatic conditions of rural areas. But it is not a good meat producer because of its small body size. Its average egg weight is also smaller than 45.91g (Akhtar, 2007). On the other hand, leghorns are good layers of white eggs, laying an average of 280 per year and sometimes reaching 300 or even 320 (https://naitc-api.usu.edu/media/uploads/2016/06/29/ParentOffspringCards.pdf). They are efficient at turning the feed they eat into lots of eggs. Leghorns are also active and efficient foragers, which is great for backyard chicken raising.

Productive and profitable layers begin with good quality pullets. Having the correct managements at brooder and grower stage will enable pullets to achieve their genetic potential at the start of egg production. Problems that develop during the growing period cannot be corrected after egg production begins. Though the White leghorn and Fayoumi breeds are widely available and reared by smallholder farmers in Ethiopia, there is no extensively studied research work on their brooders growth performance and their rearing cost under Ethiopian management strategies. Therefore, the objective of this study was to evaluate the growth performances of Fayoumi and White leghorn brooders based on their body weight and weight gain, feed intake and feed conversion ratio, and their survival rate during the twelve weeks of age.

## 2. Materials and Methods

### 2.1. Description of the Study Area

The experiment was conducted at Haramaya University poultry farm, located at 505 km east of Addis Ababa. The site is situated at an altitude of 1980 meter above sea level, $9^{0}$ 26 ' N latitude and $42^{0}$ 3' E longitude. The area has an average annual rainfall of 741.6 mm. The mean annual minimum and maximum temperatures are $8.25^{0}$ C and $23.4^{0}$ C, respectively.

*Corresponding Author. E-mail: ewonetu2011@gmail.com


ISSN 1993-8195 (Online), ISSN 1992-0407 (Print)

### 2.2. Experimental Egg Collection and Selection

A total of one thousand one hundred and fifty-two (1152) hatching eggs of Fayoumi and White leghorn strains of nearly similar average age were used from Haramaya university poultry farm. From each breed five hundred seventy-six (576) intermediate size eggs were selected based on shape, free of shell cracks and stored in cold room for seven (7) days until the required amounts were obtained. The eggs were individually weighed, marked and randomly arranged into two (2) treatment groups which were randomly sub-divided into three (3) replicates each contained one hundred and ninety two (192) eggs in a CRD.

### 2.3. Egg Incubation and its Managements

Eggs were individually placed into a tray with the broad ends pointing upwards and incubated at 37.5 °C and 70 % relative humidity for eighteen (18) days during which the tray was placed at an angle of 45° with no rotation(due to non-functionality of the incubator turner). On the 18$^{th}$ day of incubation, the eggs were transferred at once into the same Hatcher. A temperature of 36.0°C and relative humidity of 80 % were provided for the last three days. The chicks that hatched on the same day (21) were counted, weighed on a sensitive balance and the percentage hatchability was calculated (Sahin *et al.,* 2009).

### 2.4. Management of Experimental Birds

In the second part of study, all normal chicks hatched from each treatment were used for subsequent growth trial. Pens, watering and feeding troughs were thoroughly cleaned, disinfected and sprayed before placing the experimental chicks in the pen. Chicks hatched from each breed were grouped in to the same treatment, to correlate growth performances with chicken breeds. Birds were intensively raised on deep litter system for twelve (12) weeks. The litter materials used was wood shavings or saw dust. On the first day of hatching, chicks were provided water with vitamin premix (15gm vitamin premix in 10 litter water). On the second day of hatching, the birds were vaccinated against new castle disease and medication was provided using a broad spectrum antibiotics. Each pen was installed with two infra-red light on a 24 hr. basis. Hatched chicks were reared on the same diet, but kept separately according to the initial treatment of the eggs. Feed and water were given to the birds *ad libitum.* The experimental diet was composed of ground corn (44%), soybean meal (7.5%); peanut meal (20%), wheat short (25%), salt (0.2%), limestone (2.3%) and vitamin premix (1%).

### 2.5. Body Weight Measurements

Live weights of the chicks were taken at hatching and recorded as initial weight. Then, the average live weight per bird was measured every fourteen (14) days by weighing chicks in each pen and total weight was divided by a total number of birds in each pen. These live weights were used to calculate growth rate. The overall average body weight for each treatment was then computed by taking an average values for the replication.

### 2.6. Feed Intake and Feed Conversion Ratio (FCR)

A weighed amount of feed was offered once daily at 08:00 am every day and the refuse was collected next morning every day and weighed after removing external contaminants by visual inspection and hand picking. The feed offer and refuse were recorded for each replicate and multiplied by the respective dry matter (DM) content. Amount of DM consumed was determined as the difference between the DM offered and refused. Feed conversion ratio (FCR) was measured dividing the feed consumed by the live weight gain within two consecutive weeks.

### 2.7. Mortality

Mortality was recorded daily during the study. Deaths after the onset of the experiment were recorded as mortality and expressed as percent mortality at the end of the experiment.

### 2.8. Statistical Analysis

Effects of egg weight on hatchability, hatchling weight and subsequent performance of chicks were analyzed using the general linear model procedure of the statistical analysis system SAS. The means were separated using the Duncan's multiple-range test. The statistical model used was:

$$Yijk=\mu + Bi + \sum ijk,$$

*Where: Yijk is the overall observation (hatchability, feed intake, feed conversion ratio, body weight, weight gain, mortality), Bi is effect of breed (Fayoumi and White leghorn strain), ∑ijk is residual effects.*

## 3. Results and Discussion

The hatching percentage, hatchling weight, average body weight and weight gain, feed intake and conversion ratio and mortality during the 8 and 12-week rearing period of Fayoumi and leghorn are summarized in Table 1 and 2, respectively.

Table 1. The average growth performance of unsexed (male and female reared together) Fayoumi and white leghorn chicks during brooding stage (0-8 weeks).

| Parameters | Age (Weeks) | Breed | | P-value |
|---|---|---|---|---|
| | | Fayoumi | White leghorn | |
| Egg weight (g) | - | 45.12 | 50.08 | NS |
| Hatchability (%) | - | 61.01[b] | 70.32[a] | * |
| Day-old weight(g) | - | 29.39 | 33.46 | NS |
| Body weight (g/bird) | 2 | 56.30 | 65.41 | NS |
| | 4 | 93.09[b] | 130.13[a] | * |
| | 6 | 140.87[b] | 190.30[a] | * |
| | 8 | 181.93[b] | 243.01[a] | * |
| Body weight gain (g/bird) | 0-2 | 26.91 | 31.93 | NS |
| | 2-4 | 36.64[b] | 64.72[a] | * |
| | 4-6 | 56.21 | 60.16 | NS |
| | 6-8 | 41.06 | 52.72 | NS |
| | 0-8 | 160.82[b] | 209.53[a] | * |
| Feed intake (g/bird) | 0-2 | 10.94 | 13.24 | NS |
| | 2-4 | 20.97[b] | 28.68[a] | * |
| | 4-6 | 22.90[b] | 51.14[a] | * |
| | 6-8 | 19.19[b] | 74.76[a] | * |
| | 0-8 | 74.00[b] | 98.97[a] | * |
| Feed conversion ratio (g/bird) | 0-2 | 0.41 | 0.42 | NS |
| | 2-4 | 0.59 | 0.44 | NS |
| | 4-6 | 0.28[b] | 0.86[a] | * |
| | 6-8 | 0.47[b] | 1.48[a] | * |
| | 0-8 | 0.45 | 0.47 | NS |
| Mortality (%) | 0-2 | 12.24[a] | 3.52[b] | * |
| | 2-4 | 10.30 | 2.21 | NS |
| | 4-6 | 7.85 | 3.77 | NS |
| | 6-8 | 5.13 | 2.84 | NS |
| | 0-8 | 35. 52[a] | 12.34[b] | * |

*Note:[a and b] Means with the same letter are not significantly different; NS-non significant*

Table 2. The average growth performance of Fayoumi and white leghorn growers after sex identification (8-12 weeks).

| Parameters | Age in weeks | Breed | | P-value |
|---|---|---|---|---|
| | | Fayoumi | Leghorn | |
| Body weight, g/bird | 8 | 181.93[b] | 243.01[a] | * |
| | 10 | 293.43 | 298.18 | NS |
| | 12 | 331.59 | 359.78 | NS |
| Body weight gain, g/bird | 8-10 | 111.50 | 55.16 | NS |
| | 10-12 | 38.16 | 61.60 | NS |
| Final weight gain, g /bird | 8-12 | 149.66 | 116.77 | NS |
| Feed intake, g/bird | 8-10 | 22.29[b] | 73.64[a] | * |
| | 10-12 | 23.68[b] | 88.32[a] | ** |
| Final feed intake, g/bird | 8-12 | 45.96[b] | 161.95[a] | * |
| Feed conversion ratio, g/bird | 8-10 | 0.24[b] | 1.40[a] | * |
| | 10-12 | 2.17 | 1.46 | NS |
| Final feed conversion, g/bird | 8-12 | 0.34[b] | 1.39[a] | * |
| Mortality, % | 8-10 | 7.01[a] | 3.03[b] | * |
| | 10-12 | 2.64 | 3.46 | NS |
| Final mortality,% | 8-12 | 9.65 | 6.49 | NS |

*Note:[a and b] Means with the same letter are not significantly different. NS-non significant*

Table 3. The average total performance of Fayoumi and Leghorn during the 12 weeks.

| Parameters | Breed | | P-value |
|---|---|---|---|
| | Fayoumi | Leghorn | |
| Total weight gain (g/bird) | 302.20 | 326.32 | NS |
| Daily weight gain (g/bird) | 3.60 | 3.88 | NS |
| Total feed intake (g/bird) | 1839.7[b] | 2308.4[a] | * |
| Daily feed intake(g/bird) | 21.90[b] | 27.48[a] | * |
| FCR (feed: gain) | 6. 10[b] | 7.09[a] | * |
| Total mortality (%) | 44.5[a] | 18.83[b] | *** |

*Note:[a and b] Means with the same letter are not significantly different. NS-non significant*

Table 4. The average rearing cost and profit of Fayoumi and Leghorn during 12 weeks.

| Items | Breed | | P-value |
|---|---|---|---|
| | Fayoumi | Leghorn | |
| Total feed consumed (kg/bird) | 1.84[b] | 2.31[a] | *** |
| Cost of feed consumed (Birr/bird) | 18.40[b] | 23.08[a] | *** |
| Cost of feed/kg TBWG (Birr/bird) | 60.88[b] | 70.74[a] | *** |
| Labor cost # (Birr/ bird) | 0.32 | 0.32 | NS |
| Others cost*(birr/bird) | 11.25 | 11.25 | NS |
| Live pullet sale (Birr/bird) | 75.00 | 75.00 | NS |
| Live pullets sale/feed cost(Birr/bird) | 4.08[a] | 3.25[b] | *** |
| Total rearing cost (Birr/bird) | 29.97[b] | 34.65[a] | *** |
| Total Profit (Birr/bird) | 45.03[a] | 40.35[b] | *** |

*Note: #-One labor can manage 3000chicks, *- Others cost like Water, health and detergents (15% of bird sales, [a and b] Means with the same letter are not significantly different. TBWG-total body weight gain*

### 3.1. Hatchability

The overall hatchability rate was lower for Fayoumi than leghorn and varied significantly ($p < 0.01$) (Table 1). Almost similar hatchability (63.5%) was reported for Fayoumi chickens under Adami Tulu Research center in Ethiopia (Tesfa *et al.,* 2013) whereas higher (86.08%) hatchability was reported for white leghorn chickens (Islam *et al.,* 2002). In northern Ethiopia under a smallholder farmer's conditions, higher hatchability percentages (67.9 and 76.1) were reported for Fayoumi and White leghorn, respectively, by Abraham and Yayneshet (2010).

### 3.2. Body Weight and Body Weight Gain

Although eggs from leghorn breeds tended to have higher day-old weight, this difference was not statistically significant ($p>0.05$) at hatch and the first two consecutive weeks (Table 1). From 4-8 weeks, unsexed (before sex identification) Fayoumi chicks tended to record lighter weights than the leghorn counterparts and the mean average weight recorded for the unsexed leghorn chicks from hatch to eight week rearing period was about 61.08 g higher ($P < 0.05$) than in unsexed Fayoumi chicks. There were statistical differences ($P<0.05$) in the average weight gain from 2-4 weeks and from 0-8 weeks. The mean average weight gain recorded for the unsexed leghorn chicks from hatch to 8 weeks was about 48.71 g higher ($P < 0.05$) than the Fayoumi chicks. This indicated faster growth rate in leghorn chicks than Fayoumi during the eight week rearing period. These results suggest that the lower chick weight and weight gain in Fayoumi might be as a result of a lighter egg weight used for incubation (Table 1) and might be attributable to breed differences. Although there was no significant deference in body weight between the breeds during the brooder periods at 10 and 12 weeks (Table 2), female leghorn brooders tended to have heavier weights than the Fayoumi counterpart. The mean average weight recorded for the leghorn brooders from 8-12 weeks was about 28.19 g higher ($P > 0.05$) than in Fayoumi breed. There was no statistical difference ($P>0.05$) in the average weight gain from 8-12 weeks even though the Fayoumi brooders had higher (32.89g) than leghorn breeds. This indicated faster growth rate in female Fayoumi than leghorn breeds. The total average daily body weight gain (Table 3) was higher in white leghorn than Fayoumi brooders from day-old to 12 weeks of age. Correspondingly, Tadelle *et al.* (2003) recorded differences in weight gain among different six chicken populations from one-day old to 12 weeks of age. In this study result the total average weight gain recorded was lower than 405g which was reported by Tadelle *et al.* (2003) for mixed sexed local chicken ecotypes at 12 weeks of age. Many authors also reported higher body weight gain for the same age such as 538g for Cameroon indigenous chicken (Ogbu *et al.*, 2012), 371g for Nigerian chickens (Omeje and Nwosu, 1984) and 351g for southern Ethiopian chickens (Tekete, 1986). Moreover, differences in weight gain among different breeds and strains reported (Ajayi and Ejiofor, 2009; Enaiat *et al.*,2010; Rondelli *et al.,* 2003, Zhao *et al.,* 2009; Bekele *et al.,* 2010; Ogbu *et al.*, 2012).

### 4.3. Feed Intake and Feed Conversion Ratio

Unsexed leghorn chicks were ($P < 0.05$) consumed more feeds (24.97g) and need extra 0.02g of feed to gain comparable weight than Fayoumi brooders from day-old to eight weeks. Besides, the sexed leghorn brooders (8-12weeks) were significantly ($P < 0.05$) consumes more feed (115.99g) and need extra 1.05g of feed to gain analogous weight than the Fayoumi age groups. In general, the white leghorn brooders consumed and required more feed per unit gain (Table 3) than Fayoumi contemporaries from hatch to twelve weeks. This might be due to their higher body weight than the Fayoumi brooders throughout the rearing periods. Breed was significantly influenced brooder feed intake ($P<0.05$), these results are alike to the findings of Abiola *et al.* (2008) who observed that daily feed intake of chickens increased with increase in the weight of chicks and various from breed to breed. From day-old to 12weeks, the total average daily feed intake (Table 3) in white leghorn brooders was higher than the Fayoumi however it was fall in the range of feed intake per chick and grower reported by Tadelle *et al.* (2003) which was 23g for Jarso and 28g for Tilili ecotype at similar age. The lower feed conversion ratio for Fayoumi chicks (Table 3) might be due to their smaller maintenance requirements as compared to the leghorn chicks. In this study the feed conversion ratio of both breeds were higher (Table 3) than the mean ($5.64\pm0.2$) reported by Tadelle *et al.* (2003) for Tilili, Horro, Chefe, Jarso, Tepi and Fayoumi chicks at comparable age. This study has shown that Fayoumi chickens have the genetic ability to grow fast if properly managed.

### 4.4. Mortality/Survivability

There was significant difference in mortality percentage from 0-2, 0-8 (Table 1) and 8-12-week age (Table 2). The mean total mortality percentage of Fayoumi brooders from hatch to 12 weeks of age was higher than the white leghorn breeds from day-old to 12weeks of age (Table 3). This study result contrasted to Rajput *et al. (*2005) who reported farmers keep Fayoumi breed in their homes and farms with the expectation of better disease resistance and strong immunity against common diseases. The higher survivability of leghorn brooders might be due to their adaptability to the study area because this breed was imported to the study area before thirty years ago (unpublished document from Haramaya University poultry farm). In this study result, mortality was affected by breed which disagreed with Olawumi and Dudusola (2010) who found that mortality rate was not affected by breed while moderately agreed with those who found very high significant difference ($p<0.001$) in the mortality rate of different breeds (Awobajo *et al.,* 2007). Moreover, strain and breed effect on mortality were recorded among different commercial egg type (Tabbaa *et al.,* 2007). The mortality rates obtained for Fayoumi in the present study was higher and for leghorn was lower than 26.3%, the result obtained for Arbor acre strain (Badamasi *et al.,* 2014). This may be due to differences in breeds' use or management system. Lower mortality (8.1%) reported for white leghorn breed raised for the phase of brooding (60 days) under intensive management conditions in Jimma College of agriculture of Ethiopia, (Solomon, 2004). During the rearing period, birds exhibited recurrent outbreaks of disease with a symptom of wing droppings, closed one or both eyes and leg weakness but the specific disease type was not identified.

### 4.5. Rearing Cost and Profit

Economics of rearing and profit from Fayoumi and white leghorn brooders is presented in Table 4. The maximum cost incurred in white leghorn while minimum cost was observed in Fayoumi. There was significant ($P< 0.0001$) difference in total feed consumed, cost of feed consumed, and total rearing cost and total profits. The total profit obtained from sale of pullets from Fayoumi breed was higher by 4.68 birr as compared to white leghorn breeds. This was due to their small feed intake.

## 5. Conclusion

The results of this study have demonstrated that White leghorn breeds had significantly enhanced speed of weight gain as well as growth and survival rates compared to the Fayoumi breed at the brooder stage of growth. However the Fayoumi brooders outperformed the White leghorn breed in terms of good feed conversion ratio and economic benefits. Therefore, poultry producers in the study area can choose between the two chicken breeds based on which aspect of performance they are interested in chicken production. Additional research should be conducted to evaluate similar parameters performances at pullet and layer stages of growth and identify specific diseases which result in the mortality of the chickens in the study area.

## 6. Acknowledgments

The author thanks Haramaya University for funding the research and all workers of the poultry farm for the assistance they provided during the research work.

## 7. References

Abiola, S. S., Meshioye, O. O., Oyerinde, B. O. and Bamgbose, M. A. 2008. Effect of Egg size on hatchability of broiler chiks. *Archiva zootechnica,* 57: 83 -86.

Abraham, L. and Yayneshet, T. 2010. Performance of exotic and indigenous poultry breeds managed by smallholder farmers in northern Ethiopia. *Livestock Research for Rural Development* (http://www.lrrd.org/lrrd22/7/leml22133.htm. (Accessed on August 13, 2016).

Ajayi, F. O. and Ejiofor, O. 2009. Effects of genotype X sex interaction on growth and some development characteristics of Ross and Anak broiler strains in the high rainforest zone of Nigeria. *Asian Journal of Poultry Science,* 3: 51-56.

Akhtar, N., Mahmood, S., Hassan, M. and Yasmeen, F. 2007. Comparative study of production potential and egg characteristics of Lyallpur Silver Black,

Fayoumi and Rhode Island Red breeds of poultry. *Pakistan Veterinary Journal,* 27: 184-188.

Alemu, Y. and Tadelle, D. 1998.The Status of Poultry Res earch and Development in Ethiopia. In: the Proceedings of the 5th Conference. *Ethiopian Society of Animal Production,Pp.* 40-60.

Awobajo, O. K., Akintan, Y. M., Igbosanu, A. O., Mako, A. A. and Olatokunbo, O. T. 2007. The Mortality Rate in the Two Breeds of Broiler on Brooding Stage. *World Applied Sciences Journal,* 2: 304-308.

Badamasi, A. G., Ibrahim, H. and Yahaya, H. K. 2014. Comparative Evaluation of Feed Conversion Efficiency and Mortality Rate of Two Broiler Strains under the Same Dietary Conditions. *International Journal Animal and Veterinary Advances,* 6: 5-7.

Bekele, F., Adnoy, T., Gjoen, H. M., Kathle, J. and Abebe, G. 2010. Production Performance of Dual Purpose Crosses of Two Indigenous with Two Exotic Chicken Breeds in Sub-tropical Environment. *International Journal of Poultry Science,* 9: 702-710.

Demeke, S. 2004. Egg production performance of local and White Leghorn hens under intensive and rural household conditions in Ethiopia. *Livestock Research for Rural Development,* 16: 9. (http://www. lrrd. org/ lrrd 24/3/ ogbu24047.htm) (Accessed on Martch 23, 2016).

Ekarius, C. 2007. Storeys Illustrated Guide to Poultry Breeds. Storey publishing.

Enaiat, M. M., Amina, A. S. and Eman, M. A. 2010. A comparative study of productive and physiological performance between two local strains of chicks. *Egypt Poultry Science* 30: 297-316.

Islam, M. S., Howlid, M. A. R., Kabir, F. and Alam, J. 2002. Comparative Assessment of Fertility and Hatchability of Barred Plymouth Rock, White Leghorn, Rhode Island Red and White Rock Hen. *International Journal of Poultry Science,* 1: 85-90.

Mafeni, M. J. 1995. Studies of productivity, immune-competence and genetic diversity of naked neck and normal feathered indigenous Cameroon and German Dahlem Red fowl and their crosses. Ph.D Thesis, Humboldt University of Berlin, 108.

Ogbu, C. C., Udeh, I. and Nwakpu, P. C. 2012. Comparative performance of two commercial egg strains, the indigenous chickens and their random bred progenies. *Livestock Research for Rural Development*, 24 (http://www. lrrd. org/ lrrd 24/3/ ogbu24047.htm) (Accessed on April 8, 2016).

Olawumi, S. O. and Dudusola, I. 2010. Effects of Genotype and Housing on Reproductive Performance of Two Strains of Commercial Layers in the Derived Savannah Zone of Nigeria. *PAT,* 6: 102-109.

Omeje, S. S. and Nwosu, C. C. 1984. Hetrosis and superiority in body weight and feed efficiency evaluation of exotic parent stock by local Chicken F1 Crossbreds. *Nigerian Journal of Genetics,* 5: 11-26.

Rajput, N., Rind, M. L. and Rind, R. 2005. Effect of flock size on Fayoumi layer production. *Journal of Animal and Veterinary Advances,* 4: 842-844.

Rondelli, S., Martinez, O. and Garcia, P.T. 2003. Sex effect on productive parameters, carcass and body fat composition of two commercial broilers lines. *Revista Brasileira de* Ciência *Avícola, 5*: 169-173.

Sahin, E. H., Sengor, E., Cetingul, I. S., Yardimci, M. 2009. Relationship between pre-incubation egg parameters from old breeder hens, egg hatchability and chick weight. *Journal of Animal and Veterinary Advances,* 8: 115-119.

Solomon, D. 2004. Growth performance and survival of local and white Leghorn chicken under intensive management system. *Ethiopian Journal Science,* 27: 161–164.

Tabbaa, M. J., Al-Kateb, A. N. and Alshawabkeh, K. M. 2007. Effect of Breed Strain, Disease, Environmental Conditions and Management on Mortality in Commercial Egg Type Layers. *Jordan Journal of Agricultural Sciences,* 3: 52-65.

Tadelle, D., Million, T., Alemu, Y., Peters, K. 2003. Village chicken production systems in Ethiopia: Flock characteristics and performance; *Livestock Research for Rural Development,* 15: 1.

Teketel, F. 1986. Studies on the meat production potential of some local strains of chicken in Ethiopia. Ph. D Thesis, J. L. Giessen University, 210.

Tesfa, G., Samson, L. and Endalew, B. 2013. Production performance of Fayoumi chickens under intensive management condition of Adami Tulu research center. *International journal livestock production,* 4: 172-176.

Wilson, R. T. 2010. Poultry production and performance in the federal Democratic Republic of Ethiopia. *Worlds Poultry Science Journal,* 66: 441-454.

Zhao, J. P., Chen, J. L., Zhao, G. P., Zheng, M. Q., Jiang, R. R. and Wen, J. 2009. Live performance, carcass composition and blood metabolite responses to dietary nutrient density in two distinct broiler breeds of male chickens. *Poultry Science,* 88: 2575-2584.