Performance of White Leghorn Chickens Breed Maintained at Haramaya University Poultry Farm and Implications for Sustainable Poultry Production

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Abstract: Indigenous chickens in Ethiopia are characterized by slow growth and egg production potential. As a result, poultry enterprises in the country entirely depend on exotic breeds, which are productive. The White Leghorn breed is the major one among the exotic breeds. Haramaya University Poultry farm is a source of the White Leghorn poultry breed in eastern Ethiopia. However, poor management and maintenance of the breed for too long without genetic improvement is a serious constraint to enhancing poultry production in the region. The objective of this study was, therefore, to evaluate the performance of White Leghorn breed maintained at Haramaya University poultry farm and establish their current reproductive and productive potential. The productive and reproductive performance of the breed was evaluated starting from hatching to 50 weeks of age. 576 eggs with an average size of 50.01 $\pm$ 5.57g were randomly arranged into three replicates each consisting of 192 eggs. Then, a total of 363 hatched chicks were used and intensively raised on a deep litter system to evaluate body weight, feed intake, feed efficiency, body weight gain, mortality during brooder, grower and layer stages whereas egg weight and hen day egg production at layer ages were also determined. All data were analyzed using descriptive statistics. The results revealed that the mean hatchability, day old body weight, age at sexual maturity, weight at sexual maturity, hen-day egg production, and egg weight for the study breed were 70.32 $\pm$ 4.08%, 33.48 $\pm$ 0.84g, 154 days, 880.04 g, 70.35$\pm$3.22% and 53.47$\pm$2.39g, respectively. The average body weight and feed intake increased progressively during the brooder, grower and layer age. The highest weight gain was achieved during the grower age but the highest feed conversion ratio was observed during the layer stage. The mean mortality rates during the brooder and grower stages were 4.23$\pm$1.72 and 1.17$\pm$0.96, respectively. In conclusion, the White Leghorn breed at the university performed poorly with respect to most of the variables studied. Therefore, it is necessary to do more research to get insights into possible environmental and genetic factors that have contributed to the lower performance of the breed so as to address the constraints and enhance poultry production in the region.

Keywords: Brooder; Day-old chicks; Grower; Layer; Management stages; Performance; Reproductive; White Leghorn

1. Introduction

The Ethiopian indigenous chickens are characterized by slow growth, late maturity and low egg production performance which are estimated at 60 small eggs with thick shells and a deep yellow yolk color (Yami and Dessie, 1997; Niraj *et al*., 2014). Local chickens kept under the intensive management systems are inferior to exotic stock in health status and they are also slow in rate of feathering and exhibit recurrent outbreaks of disease (Solomon, 2004). Because of these characteristics of local chickens, poultry breeding industries involving intensive management systems entirely depends on exotic breeds. Among the many exotic breeds in Ethiopia, White Leghorn was imported to Jimma and Haramaya University in 1953 and 1956, respectively, under USAID project (Solomon, 2007). Since then several studies were conducted on the breed's productive and reproductive performance in different parts of Ethiopia (Teketel, 1986; Brannang and Persson, 1990; Abebe, 1992; Solomon, 2004 and 2007).

White Leghorn chickens are known for laying large number of eggs, need less feed, and very efficient layers (Haftu, 2016). The study conducted by Solomon (2004) at Jimma College of Agriculture characterized the 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 body weight of the breed at 6 months ranged from 1300 g at Haramaya University (Abebe, 1992) to 1660 g at Awassa University (Teketel, 1986). Besides, Brannang and Persson (1990) reported mean

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body weight of 1050 g at an age of 5 months for the breed at Assela. This breed lays an average of 280 per year and sometimes reaches 300 or even 320 as cited by Ewonetu (2017). In Pakistan, at Faisalabad University of Agriculture, Ahmad *et al.* (2010) reported 97.84-98.16 g daily feed intake per bird, 86.87-88.14 % hen day egg production, 1.19-1.22 feed conversion ratio per dozen egg, and 25.50-29.70 g weight gain for the single comb White Leghorns in their first laying year cycle (20 weeks of laying period). Besides, in India, Thirunavukkarasu *et al.* (2006) evaluated the single comb White Leghorn layers at 60, 65 and 70 weeks of age for mean hen day egg production and reported 76.34, 79.06, and 76.04%, respectively. Moreover, the performance of the breed during the 12 weeks of age evaluated for daily weight gain, daily feed intake, feed conversion ratio and mortality were 3.88 g, 27.48 g, and 18.38 %, respectively, at Haramaya University Poultry research farm (Ewonetu, 2017).

From the above background, it is clear that a number of studies have been conducted on characterization of the breed in different parts of Ethiopia and other countries. However, limited research has been conducted to understand the whole life cycle of the breed from the age of hatching to the end of laying stage as well as to elucidate the associated constraints that may hamper realization of reproductive and productive potential of the White Leghorn breed. University has been maintaining this breed at its Poultry farm since 1956 and is disseminating chicks to households that engage in small-scale poultry farming in the region (Ewonetu, 2017).

To date, the farm is maintaining a small population of the breed and conserving a whole population as one unit by multiplying generation after generation from the population by non-random mating. Consequently, such mating may result in an overall reduction in performance due to inbreeding (Troianou *et al.*, 2018). This reduction may be manifested in many ways such as poorer productive and reproductive efficiency including higher mortality rates, lower growth rates, and lower hen day egg production (Kutter and Nitter, 1997; as cited by Udeh and Omeje, 2011). This breed has not been extensively characterized for too many years. Thus, evaluation of the productive and reproductive potential of the breed's whole life cycle is necessary to understand the present performance and future consequences of the poultry farming at the university and in the region as a whole. Therefore, the objective of this study was to evaluate the productive and reproductive performance of the White Leghorn breed being maintained under an intensive management system at Haramaya University.

2. Materials and Methods

2.1. Study Area

The experiment was conducted at the Poultry Farm on the main campus of Haramaya University. The main campus of Haramaya University is located in the Hararghe Zone of the Oromia Regional State in the eastern part of the country, at a distance of about 510 km from Addis Ababa. The campus is situated at a distance of 5 km from the nearby town of Haramaya, which is found on the main road connecting the capital, Addis Ababa with the eastern city of Harar. The geographical location of the research site is at 9° 26' N latitude and 42°3' E longitudes and an altitude of about 2010 meters above sea level. The area receives average annual rainfall of 741.6 mm. The mean annual minimum and maximum temperatures of the site are 8.25 °C and 23.4 °C, respectively, as noted by Ewonetu (2017).

2.2. Experimental Egg Collection and Incubation

The experiment was conducted from January 2017 to February 2018 for 13 months. A total of five hundred and seventy-six hatching eggs with an average size of 50.01 $\pm$ 5.57g were collected from White Leghorn breed and randomly arranged into three replicates each consisting of one hundred ninety-two eggs. The eggs were incubated at the temperature of 37.5 °C and relative humidity of 55% for eighteen days. On the 18th day of incubation, the eggs were transferred into a hatchery and further incubated for three days at the temperature of about 36.5 °C and relative humidity of 75% relative humidity.

2.3. Management of Chickens and Feed Chemical Composition

Chicks hatched from each replicate were counted; weighed using a sensitive digital balance and the hatchability percentage was calculated using the formula described by Sahin *et al.* (2009). A total of three hundred sixty-three chicks were randomly grouped to replications and raised for 50 weeks on deep litter. On the first day of hatching, chicks were provided with water with vitamin premix and vaccinated against diseases. The chicks in each replication were reared on the same diet composed of ground corn, soybean meal, peanut meal, wheat short, salt, limestone and vitamin premix. However, the proportion and composition of the diet were re-formulated for the chicks according to their stages of growth (Table 1). The chicks were provided with feed and water on *ad libitum* basis. Representative samples of feed ingredients were analyzed for dry matter, ether extracts, crude fiber and ash before the actual ration formulation following the procedure of proximate analysis method (AOAC, 1990). Besides, Kjeildhal procedure was employed to determine the nitrogen (N) content of each ingredient and the crude protein content was determined by multiplying the N value with 6.25 (Magomya *et al.,* 2014). The total metabolizable energy content was calculated indirectly by using the formula presented by Wiseman (1987) that is ME (Kcal/ kg DM) = 3951+54.4 EE–88.7 CF–40.8 Ash.

Table 1. Feed ingredients and nutrient composition (% for DM).

Feed ingredient (%)	Management stages (weeks)			Mean Nutrient composition (% for DM) [a]					ME kcalkg^{-1}
	Brooder (0-8]	Grower (8-22]	Layer (22-50]	DM	CP	EE	Ash	CF	
Ground corn	55.00	45.15	45.00	89.00	7.10	5.30	2.30	8.00	3436.88
Soybean meal	12.00	15.00	17.00	93.20	38.50	8.90	8.00	9.00	3310.46
Peanut meal	9.00	13.00	20.00	94.70	37.30	9.60	6.20	12.00	3155.88
Wheat Short	20.00	25.00	10.15	90.30	12.00	3.30	6.80	6.2.00	3303.14
Limestone	3.15	1.00	7.00	-	-	-	-	-	-
Vitamin premix	0.50	0.50	0.50	-	-	-	-	-	-
Salt	0.35	0.35	0.35	-	-	-	-	-	-
Average				91.80	23.73	6.78	5.83	8.80	3301.34

Note: [a] *DM = Dry Matter; CP = Crude Protein; EE = Ether Extract; CF = Crude Fiber and ME = Metabolizable Energy.*

2.4. Body Weight Measurements

Chick live weights were taken at hatching and recorded as initial weight. Then, the average weight per chicken was measured every two weeks for each replication by weighing the chickens in each pen and the total weight was divided by the total number of chickens in each replication to calculate the weight gain. The overall average body weight for two consecutive weeks was then computed by taking the average values for the replication.

2.5. Feed Intake and Conversion Ratio (FCR)

Weighed feed was offered once a day at 08:00 am and refuse was collected and weighed in the morning of the next day. The feed offered and refused were recorded for each replicate to determine the chicken's daily feed intake and calculate the overall average feed intake per day per chicken. Feed conversion ratio was measured by dividing feed consumed into live weight gain for each growth stages (brooder and grower) and also calculated for layers on egg production basis.

2.6. Egg Production and Egg Weight

Egg weight was measured individually every day for each replication using an electronic weighing balance and the average was taken for the two weeks. The mean daily hen day egg production (HDEP) for each replication was calculated every two weeks using the following formula as cited by Shafik *et al.* (2013).

$$\text{HDEP} = \left(\frac{\text{\# of eggs produced on that day}}{\text{\# of alive hens in production on that day}}\right) \text{X } 100$$

2.7. Mortality

Deaths were recorded daily after the onset of the experiment and it was calculated for each growth stages as mortality rate at the end of the experiment.

2.8. Statistical Data Analysis

Data entry and management was made using Microsoft Excel sheets and all data were finally analyzed using Statistical Analysis System version 9.1.3 (SAS, 2008) for descriptive statistics such as mean, percentage, and standard deviation.

3. Results and Discussion

3.1. Hatchability

The average hatchability based on total eggs set reported in this study was lower (70.32 $\pm$ 4.08%) than results reported by Abraham and Yayneshet (2010) in northern Ethiopia (76.1%), Kebede *et al.* (2014) in other region of Ethiopia (78.6-81.4%) and Islam *et al.* (2002) at Bangladesh livestock research institute (86.1%) for the same breed. This hatchability variation against the same breed might be due to the differences in egg weight used for incubation, age of parent flocks from which the eggs were obtained, and management given to parental flocks as found in many previous studies. For instance, Ulmer-Franco *et al.* (2010) reported lower hatchability in eggs that were larger than the average egg. However, DeWitt and Schwalbach (2004) reported that large size eggs have higher hatchability in New Hampshire and Rhode Island Red chicken breeds at 30 week of age. Similarly, Wilson (1991) also reported that large-sized eggs had a higher hatchability value than medium- and small-sized eggs. Moreover, Yassin *et al.* (2008) gave an account of breeder factors that affect hatchability such as strain, health, nutrition and age of the flock, egg size, weight and quality, egg storage duration and conditions, egg sanitation, and season of the year.

3.2. Day-old Body Weight

The average day-old body weight recorded in this study was 33.5 $\pm$ 0.84 g which is lower than the hatchling weight (42 g) recorded for the same breed at Jimma College of Agriculture (Solomon, 2004). Likewise, Islam *et al.* (2002) reported higher average chick weight (38.96 g) for the same breed at Bangladesh livestock research institute. However, similar results were reported by Zewdu and Berhan (2013) concerning average one-day-old body weight (33.88 ± 1.8 g) for the same breed at Haramaya University poultry farm. Fahey *et al.* (2007) also reported almost a similar result (33.1 ± 1.04g) for the body weight of one-day-old White leghorn chicks.

However, Barua *et al.* (1992) reported lower (25.48g) average one-day-old body weight for the same breed at Bangladesh Agricultural University Poultry Farm. This variation in day-old weight might be due to the differences in non-genetic parameters given for parental flocks and also might be the influence of study agro-ecologies. The influence of non-genetic factors like feeding practices, flock management, housing, and season on production performance such as day-old body weight were reported in earlier studies (Hossen, 2010; Ochieng *et al.,* 2011). Besides, Rudra *et al.* (2018) noticed the effect of feed, environmental conditions, and climatic conditions in different agro-ecologies on live weight of chickens. Moreover, Suarez *et al.* (1997) reported that chick weight at hatch is heavily influenced by the weight of the egg from which it hatched.

3.3. Age and Weight at Sexual Maturity

The average age at sexual maturity measured as age at first egg was attained at about 154 days (5.13 months) for the breed. This result falls within the range of 149-169 days as reported for the same breed under extensive management by Solomon (2007) at Jimma College of Agriculture in Ethiopia. However, a relatively earlier maturation was attained for the same breed at the mean age of 139 days at Swedish University of Agricultural Sciences, Skara (Dominic *et al.*, 2012), 138.31 ± 3.44 days in India (Reddy *et al.*, 2001) and 149 days (Solomon, 2004) at Jimma College of Agriculture in Ethiopia. On the contrary, the late age for sexual maturity of 175.2±7.6 days (Khalil *et al.,* 2004), 192 days (Goto *et al.*, 2011) and 245±6.08 days (Addis and Malede, 2014) were reported for White leghorn in previous studies. On the other hand, the average weight at sexual maturity for this breed was attained at about 880.04 g and this was lower than the weight at first egg reported for the same breed at Bangladesh Agricultural University Poultry Farm (1352.67g; Barua *et al.*, 1992) and at Indian Veterinary College and Research Institute (1400.16±23.25g; Thirunavukkarasu *et al.*, 2007). The late age for sexual maturation of the breed in this study might be due to smaller egg weight (50.01 ± 5.57g) used for hatching which may result in smaller day-old weight (33.48 ± 0.84g).

Table 2. White leghorn chicken characterization at brooder ages (Mean ± SD).

Age (weeks)	BW(g)	BWG (g)	FI (g)	FCR (weight)	Mortality (%)
0-2	49.45±3.32	2.28 ± 0.14	13.24±0.68	0.14±0.02	6.20+1.63
2-4	97.77±5.01	4.62 ± 0.28	26.68±4.14	0.15±0.01	5.02+1.96
4-6	160.21±7.06	4.30 ± 0.23	49.14±3.87	0.28±0.01	3.07+1.73
6-8	216.66±11.32	3.77 ± 0.67	71.42±5.69	0.48±0.08	2.64+1.78

Note: *BW= body weight, BWG = Body weight gain, FI= Feed intake, FCR = Feed conversion ratio.*

Table 3. White leghorn chicken characterization at Grower/Pullet ages (Mean ± SD).

Age (weeks)	BW(g) [a]	BWG (g)	FI(g)	FCR (weight)	Mortality (%)
9-10	270.60±26.18	3.94±1.58	81.97±6.54	1.40±0.28	1.81±0.97
10-12	328.98±34.52	4.40±0.65	89.57±6.54	1.46±0.30	1.26±1.42
12-14	379.46±29.25	2.81±0.46	92.55±8.33	2.31±0.41	0.97±0.96
14-16	431.27±26.13	4.59±1.91	97.59±8.30	1.64±0.84	0.66±0.57
16-18	487.95±28.85	3.51±1.20	103.10±9.76	1.68±0.57	NMR
18-20	570.34±26.13	8.12±1.39	107.63±11.74	0.57±0.21	NMR
20-22	753.11±73.30	18.13±8.94	110.52±13.25	0.34±0.29	NMR

Note: *BW=body weight, BWG =Body weight gain, FI= Feed intake, FCR= Feed conversion ratio NMR=No mortality record.*

Table 4. White leghorn chicken characterization at Layer ages (Mean ± SD).

Age (weeks)	BW(g)	BWG (g)	FI (g)	HDEP (%)	EW (g)	FCR (Egg)
22-24	661.73±41.87	0.33±3.35	116.49±17.36	26.42±6.21	49.10±3.69	1.73±1.03
24-26	811.62±46.56	0.83±3.04	123.85±11.30	48.72±6.63	50.49±2.76	2.98±2.45
26-28	961.51±66.00	9.30±10.20	129.99±5.55	55.17±6.43	51.58±2.04	2.48 ±3.07
28-30	1067.39±69.85	5.83±7.72	133.36±5.70	62.14±8.66	52.28±1.61	1.27 ± 0.93
30-32	1104.15±37.26	-0.58±5.06	136.62±5.10	65.03±7.22	52.55±1.54	2.88±1.98
32-34	1120.05±56.57	2.87±2.10	139.59±4.28	68.86±4.61	52.86±2.05	7.74±10.22
34-36	1163.71±12.33	3.39±4.63	142.95±3.77	74.17±0.57	53.17±2.03	5.40±38.45
36-38	1139.22±65.92	-6.89±7.78	146.35±4.43	75.70±1.26	53.77±2.29	3.11±3.31
38-40	1124.00±26.12	4.71±16.96	153.50±5.85	80.73±0.20	54.41±2.38	2.11±2.58
40-42	1155.47±52.77	1.35±5.87	175.57±17.29	83.64±0.81	55.07±2.74	2.61±2.94
42-44	1186.94±82.31	1.36±5.86	189.36±5.87	85.37±1.77	55.48±2.76	10.09±7.66
44-46	1177.38±15.63	-1.13±0.71	199.54±8.16	85.58±1.39	55.67±2.86	7.41±14.46
46-48	1171.60±23.26	-1.06±8.35	201.79±8.57	86.31±1.39	56.02±2.51	2.80±1.30
48-50	1226.98±72.93	8.98±4.53	212.59±6.60	87.04±0.23	56.12±2.48	2.30 ± 1.80

Note: *BW=body weight, BWG= body weight gain, FI= Feed intake, FCR= Feed conversion ratio, HDEP=hen day egg production, EW=egg weight.*

Table 5. White leghorn chicken characterization at different age groups (Mean ± SD).

Parameters (Mean ± SD)	Brooder (0-8)	Grower (9-21)	Layer (22-50)
Body weight (gbird^{-1})	132.47±6.87	505.51±36.79	1127.88±10.48
Feed Intake (gbird^{-1})	40.12±3.48	97.56±8.86	157.26±7.55
Weight gain (gbird^{-1}day^{-1})	3.74±0.24	6.50 ± 1.21	2.09±0.15
Feed conversion ratio	0.26 ±0.03	1.34±0.13	6.06 ±2.55

3.4. Egg Production and Weight

The overall average hen-day egg production (70.35±3.22%) recorded in this study was lower than 86.87 ± 0.35, 88.14 ± 0.93 and 87.55 ± 0.38% reported for the same breed in Pakistan (Ahmad *et al.*, 2010) (Table 4). Besides, higher egg laying percentage were reported for White leghorn reared on floor (81.297 ± 23.994%) and in cages (80.681a± 23.946) from 20-40 weeks in Mexico (Itza-Ortiz *et al.*, 2016). However, lower percentages of hen day egg production (58.25-69.9) were reported for White leghorn breed within 22-38 weeks (Promila *et al.*, 2017). The hen day egg production (HDEP) was increased with advance in age (Table 4). The lower percent of hen-day egg production in this study could be attributed to the variations in environmental conditions provided to the breed. Moreover, the diverse age at first egg of chickens might lead to higher differences in HDEP due to the positive correlation between hen age and body weight with egg production which is consistent with the results reported by Malik *et al.* (2008).

The average egg weight for the breed from 22-50 weeks was 53.47±2.39 g/egg which was lower than other results (57.801 ± 4.039 and 57.702 ± 5.073 g) reported for White leghorn in Pakistan (Ahmad *et al.*, 2010). Besides, Islam *et al.* (2002) reported higher average egg weight (59.48g) for the same breed at Bangladesh Livestock Research Institute. However; Tamasgen (2015) noted relatively lower egg weight (51-52 g) for the same breed at Haramaya University poultry research farm. The egg weight was increased with the layer's age (Table 4). This concurs with the results of earlier studies that showed increased egg weights with increased age of hens (Lukáš *et al.*, 2009; Padhi *et al.*, 2013). The diverse age at first egg of chickens might lead to higher differences in egg weight due to the positive correlation between hen age and egg weight which is consistent with earlier reports (Niknafs *et al.*, 2012).

3.5. Body Weight and Gain

The biweekly weight taken for the study breed was progressively increased during the brooder, grower and layer age (Table 2, 3, and 4). The body weight recorded at brooder and grower age (Table 5) was lower than 350 g and 1400 g, respectively. Similar results were reported at the same age for the same breed by Solomon (2004). Besides, the body weight recorded at the age of 24-26 weeks (Table 4) was lower than the body weight (1300 g) recorded during the same age for the same breed at the same study site (Abebe, 1992). Moreover; Brannang and Persson (1990) reported higher body weight (1050 g) at the age of 20-22 weeks for White Leghorn than the results recorded in this study for the same age. Moreover, Dominic *et al.* (2012) reported higher body weight (1629.3±110.4) for the breed at 28-30 weeks. The daily body weight gain of the breed during the brooder, grower and layer age groups are presented in Tables 2, 3, and 4, respectively. Higher body weight gain was recorded during the grower than brooder and layer periods (Table 5). The higher daily weight gain (5.2 and 11.4g) was reported at 60 and 90 days of ages, respectively, for the same breed at Jimma College of Agriculture (Solomon, 2004). The decreased and/ or negative daily body weight gain observed during the layer stage (Table 5) might be to compensate daily egg production rate.

3.6. Feed Intake and Efficiency

The daily feed intake per bird calculated on daily basis for the breed at brooder, grower and layer stages were increased with advanced age and egg production (Tables 2-4). This result was consistent with the findings of Abiola *et al.* (2008) who observed an increased daily feed intake with increase in the weight of chickens though it varied from breed to breed. Lower feed intake for the same breed were reported during the first (97 ± 1.8 - 105 ± 1.9), second (108 ± 0.5- 111 ± 2.5) and third (109 ± 1.47- 120 ± 1.61g) months of laying (Jesus Eduardo *et al.*, 2013). Besides; Ahmad *et al.* (2010) reported lower feed intake (98.00±0.10, 98.16±0.33, 97.84±0.28g) for White Leghorn layers from the point of lay to 40 weeks of age in Pakistan. The feed conversion ratio on body weight basis during brooder age was increased with age (Table 2). Higher dry matter feed conversion (4.92-5.97) was reported for the same during the brooder age (Zewdu and Berhan, 2014). In addition, Solomon (2004) reported 5.8 and 8.9 feed conversion efficiency, respectively, for White Leghorn during the brooding and growing periods. However, lower layers feed conversion was reported during the first, second and third months from 1.71 ± 0.03- 1.84 ± 0.04, 1.85 ± 0.03- 1.92 ± 0.04 and 2.03 ± 0.03- 2.07 ± 0.06, respectively (Jesus Eduardo *et al.*, 2013). Moreover, Ahmad *et al.* (2010) reported lower feed conversion ratio per dozen eggs (1.19±0.009-1.22±0.009) for the same breed in Pakistan during their first laying year cycle. The variation in feed intake and feed efficiency for the same breed in different study sites might be related to variation in provided environmental conditions such as nutrition, temperature, humidity, rate of lay, egg weight, body weight, and type of housing. Likewise, Scott (2005) quoted the influence of nutrient energy content, environmental temperature, stocking density, feeder space and water availability on chicken feed intake and efficiency. Among environmental factors, temperature is commonly assumed to be the most important factor influencing chicken health, behavior and production (Webster and Czarick, 2000). If there are variations of temperature according to different locations within the poultry house, then chickens will consume lesser or greater amounts of nutrients than required hence productive and reproductive differ greatly and the great fluctuation in house temperature during cold weather may lead to poor feed conversion ratio and to health problems (Talha *et al.,* 2011).

3.7. Mortality

Although high mortality rate was recorded during the first eight weeks of brooding age, it was sustained throughout the growing period to sixteen weeks of age and it was significantly reduced with advanced age (Table 2 and 3). However, mortality was not recorded after sixteen weeks (Table 3). This might be due to resistance development to disease with advanced age. The mortality rates recorded during brooder (Table 2) and grower (Table 3) stages were relatively lower than the mortality rates reported during brooder (8.1%) and grower periods (6.5%), respectively, for the same breed (Solomon, 2004). A higher mortality rate (7.1%) was also reported by Kebede *et al.* (2014) for the breed under intensive management condition. Very high mortality rates for White Leghorn brooders (48.8%), growers (48.5%) and layers (21.3%) were reported for the breed under extensive management conditions in northern Ethiopia (Abraham and Yayneshet, 2010). Moreover, Barua *et al.* (1992) reported higher average mortality rate (15%) for the White Leghorn in Bangladesh from the age of hatching to 23 weeks. The variation in mortality rate of the same breed as compared to previous studies at different study sites or in different countries could be due to the variation in study agro-ecologies and health management on the farm such as disease-prevention management techniques and hygienic practices at the farm level. The risk of disease introduction and the related economic impact due to mortality was minimized by strict application of disease-prevention management techniques and hygienic practices at the farm level (Marangon and Busani, 2006). The fluctuation of chicken's body temperature is somewhat depending upon the temperature of its environment or study agro-ecologies and the effect of stress caused by elevated temperatures can result in heavy economic losses from increased mortality and reduced productivity (St-Pierre *et al.,* 2003). Furthermore, the cold weather in poultry house and at any study location may lead to poor feed conversion ratio and to health problems (Talha *et al.,* 2011).

4. Conclusion

The results of this study have demonstrated that the mean hatchability, day-old body weight, age at sexual maturity, weight at sexual maturity, hen-day egg production and egg weight of the study breed were 70.32 ± 4.08%, 33.48 ± 0.84g, 154 days, 880.04 g, 70.35±3.22% and 53.47±2.39g, respectively. The body weight and feed intake were increased progressively during the brooder, grower and layer age groups whereas higher weight gain was achieved during grower ages. However, the highest feed conversion ratio was observed for the layer stage. The mortality rates during brooder and grower stage were 4.23±1.72 and 1.17±0.96, respectively. In general, compared to the performances of White Leghorn chickens researched by other researchers in other places, study sites, the White Leghorn chickens in this study area performed less in most variables investigated. Therefore, control mating design by establishing sire and dam lines and then recurrent selection within breed on different set of traits should be applied to improve the productive and reproductive performance of the breed. This study was conducted from day-old to 50 weeks of age; therefore, similar studies should be conducted including the third cycle laying stage to evaluate the whole life productive and reproductive performance of the breed. Further studies should also be conducted on the breed to understand the specific cause of their lower performance and evaluate inbreeding coefficients of the population in the farm.

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