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# Comparative growth performance of exotic chickens under intensive management conditions in Southwest Ethiopia

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*ABSTRACT: In Ethiopia, the expansion of commercial poultry production is limited by inadequate supply of high performing breeds of chicken. This situation warrants the identification, introduction and evaluation of improved breeds of chicken that could adapt and perform under the current Ethiopian situation. One hundred fifty of each of Dominant Sussex, Lohman Brown and Novo Brown breed of day-old chicks obtained from Debre Zeit Research Station was placed at Jucavm brooder house on standard commercial starter's ration in completely randomized design with three replicates. At the end of the brooding period, each group was transferred to grower's house and switched to standard growers at an age of 8 weeks. Finally, all the data collected on performance of the experimental breeds of chickens were subjected to statistical analysis. The results obtained showed that the mean hatching weight of Novo Brown and Dominant Sussex were comparable and significantly higher than that of Lohman Brown (P<0.05). All the three breeds of chicken tested performed well in mean hatching weight, when rated against other exotic breeds introduced to Ethiopia in the past. The mean daily body weight gain recorded from Nova Brown and Dominant Sussex breeds of chicks during brooding period were comparable and significantly higher (P<0.05) than the mean daily body weight gain recorded from Lohman Brown. Mean live weight of 573g/h was attained by Nova Brown and Dominant Sussex chicks at an age of two months, the value of which was significantly (P<0.05) higher than that of Lohman Brown. Moreover, Novo Brown growers had significantly higher mean weekly body weight gain than the other two breeds (P < 0.05), followed by Dominant Sussex. All the three breeds tested, performed better during the brooding period than during the rearing period in terms of feed conversion ratio. Nova Brown breed of chicks consumed less feed and brought significantly higher mean daily body weight gain both during brooding and rearing periods (P<0.05) compared to the others, indicating that Nova Brown was superior to the other two breeds in feed conversion efficiency. Mortality from hatching to 2 months of age (8%) was higher for Dominant Sussex, compared to 1.3% of mortality recorded from each of the other two breeds. Death rate encountered during the rearing period followed similar tendency as that of brooding period. Percent mortality from 9 to 20 weeks of age (21%) was higher for Dominant Sussex than for the other two breeds (3-4%). Postmortem examination of dead birds failed to identify any particular disease condition, indicating that the relatively higher mortality recorded from Dominant Sussex could be attributed to susceptibility to stress and environmental factors. In summary, the results of this experiment indicated that the three breed of chicken have well performed (except the adaptive potential of Dominant Sussex chickens) under Jimma condition in most of the economically important production traits studied. However, comparative evaluation of the reproductive performance of the three breeds seems to be the future direction of research under objective condition of Jimma.*

**Key Words:** Growth performance; Breed; Exotic; Dominant Sussex d104; Lohman Brown; Novo Brown

## 1. INTRODUCTION

Poultry production has an important economic, social and cultural benefit and plays a significant role in the provision of animal protein and family income in the developing countries. The contribution of poultry to the total global animal protein production is assumed to reach about 40% by the year 2020, the major increase being in the developing world (Delgado *et al*., 2001). In sub Saharan Africa, 85% of the rural population keeps chicken as a source of affordable animal protein and household income (Aklilu *et al*., 2007). Poultry is also an employment opportunity for the youth, elders and women in the urban and peri-urban areas and Ethiopia is not exception to this situation. Recent estimates put the Ethiopian poultry population at about 60million out of which 90.85, 4.76, and 4.39% is reported to be indigenous, hybrid and exotic chickens respectively (CSA, 2016/17). The poultry sub-sector in Ethiopia could be characterized into three major production systems

based on some selected parameters such as breed, flock size, management practices, technological input and level of bio-security exercised (Bush, 2006). The three production systems are backyard (traditional) poultry production, small-scale modern poultry and large scale commercial poultry. Each of these production systems sustainably coexist and contribute to the socio-economic status of different target societies (Tadelle *et al*., 2003c). The backyard (traditional) poultry production system is entirely dominated by indigenous chickens and characterized by low input - output and periodic devastation of the flocks due to disease outbreaks (Tadelle *et al*., 2003b). The indigenous chickens are low in productivity owing to their low egg production performance, slow growth rate, late sexual maturity, pronounced broodiness and high chick mortality. Poor management practice and veterinary services also contribute to the low productivity of the indigenous chickens. It has been seen that improvement of basic husbandry practice and health care improve the performance of indigenous chicken, but not to an economically acceptable level (Teketel, 1986; Abebe, 1992).

Local chickens are considered to be disease resistant and adapted to their scavenging environmental conditions. However, local chickens kept under the intensive system of management (in confinement) are inferior to exotic stock in health status and characterized by a lack of interest in their environment, wing droppings, huddling at the corner, leg weakness and cannibalism. They are also slow in rate of feathering and exhibit recurrent outbreaks of disease (Demeke, 2004). The percentage mortality from hatching to maturity was significantly higher for local chickens kept under an intensive management system (24%) compared to the Leghorns (7.3%) kept under similar condition. Higher mortalities and morbidities have been reported among local birds than White Leghorns when raised under intensive management conditions in Awassa (Teketel Forsido, 1986) and Debre Zeit (Abebe Hailu, 1987). In Ethiopia, the importation of exotic breeds of chicken goes back to the early 1950s (Solomon, 2008). About 99% of the Ethiopian poultry population consists of indigenous chickens, while the remaining 1% consists of imported exotic breeds of chickens during the 1970s and 1980s (Alamargot, 1987). There has been an increase in the number of exotic breeds of chickens and at present it is estimated that these make up about 4.39% of the national poultry population CSA, 2016/17). But, the contribution of exotic poultry to the Ethiopian economy is significantly lower than that of other African countries and all the available evidence indicates that all the imported breeds of chickens performed well under the intensive management system (Yami and Dessie, 1997). In addition, with an annual human population growth rate of 2.4%, the present above 80 million Ethiopia's human population will increase to about 149.3 million by the year 2040 (FAO, 2005). Thus, the demand for animal products is expected to increase substantially.

Therefore, to meet the ever-increasing demand for meat and eggs, increase the contribution of exotic chicken to Ethiopian economy and expansion of commercial poultry production introduction of superior/exotic breed has been proposed as one of the plausible option. As a result, currently the Ethiopian Institute of Agricultural Research introduced Lohman Brown, Novo Brown and Dominant Sussex d104 Final hybrid layers. The Lohman Brown is egg type breed of hybrid origin, selectively bred from New Hampshire's and other brown egg laying breeds of chickens (Felt well, 2011). They start lying at an age of 18 weeks and reported to lay up to 300 brown eggs per year. Novo Brown starts lying at an age of about 20 - 24 weeks. Under commercial conditions, productivity of Novo Brown is reported to be around 330 eggs per year. Dominant Sussex D 104 is a result of crossing paternal Sussex stock with slow feathering maternal stock and an attractively colored layer for small scale and free-range production conditions. This bird is adapted for sub-optimal and harsh production conditions of free-range system and small scale farming. This being the case, the major objectives of this research project was on-station evaluation of Dominant Sussex d104, Lohman Brown and Novo Brown Final hybrid chickens in Jimma with the following specific objectives:

- Comparative on-station evaluation of the survival rates of Dominant Sussex d104, Lohman Brown and Novo Brown Final hybrid chicken in Jimma.
- Comparative on-station evaluation of the growth performance of Dominant Sussex d104, Lohman Brown and Novo Brown Final hybrid chicks in Jimma.

## 2. MATERIAL AND METHODS

### 2.1. Description of the Experimental Site

This experiment was conducted at Jimma University College of Agriculture and Veterinary Medicine (JUCAVM), located at 357 km Southwest of Addis Ababa and at about $7^0$ 33' N latitude and $36^0$ 57' E longitudes. The altitude of JUCAVM is 1700 meters above sea level. The mean maximum and minimum temperature of the study area is $26.8^0$C and $11.4^0$C, respectively and the mean maximum and minimum relative humidity is 91.4% and 39.92% respectively. The mean annual rainfall of the area is 1500mm (BPEDORS, 2000).

### 2.2. Management of Experimental Chicks

A total of 500 unsexed day-old chicks of the three breeds were brought from Debre zeit Research Center and housed at JUCAVM brooder house. One hundred fifty chicks of each of Dominant Sussex d104, Lohman Brown and Novo Brown

breeds were randomly selected from the total of 500 in each case. The selected chicks of each breed were placed in separate pens and placed on standard commercial starters ration for 7 days. At the end of the 7 days, each group (breed) of 150 chicks was further sub-divided into three groups, each with 50 chicks of equal mean group weight (total of 9 groups each with 50 chicks). Finally, each group of 50 experimental chicks was randomly assigned to the experimental pens in completely randomized design with 3 replicates (as shown in Table1). Each pen was equipped with all the required chick brooding facilities and had an area of $6m^2$ (3m x 2m) concrete floor adequately covered with litter materials.

All the groups of the experimental chicks were placed on commercial standard starters ration purchased from Debre Zeit for the study period of 8 weeks. At the end of the 8 weeks of brooding period, the males and females were separated and both the female and male groups were transferred to individual grower's house, equipped with all the necessary facilities and switched off to commercial standard growers ration for study period 9-20 weeks.

Table 1. Treatment allocation of chicken

| Treatment | Replication | No. Chicks/Replication | No. Chicks/Treatment |
|---|---|---|---|
| Lohman Brown | 3 | 50 | 150 |
| Novo Brown | 3 | 50 | 150 |
| Dominant Sussex | 3 | 50 | 150 |
| Total | 9 | 150 | 450 |

Table 2. Vaccines provided to experimental chicken

| Ages | Vaccines given for | Directions |
|---|---|---|
| Day old | Maker's disease | Injected under the skin on the back of the neck |
| 2 week old | Newcastle | Eye drop |
| 3 week old | Antibiotics | With drink water |
| 4 week old | Gumboro | Eye drop |
| 7 week old | Antibiotic | With drink water |
| 9 Week old | Antibiotic | With drink water |



**2.3. Performance Data Collection**

The parameters used in differentiating the production performance of the three experimental breeds included mean hatching weight, final body weight, body weight gain, feed consumption, feed conversion ratio and survival rate. Feed intake was measured by subtracting the amount of refused from the amount offered on DM basis. Body weight was taken on weekly basis. The mean dry matter conversion ratio was measured as the amount of feed consumed per unit body weight gain as shown below.

$$FCR = \frac{\text{Daily feed consumed (g)}}{\text{Daily body weight gain (g)}}$$

**2.4. Statistical Analysis**

The data collected were analyzed using the procedures suggested by Gomez and Gomez (1984) using SPSS (Statistical Package for Social Science) software version 20. When the analysis of variance indicates the existence of significant difference among the treatment means at 5% level of significance for the quantitative data, Turkey's Honestly Significant Difference (HSD) test was employed to test and locate the treatment means that are significantly differed from the rest. The following model suggested Montgomery, (2001) was used.

$Yij = \mu + Ti + eij$, Where,

Yij = is the overall observation $\mu$ = population mean, Ti = effect of the ith breed (i=1, 2, 3), Eij = Random error

## 3. RESULTS AND DISCUSSION

### 3.1. Brooding Performance

#### 3.1.1. Hatching weight

The growth performance of Novo Brown, Lohman Brown and Dominant Sussex final hybrid chicks during brooding phase are presented in Table 3. The mean hatching weight (35g/h) of Lohman Brown breed of chicks was significantly lower ($P<0.05$) than the mean hatching weight of Novo Brown and Dominant Sussex (Table 3), could be attributed to genetic built up of the birds. The result of the current study showed that there was no statistically significant difference ($P>0.05$) between Novo Brown and Dominant Sussex in mean hatching weight even if Novo Brown tended to be better than Dominant Sussex. The better mean hatching weight recorded from Novo Brown could probably be due to larger egg weight and size than the others. Wilson (2000) confirmed that that egg weight affects chick weight and hatching chick weight composes of 62-78 % of egg weight, and the correlation between egg weight and chick weight decreases as the parent's age increases. Farooq (2001) also reported positive correlation ($r=0.4962$) between egg weight and hatching chick weight from an experiment conducted with RIR, Desi and Fayumi chickens in Pakistan. Abiola *et al.* (2008) suggested that chicks with higher mean hatching weight had the highest growth rates starting early age to an age of 20 weeks. Following the same trend, chicks with light hatching body weight had the lowest growth rates. Mean hatching weight of 35.2g/h, the value of which is similar to the mean hatching weight of Lohman Brown breed of chicken recorded in this study was reported from RIR breed of chicken kept under intensive management system in North West Ethiopia (Hassen *et al*., 2006).

Comparatively lower hatching weight of 31.30 and 28.08 g/h was reported from RIR kept under intensive management system in Pakistan as reported by Khawaja *et al*. (2012) respectively. Farooq *et* al. (2001) also reported lower mean body weight of Fayoumi day old chicks kept under subtropical conditions. Mostageer *et al*. (1975) observed that lower live weight at hatching averaged 28.5 g for the Fayoumi and 34.5 g for the RIR, without showing any significant difference between the males and females on hatching. Mean body weight of 30.12, 23.71 and 28.54g/h was recorded from day old chicks of RIR, local Tanzanian chickens and crossbred of RIR and Tanzanian by Malago and Baitilwake (2009) respectively, indicating that the mean hatching weight obtained in this study was higher than most of the values reported.

The result of the current study showed that all the three breeds of chicken studied (Nova Brown, Dominant Sussex and Lohman Brown) were superior to RIR, breed of chicks that had been used in the Ethiopian national poultry extension system over the last 30 years in mean hatching weight.

#### 3.1. 2. Feed consumption

Lohman Brown breed of chicks had significantly ($p<0.05$) higher mean daily feed intake (34g/d/h) than the Novo Brown (29g/h/d) and Dominant Sussex (30g/h/d) breeds of chicks. The results obtained showed that there was no significant difference ($P<0.05$) between the latter two breeds of chicks in mean daily feed consumption during the brooding period (Table 3). The mean daily feed consumption obtained in this study from Lohman Brown breed of chicks was similar to that of Demeke (2004), who reported mean daily feed intake of 34g/h/d from White Leghorn chicks kept under intensive production system in Jimma. The total feed intake of Lohman Brown (1919g/h) over the entire brooding period was also significantly higher than that of Novo Brown (1654g/h) and Dominant Sussex (1698g/h). Generally, a total of 1.44, 1.48 and 1.75 kg of feed were required to attained mean body weight of 500g/h by Novo Brown, Dominant Sussex and Lohman Brown breeds of chicks respectively indicating that Novo Brown breed of chicks tended to be efficient in rate of growth as compared to the other two.

#### 3.1.3. Feed conversion ratio

Feed Conversion Ratio (FCR), expressed as grams of feed consumed per unit of body weight gain was 3.46, 3.50 and 3.84 for Novo Brown, Dominant Sussex and Lohman Brown respectively. Lohman Brown had significantly ($p<0.05$) higher mean FCR (3.84) and consumed more feed per unit of body weight gain as compared to the other two breeds of chicks during brooding period. Lohman Brown required 10.9 and 9.7% more feed to promote a gram of body weight gain as compared to Nova Brown and Dominant Sussex breed of chicks respectively. The results obtained from the current study showed that there was no significant difference ($P>0.05$) between Nova Brown and Dominant Sussex breeds of chicks in feed conversion ratio. However, Nova Brown breed tended to produce at cheaper rate when feed cost is considered as the major cost of production, since feed conversion ratio is a measure of an animal's efficiency in converting feed into the desired output. Feed Conversion Ratio of 9.5 was reported from RIR kept under intensive management system in North West Ethiopia (Hassen *et al*., 2006), while FCR of 4.64 and 4.72 were reported for RIR kept under intensive management system in Pakistan as reported by Khawaja, *et al*. (2012) respectively. Demeke (2004) reported FCR of 5.8 from White Leghorn chicks kept under intensive

production system in Jimma. Difference in FCR values could also be attributed to different in feed composition, moisture content, environmental conditions and management.

**3.1.4. Rate of chick growth**

Mean body weight of 573, 574 and 547 g/h was attained by Nova Brown, Dominant Sussex and Lohman Brown breed of chicks respectively at an age of two months (Table 3). The mean body weight attained by Lohman Brown breed of chicks was significantly lower (P>0.05) than that of Novo Brown and Dominant Sussex breeds of chicks. On the other side, there was no statistically significant different (P>0.05) between the Nova Brown and Dominant Sussex in rate of chick growth. The variation between the three breeds in the mean body weight attained at an age of 2 months could possibly be attributed to the difference in mean hatching weight. The highest final body weight attained by the Dominant Sussex breeds also might be due to high feed consumption. Similarly, body weights of selected breeds of chickens are associated with feed intake (McCarthy and Siegel, 1983). The comparatively higher feed consumption attained might in turn resulted in more intakes of energy and protein, which eventually results in building up of muscle.

Unlike Dominant Sussex, Novo Brown consumed less feed but was found to be comparable to Dominant Sussex breed of chicks in Rate of growth. This result tends to indicate that Novo Brown breed of chicks were highly efficient in converting feed into muscle. In a country like Ethiopia, where the gap between feed supply and animal production seems to be growing ever wider, breeds of chicks with high feed conversion efficiency is appealing. The result of this study indicated that the mean body weight attained by all the three breeds of chicks at an age of 8 weeks were higher than the mean body weight attained by White Leghorn breed of chicks (350g/h)at an age of eight weeks when kept under intensive management in Jimma (Demeke, 2004). Mean daily body weight gain of 9.54 and 9.56g/h was recorded from Novo Brown and Dominant Sussex breeds of chicks, both of which were significantly higher (P<0.05) than the mean daily body weight gain (9.14g/h) recorded from Lohman Brown breed of chicks. There was no statistically significant difference between the former two (P>0.05) in mean daily body weight gain. Mean daily body weight gain of 8.8 g/h was recorded from RIR kept under intensive management in North West Ethiopia (Hassen *et al*., 2006), the value of which is lower than the mean daily body weight gain recorded from the current study. Moreover, mean daily body weight gain of 5.2g/h was recorded from White Leghorn breed of chicks kept under intensive management in Jimma (Demeke, 2004). The results of this study indicated that the mean daily body weight of all the three breeds studied (Novo Brown, Dominant Sussex and Lohman Brown) were higher than the mean daily body weight gain of RIR and White Leghorn breeds of chicks during the brooding period of 2 months.

There was significant difference between the three breeds in total body weight gain brought over the brooding period (P<0.05). The body weight gain brought by both Novo Brown and Dominant Sussex (534 and 535g/h) were significantly higher than that of Lohman Brown (511g/h) (P < 0.05). Dominant Sussex tended to be higher in final body weight than the others, probably attributed to better feed consumption. According to the result of this study the total body weight gain brought over the brooding period were higher than that of Khawaja *et al*., (2012), who reported total body weight gain of 491g/h from crossbred chicks of FIRI (Fayoumi male with RIR female) and 462g/h from RIFI (Fayoumi female and RIR male) at an age of 8 weeks in Pakistan and then that of El-Maghraby *et al*. (1975), who reported total body weight of 316g/h from FIRI and 299 g for RIFI. The difference in efficiency of growth performance of young chicken is may be due to interaction of multiply genes that could be improved through genetic selection (Chambers, 1990).

Table. Comparative growth performance of the experimental chicks during brooding

| Parameter | Nova Brown (Mean ± SE) | Dominant Sussex (Mean ± SE) | Lohman Brown (Mean ± SE) | Sig. |
|---|---|---|---|---|
| Hatching body weight (g/h) | $39.1^{a}$±01 | $38.4^{a}$±002 | $35.2^{b}$±001 | .003 |
| Final body weight (g/h) | $573.3^{a}$±5.6 | $574^{a}$±7.0 | $547.16^{b}$±12.2 | .028 |
| Weekly body weight gain ( g/h ) | $66.78^{a}$±0.71 | $66.95^{a}$±0.87 | $63.99^{b}$±1.53 | |
| Daily body weight gain(g/h) | $9.54^{a}$±0.1 | $9.56^{a}$ ±0.21 | $9.14^{b}$±0.12 | .000 |
| Daily feed intake (g/h) | $29.55^{b}$±0.99 | $30.33^{b}$±0.64 | $34.27^{a}$±1.1 | .034 |
| Feed conversion ratio(g feed/ g gain) | $3.09^{b}$±0.15 | $3.17^{b}$±0.10 | $3.74^{a}$ ±0.61 | .010 |
| Total weight gain during brooding(g/h) | $534.2^{a}$±5.6 | $535.6^{a}$±13.7 | $511.9^{b}$±12 | .028 |
| Total feed intake during brooding (g/h) | $1654.8^{b}$±55.4 | $1698.9^{b}$±130 | $1919.1^{a}$±62 | .002 |
| Mortality during brooding (%) | 1.3±0.01 | 8±0.1 | 1.3±0.03 | |

a, b, Means with different superscripts in a row are significantly different at P < 0.05

**3.1.5. Rate of survival**

The results of the rate of survival of the experimental chicks during the brooding period are shown in table 3 Mortality from hatching to 8 weeks of age was lower for Lohman Brown and Novo Brown than for Dominant Sussex, indicating that Lohman Brown and Novo Brown had better survival rate during brooding period as compared to the other breed of chicks. Mean total chick mortality to an age of 8 weeks of 5-6 and 5-10% were reported from modern commercial poultry farms and government owned breeding and multiplication poultry centers in Ethiopia (CACC 2003 as cited by Solomon 2008). Mean total mortality to an age of 8 weeks of 1.3% was recorded from Novo Brown and Lohman Brown and 8% from Dominant Sussex in the current study, the value of which lies within the mortality range reported from exotic chicks placed under the management capacity of the government owned breeding and multiplication centers (Table 3). The survival rate of all the three exotic breeds of chicks tested in the current experiment were found to be better than RIR breed of chicks tested under intensive management system in Ethiopia, Pakistan and Bangladesh. Mean mortality of 18.9, 20 and 12.5% was reported from RIR chicks kept under intensive brooding management system in North West Ethiopia, Pakistan and Bangladesh respectively (Hassen *et al*., 2006; Khawaja *et al*., 2012). Percent mortality and/or survival rate are important indicator of adaptability of exotic chicken to tropical local objective condition (LayWel, 2006). Mortality rate recorded from Dominant Sussex at an age of 8 weeks was similar to the mortality rate obtained from White Leghorn (8.1%) kept under intensive brooding management in Jimma at an age of 8 weeks (Demeke, 2004). On the contrary the survival rate of all the three breeds tested (1.3-8%) were better than that of Potchefstroom Koekoek breeds kept on farm management condition in Mana district southwestern Ethiopia, Southern Ethiopia and Areka in Southern Ethiopia, (Kasa Biratu and Saba Haile, 2016 and Aman *et al*., 2016).

Isa Brown and the Egyptian Fayoumi breeds of chickens were also introduced to different parts of Ethiopia with the expectation of fairly good level of adaptability to local on farm condition. Meseret (2010) reported 41% mortality from Isa Brown chicks kept under farmer's condition in Gomma district. Total mortality of 54.85% was recorded from Fayoumi breed placed under farmer's management condition at Arsi-Negele district (Samson *et al*., 2013). The *post mortem* examinations performed failed to identify the cause of such a high rate of mortality. It was suggested that confinement of the chicken's results in high stress levels may cause high morbidity and mortality.

**3.2. Growing Performance during Rearing**

**3.2.1. Growing performance of pullets**

***3.2.1.1. Feed intake***

The production performances of the experimental chickens during growing period (9-20 weeks) are shown in Table 4. The mean daily feed intake of the Lohman Brown pullets (71g/h/d) was significantly higher than that of Novo Brown and Dominant Sussex (67-69g/h/d) pullets ($P<0.05$). There was no statistically significant difference between Novo Brown and Dominant Sussex ($P>0.05$) pullets in mean daily feed consumption. The results obtained tend to indicate that the mean daily feed intake of Lohman Brown pullets (71g/h) was better than that of the other two breeds (67-69g/h/d). The observed variation in mean feed consumption could only be explained by genetic variation of the chickens. Lohman Brown pullets had significantly higher total feed intake during the growing period (9-20 weeks) than the other two breeds ($P < 0.05$), followed by Dominant Sussex indicating that the total feed consumption of Novo Brown pullets was the lowest of all.

A total of 7.2, 6.7 and 6.5 Kg of feed/head were consumed by Lohman Brown, Dominant Sussex and Novo Brown respectively to an age of 20 weeks. The mean feed intake of the lohman breeds at 20 weeks was approximate to the recommended value in their relevant Management Guide, which is about 7 kg/h at 20 weeks of age (Lohman Brown, 2000). In contrast to this result, mean daily feed intake of 83g/h was reported for Rhode Island Red (RIR) pullets kept under intensive management in North West Ethiopia, indicating total feed intake of 12.8 kg/head to an age of 20 weeks (Hassen *et al*., 2006), the value of which are higher than that obtained from the current study. On the other side, total feed intake of 7.62 and 7.1 Kg/head to an age of 20 weeks was reported for RIR pullet kept under intensive management in Pakistan and Bangladesh respectively (Khawaja *et al*., 2012), the values of which seems comparable to that of Lohman Brown obtained in the current study.

***3.2.1.2 Feed conversion ratio***

The feed conversion ratios of the experimental pullets are shown in Table 4. There was significant difference between the three breeds in feed conversion ratio (Table 4). Lohman Brown pullets (7.14) had significantly higher FCR value than the Novo Brown pullets (6.4) ($P < 0.05$). Lohman Brown tended to have higher FCR than the Dominant Sussex (6.8). The results obtained showed that Novo Brown breed of chickens have a better genetic make-up, which makes them very efficient in converting the relatively small feed they consumed into relatively more muscle than the other two breeds (Dominant Sussex and Lohman Brown), followed by Dominant Sussex breeds come second next to the Novo Brown breeds for their feed conversion efficiency ratio. Under the conditions of this experiment, the Lohman breed chickens are not the favored breeds in terms of their genetic make up for they consume more feed per unit gain of body muscle. Haque *et al.* (1999) reported feed

conversion ratio 5.7 for Fayoumi in a group of 3 male and 20 females at an age of 17 weeks, the value of which is lower than that of the present study.

Haque *et al.* (1999) also reported that the indigenous naked neck (D. Nana) X RIR showed the better feed conversion efficiency (5.10) compared to the pure exotic breed of Fayoumi (6.20) and WLH (5.40). Crosses of D. Nana × WLH and D. Nana × Fayoumi had feed conversion ratio of 5.20and 10.25, respectively at an age of 16–17 weeks. The results of the present experiment showed that Novo Brown and Dominant Sussex are found to be the best performer in terms of FCR (6.65 and 7.15, respectively) at an age of 20 weeks, compared to that of Lohman Pullets. Novo Brown pullets consumed significantly lower feed in contrast to the other two breeds, but attained significantly higher body weight, which could be explanation in terms of the genetic make of the birds. The same holds true for the Dominant Sussex in comparison to that of Lohman Brown.

***3.2.1.3 Body weight gain***

The result of the body weight gain of the experimental pullets is shown in Table 4. There was significant different between the experimental pullets in mean daily body weight gain ($P<0.05$). The mean daily body weight gain of Novo Brown (10.46g/h/d) was significantly higher than that of the other two followed by Dominant Sussex (10.13g/h/d) and Lohman Brown (9.93g/h/d) respectively. The mean weekly body weight gain, mean total body weight gain during growing period and mean body weight attained at an age of 20 weeks showed the same trend to that of mean daily body weight gain (Table 4). Live body weight of 1.4, 1.3 and 1.2 Kg/head was attained by Novo Brown, Dominant Sussex and Lohman Brown pullets respectively, all the values of which are significantly different from each other ($P<0.05$). Thus Novo Brown pullets had significantly better growth performance followed by Dominant Sussex and Lohman Brown respectively ($P<0.05$). According to Hassen *et al.* (2006) reported that the final body weight attained at an age of 20 weeks and total body weight gain during the growing period was 1394 and 1359 g for RIR pullets respectively.

The result obtained from Novo Brown in the current study, are comparable (131333 respectively) to that of RIR pullets final body weight at an age of 20 weeks and total body weight. The relatively poor growth rate obtained from Lohman Brown pullets could be attributed to genetic makeup of the breed, particularly to the lower mean hatching weight and poor performances during brooding. This result of Lohman Brown is similar to that of Horst (1988), who reported 1170 g body weight of Fayoumi pullet at an age of 20 weeks. On the contrary,Mostageer *et al*. (1975) reported mean body weight of 734 and 945g for Fayoumi and White Leghorn pullets at an age of 16 weeks respectively. According to*Kicka et al*. (1977), Fayoumi, RIR and Fayoumi × RIR reached body weight of 1170, 1250, 1290 g at egg first laying in the tropics respectively.

***3.2.1.4 Sexual Maturity***

Age at first egg was 137 for Lohman Brown and 140 days for both Novo Brown and Dominant Sussex indicating that Lohman Brown started egg laying earlier than the other two breeds. Age at sexual maturity is generally determined by the age when first egg is laid, which is considered as one of the important factors in determining the overall profitability of the flocks. These observed differences in age at first egg of three breed under the present study could be due to genotype, which is in agreement with the reports of Demeke (2004); and Lemlem and Tesfaye (2010). Kumar *et al*. (2014) reported relatively late (154 and 139 days) sexual maturity for RIR and Bovans White kept under intensive management system in Mekelle respectively as measured by age at

Table . Comparative growth performance of experimental pullets during growing period

| Parameter | Nova Brown (Mean ± SE) | Lohman Brown (Mean ± SE) | Dominant Sussex (Mean ± SE) | Sig. |
|---|---|---|---|---|
| Daily feed intake (g/h) | $67.0^{b}$±1.27 | $71.1^{a}$±0.62 | $69^{b}$±1.02 | .001 |
| Total feed intake(g/h) | $4888^{b}$±160.8 | $5288^{a}$±40.9 | $5039^{a}$±26.6 | .008 |
| Weekly body weight gain ( g/h ) | $73.27^{a}$±0.25 | $69.5^{c}$±0.39 | $70.9^{b}$±0.42 | .002 |
| Daily body weight gain(g/h) | $10.46^{a}$±0.03 | $9.93^{b}$±0.55 | $10.13^{a}$±0.06 | .007 |
| Age at first laying(days) | $140^{a}$±0.01 | $137^{a}$±0.03 | $140^{a}$±0.02 | .035 |
| Feed conversion ratio(g feed/ g gain) | $6.4^{b}$±0.22 | $7.16^{a}$±0.54 | $6.8^{ab}$±0.15 | .001 |
| Total weight gain (g/h) | $1333^{a}$±9.1 | $1113^{c}$±29.5 | $1235^{b}$±23.3 | . |
| Weight at first laying (g/h) | $1373^{a}$±9.1 | $1148^{c}$±29.5 | $1274^{b}$±23.3 | .000 |
| Mortality during rearing (%) | 3.5±0.03 | 5±0.01 | 21±0.03 | |

a, b, c: Means with different superscripts in a row are significantly different at $P < 0.05$.

first egg. Mean sexual maturity of 149 and 147days was reported for RIR pullets kept under intensive management system in Ethiopia and Pakistan respectively (Hassen, 2006 and Khawaja *et al*., 2012).Demeke (2004) noted that sexual maturity of White Leghorn kept under intensive and extensive management systems ranged between 149 and 169 days, while that of Fayoumi crosses kept under intensive management ranged between 147 and 151 days (Rahman *et al*., 2004). Age of Sexual maturity has long been considered an important fecundity and hereditary trait. The primary studies for this trait decided that it is one of the easiest characters to establish in a flock through selective breeding, especially if attention is given to selection. Pullet starting to lay at an earlier age is smaller than that of late sexual maturity (Hutt, 1949).This implies that age at first egg is correlated with body weight according to breeds, the smaller the body weight the earlier the age at sexual maturity which is similar to the current study in the case of Lohman brown chicks.

***3.2.1.5. Survival Rate***

Mortality during the growing period (9-20 weeks) was lower for Nova brown followed by Lohman Brown. Higher mortality of 21% was recorded from Dominant Sussex. In this study, the mortality occurred during the brooding period was lower than that occurred during the growing period in all the three breeds studied; thus further improvement in managerial practices is necessary to reduce the mortality among the chicks regarding the fact that no particular infectious disease was reported during the experimental period from repeated diagnosis of dead birds. The high mortality (21%) recorded from Dominant Sussex might be caused by genetic and environmental factors, like stress, against which no genetic barrier can guard. Viability is a composite characteristic concerning the question of the adaptive value of the organism. Furthermore, it relates to all physiological steps leading from genotype to the resultant phenotype. The mortality rate reported from Novo brown and Lohman Brown (3.5-5%) in the current study are lower than 18.3% in RIR reported by Hassen *et al*. (2006). However, mortality rate of dominant Sussex (21%) recorded in the current study was higher than that of 18.3% reported from RIR. The mortality figures obtained from Dominant Sussex was also higher than that
of Demeke (2004) who reported 5 and 7% mortality for local and White Leghorn pullets kept under scavenging
and intensive systems, respectively. Tadelle *et al*. (2003a) found up to 49% mortality in village chickens in Ethiopia. Grobbelaar *et al*.(2010) also reported up to 22.2% mortality for Potchefstroom Koekoek kept under controlled environment. The major causes of death of the birds were reported to be genetic susceptibility, stress and nutritional stress (Chitate and Guta 2001). Management generally contributes up to 6% losses in chickens (Alfred *et al*., 2012).

## 4. CONCLUSION AND RECOMMENDATION

In Ethiopia, poultry development initiatives placed special emphasis on the introduction of exotic breeds of chickens, aimed at promoting small scale exotic poultry production within the rural farming population and up-grading of the indigenous chickens by crossing with exotic males. Unfortunately, however, genetic limitation is one of the major bottle necks for the development of the sector and the expansion of the commercial poultry production is limited by inadequate supply of high performing chicken breeds locally. Research system is currently attempting to alleviate this problem by identifying, introducing and evaluating improved poultry breeds that can adapt and perform under Ethiopian situation. This experiment was carried out to study the on station growth performance of Lohman Brown, Novo Brown and Dominant Sussex breeds of exotic chicken under the objective condition of Jimma. Novo Brown breed was characterized by better growth performance, feed conversion efficiency and weight at sexual maturity. Dominant Sussex chicks were also performed better in growth performance and weight at sexual maturity. But, it was performed poor in rate of survival than both Lohman Brown and Nova Brown chicks. Lohman Brown was characterized by relatively early maturity. Generally, all breeds have performed better performance under Jimma condition except the adaptive potential of Dominant Sussex chicks. The following recommendations were suggested based on the results of the current study.

- Novo Brown and Lohman Brown along with other basic input setup could be included into technical poultry extension packages.
- Further on station evaluation of egg production potential of the three breeds of chickens in different areas should be done.
- Experimental study aimed at improving adaptive potential of Dominant Sussex D104 breeds in the Jimma zone seems to be urgently needed.

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