RESEARCH ARTICLE

Egg production performance of three strains of laying hens kept in floor pens

Mebratu Yigzaw[1*], Solomon Demeke[2], Wasihun Hassen[2]

Yigzaw M, Demeke S, Hassen W. Egg production performance of three strains of laying hens kept in floor pens. AGBIR.2024;40(3):1100-1103.

Genetic limitation is one of the major bottlenecks for the development of the poultry production and the expansion of the commercial poultry production is limited by inadequate supply of high performing chicken breeds in Ethiopia. Research system is currently focused to solve this gap by introducing the best productive breeds that can adapt and perform in Ethiopia. This experimental trial was done out to study the evaluation of egg production performance of lohman brown, novo brown and dominant Sussex final hybrid layers under the objective condition of Jimma. One hundred fifty of each of breed of layers obtained from Debre Zeit research center and was placed at Jimma university poultry farm on standard commercial layer's ration in completely randomized design with three replicates. Finally, all the data collected on performance of the experimental breeds of chickens were subjected to statistical analysis. There was no significant difference ($P<0.05$) between the three breeds tested in age at the first egg, even if Lohman Brown tended to lay comparatively earlier (137 days). The hen day egg production rate and egg weight of dominant Sussex was better than other two breeds. 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 egg quality and reproductive performance of the three breeds seems to be the future direction of research under objective condition of Jimma.

Keywords: Egg production; Breed; Exotic; Survival; Diseases

INTRODUCTION

Ethiopian chickens estimated to be about 56.53 million of which 94.3%, chicken population is indigenous breed [1]. Even if the indigenous chickens are better to adapt the harsh environment, they are tolerant to diseases and are good brooders, but they are poor in their reproductive and productive performance. Therefore, in order to improve the performance of the local chickens, the exotic chickens were imported and were then crossed with local chickens to improve the genetic potential of indigenous breeds [2]. In Ethiopia, the introduction of exotic chicken goes back to the early 1950's. It has been reported that many exotic breeds of chicken (white and brown leghorns, Rhode Island Red, Bovans, New Hampshire, Cornish, austral up and light Sussex) were introduced over the past years. The most important inputs have been the introduction of improved (exotic) breed, improved feed, vaccine and medicament and credit aiming at increased productivity [3]. Currently, the exotic chicken figured around 4.39% of the national chicken population. However, their significance to Ethiopian economy is lower. Besides, according to food and agriculture organization of the United Nations Ethiopian population figure prediction report for 2040 with 2.4% of Ethiopian annual population growth rate, it reaches 149.3 million. In order 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 through introduction and evaluation of superior/exotic breed has been proposed as one of the promising option. As a result, currently the Ethiopian Institute of agricultural research introduced lohman brown, novo brown and dominant sussex d104 final hybrid layers. Therefore, the aim of this research project was evaluating the egg production performance of the three exotic layers under the objective conditions of Ethiopia.

MATERIALS AND METHODS

Experimental site

This experiment was conducted at Jimma university college of agriculture and veterinary medicine, located at 357 km Southwest of Addis Ababa and at about 7° 33' N latitude and 36° 57' E longitudes. The altitude is 1700 meters above sea level. The mean maximum and minimum temperature of the study area is 26.8°C and 11.4°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 1500 mm [4].

Layer treatment

One hundred fifty layers of each breed were used for the experimental trial. Each experimental breed were randomly placed in nine experimental separated pens each pen contain fifty layers of equal mean group weight with completely randomized design with three replication. Then, experimental layers were offered on standard commercial layer ration for seven days trial. Layer ration feed was given three times per day and were collected and weighed on the next morning at 2:00 pm. Enough and clean water was made given all the times. The experimental pens were cleaned and disinfected before the arrival of the chicken. Body weight measurement was taken every week. Mortality and disease conditions were recorded as occurred (Table 1).

TABLE 1
Treatment allocation in completely randomized design

Treatment	Replication	No. chickens/Replication	No. chickens/Treatment

[1]*Department of Agriculture, Climate and Food Science, Injibara University, Injibara, Ethiopia*

[2]*Department of Agriculture and Veterinary Medicine, Jimma University, Jimma, Ethiopia*

Correspondence: *Mebratu Yigzaw, Department of Agriculture, Climate and Food Science, Injibara University, Injibara, Ethiopia; E-mail: yemisuraj@yahoo.co.uk*

Received: *22-May-2023, Manuscript No. AGBIR-23-99535;* **Editor assigned:** *25-May-2023, PreQC No. AGBIR-23-99535 (PQ);* **Reviewed:** *09-June-2023, QC No. AGBIR-23-99535;* **Revised:** *21-Dec-2023, Manuscript No. AGBIR-23-99535 (R);* **Published:** *28-May-2024, DOI: 10.35248/0970-1907.24.40.1100-1103*

Lohman Brown	3	50	150
Novo Brown	3	50	150
Dominant Sussex	3	50	150
Total	9	150	450

Rate of egg production

The production traits used to differentiate the experimental breeds was including egg weight, egg mass and egg production rate per day. The egg was measured using sensitive balance by collecting eggs daily and weighted in group immediately after collection for each replication and average egg weight was computed by dividing the total egg weight to the total number of eggs. After mean weight has been determined, the following formula was employed to calculate the egg mass per pen on daily bases developed by North.

M=PXW

Where,

M=av. egg mass/hen/day

P=% hen-day egg production

W=av. egg weight in gram

Feed intake was measured by subtracting the amount refused from the amount offered on DM basis. Body weight was taken on weekly basis. The mean dry matter conversion ratio was determined as the ratio of gram egg mass from gram dry matter consumed [5].

FCR=Daily feed consumed (g)/daily egg mass (g)

Eggs were collected daily from each pen. The sum of the collections was recorded as egg production for that day. The number of birds alive per replicate on each day was also recorded. Rate of lay for each replicate was expressed as the average percentage hen-day egg production following the method developed by Hunton as follow:

% Hen-day egg production=Number of eggs collected per day/number of hens present on that day × 100

Statistical analysis

The data collected were analyzed using the procedures suggested by Gomez and Gomez 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, was used.

$Y_{ij}=\mu+T_i+e_{ij}$

Where,

Y_{ij}=Is the overall observation (Egg production, egg weight, feed intake, body weight....)

μ=Population mean

T_i=Effect of the i^{th} breed (i=1, 2, 3)

E_{ij}=Random error

RESULTS AND DISCUSSION

There was significant difference between the three breeds in mean egg weight (P<0.05). The mean egg weight of Novo Brown and Lohman Brown was 57.1 and 57.3 g respectively and Dominant Sussex had significantly larger (P<0.05) mean egg weight (59.4 g) than the others, which may arise from the breed difference. There was no significant difference between the eggs of Novo Brown and Lohman Brown in mean egg weight (P<0.05). The rate of egg production of the experimental chickens is shown in Table 2. Novo Brown and Dominant Sussex breeds had significantly higher (P<0.05) rate of egg production than Lohman Brown as measured by percent hen-day egg production, this difference could be attributed to their better genetic potential for higher egg production. Similarly, the egg production performance of Lohman Brown was lower than (80%) Lohman company recommendation under conditions of intensive-industrial farm type, in batteries, ensuring an optimized management [6]. The results obtained have shown a diminution by 14.5% in the productive level, because of the used technology which keeps the poultry movement and increase egg production, and also the feed shortage occurred (2-3 weeks) during this experiment. The low performance of the experimental layers of the current study was due to the occurred shortage of commercial layers ration for 2-3 weeks during the study, since egg production performance is linearly related to the levels of feed offered (Figure 1).

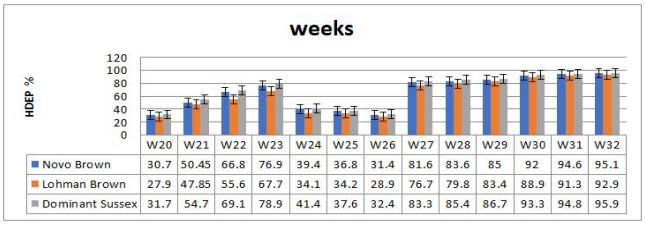

Figure 1: Peak hen day egg production performance of layers.

There was no significant difference (P>0.05) between the three breeds in body weight gain during laying period. Lohman Brown chickens had also significantly higher Feed conversion efficiency value (3.7) than the others. As shown in Table 2, there was significant difference between the three breeds in egg mass production (P<0.05). Dominant Sussex breeds had significantly higher egg mass production (40.5) than Lohman Brown breeds whose average egg mass production was 29.0 (P<0.05), which could be due to their higher egg number and egg weight recorded from Dominant Sussex layers. The egg mass production of Novo Brown breeds is intermediate between the Dominant Sussex and the Lohman Brown breeds, without showing significant difference with both (P<0.05). Dominant Sussex experimental layers tended to show higher mortality than the others.

TABLE 2

Egg production performance of the experimental layers

Parameter	Novo Brown (Mean ± SE)	Lohman Brown (Mean ± SE)	Dominant Sussex (Mean ± SE)	Sig.
Egg weight(g)	57.1^{b} ± 0.7	57.3^{b} ± 0.61	59.4^{a} ± 0.43	0.01
Egg mass (g/day/bird)	38.1^{ab} ± 0.91	35.9^{b} ± 0.35	40.5^{a} ± 0.52	0.013

Hen day egg production%	66.5^{a} ± 1.47	62.2^{b} ± 1.41	68.1^{a} ± 0.45	0.002
Body weight gain (g/h/day)	3.96^{a} ± 0.85	3.37^{a} ± 0.93	3.71^{a} ± 0.66	0.696
Feed intake (g/h)	112.4^{b} ± 0.8	133^{a} ± 4.56	119.3^{b} ± 4.88	0.026
Feed conversion efficiency (g feed: g egg mass)	2.93^{b} ± 0.14	3.7^{a} ± 0.27	2.93^{b} ± 0.18	0.013
Mortality	2.63^{b} ± 0.50	2.83^{b} ± 0.16	3.58^{a} ± 0.16	

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

Higher weight of egg from commercial breed is not a surprise since such breed submitted to important breeding pressure for egg weight improvement. Mean egg weight of 59 and 58 g was reported from Koekoek hens in northern Tigray and in South Africa, the values of which were comparable to the mean egg weight range (57-59.4 g) obtained from the current study. Singh et al. also reported mean egg weight of 59.4 and 57.9 g at an age 30 weeks from Lohman Brown and Lohman White strains using floor production system, respectively in Canada. According to Silversides and Scott, comparable mean egg weight 58.5 and 55.9 g was recorded from Isa Brown and Isa White respectively. Tadesse et al. reported mean egg weight of 48.8, 58.75 and 60.27 g for Koekoek, Isa Brown and Bovan Brown kept under village condition in East Shewa respectively. The average egg weight recorded for Isa Brown and Bovan Brown under village/ scavenging condition was 52.24 g, the value of which was lower than that obtained in the current study [7]. The difference in size may be due to different management, age of production, level of egg production and different agro-ecological conditions among different studies.

The egg production performance of lohman brown and lohman silver was reported to be 80% in Nigeria under intensive production system, the value of which was higher than that (63-68%) recorded from the current study [8]. Slightly lower Performance rate ranging between 57-64% was reported from *Potchefstroom Koekoek* kept under on station at Debrezeit agricultural research center (Debrezeit agricultural research center annual report). Mean daily egg production ranging between 0.63 and 0.68 eggs/hen chicken was recorded from the current study, the value of which was higher than that of Tadesse, who reported mean daily egg production of 0.51 eggs/hen was obtained from *Potchefstroom Koekoek* in East Showa Zone, Lume district under farmer's management condition as reported by Kasa Biratu and Saba Haile. Kasa Biratu and Saba Haile also reported higher Mean daily egg production of 0.76 and 0.73 egg/hen from Isa Brown and Bovan Brown kept in East Shewa Zone respectively. The results of the rate of egg production of the current study was higher to that of Grobbelaar, et al. who reported mean daily egg production of 0.54 egg/hen from Koekoek breed of chickens, but comparable than that reported by Gebreselassie, et al., who reported 0.66 eggs/day from Koekoek breed of chicken kept under farmer condition in Tigray. Likewise, egg production can be affected by breed, feed consumption (quality and quantity), water intake, intensity and duration of light received, parasite infestation, diseases, management and environmental factors [9].

Lohman Brown chickens consumed significantly higher feed (133.0 g/h/d) than the others (P<0.05), possibly because of genetic differences in physical activity/physical condition, basal metabolic rate and body temperature [10]. This is also higher from the Lohmann company recommendation (110 g/h/ d) under cage house production system, which may be due to difference in housing system. Relatively lower mean daily feed intake (93.8 g) and Feed conversion efficiency of 2.39 was reported by Singh et al. from Lohman White layers. Relatively higher feed conversion value of 6.8 and 8.7 was also recorded from Fayoumi and Desi kept under intensive production system in Pakistan, this might be attributed to the differences in genotype and environments used. Feed conversion efficiency of 5.02, the value of which is lower to that of all breeds in the current study was reported from Desi by Khawaja et al. The same author reported feed intake of 112 g/h/d from Desi values of which were similar to that recorded from Dominant Sussex and Novo Brown breeds of chickens in the current study. Higher feed intake (149 g/day/hen), but slightly lower feed conversion efficiency value (2.8-3) also reported from Lohman Brown and Lohman Silver under intensive management condition in Nigeria, Moting. Lower value of egg mass was recorded in Islamabad Pakistan from Rhode Island Red (23.3 g/day/bird), Desi (12.88) and Fayumi (15.6) hens kept under intensive production system. Comparable rate of mortality was reported by Singh et al., from Lohman Brown (1.67) and Lohman White (3.33). But, higher result of mortality (5-10%) during egg production was recorded from Lohman Brown and Lohman Silver in Nigeria, under on station production system, Moting.

CONCLUSION

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. 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 egg production 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 feed conversion efficiency and egg production. Dominant Sussex chicks were also performed better in rate of egg production, egg weight and egg mass measurement. 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. 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 on egg quality and reproductive performance of the three breeds of chickens in different areas should be done.

ACKNOWLEDGEMENTS

Authors gratefully acknowledge the support and kind commitment of data collectors.

AVAILABILITY OF DATA AND MATERIALS

The data used in this study are available from the corresponding author upon reasonable request.

DISCLOSURE STATEMENT

Authors declare no competing interest.

FUNDING

No funding was used for this study.

ETHICAL DECLARATION

This study involved a data sheet-based body weight measurement study of chickens. The study protocol was assessed and approved by Jimma university, college of agriculture and veterinary medicine research and extension office. Body weight measurement was carried out by animal

science expert adhering to the regulations and guidelines on animal husbandry and welfare.

REFERENCE

1. Gebreselassie G, Meseret R, Mulalem Z, et al. Comparative production performance evaluation of exotic and indigenous chickens under farmers management practice in Tigray, Northen Ethiopia. Sci J Biol Sci. 2015;4(12):181-186.
2. Grobbelaar JA, Sutherland B, Molalakgotla NM. Egg production potentials of certain indigenous chicken breeds from South Africa. Animal Genetic Resources/Resources genetiques animales/Recursos geneticos animales. 2010;46:25-32.
3. Hocking PM, Bain M, Channing CE, et al. Genetic variation for egg production, egg quality and bone strength in selected and traditional breeds of laying fowl. Br Poult Sci. 2003;44(3):365-373.
4. Biratu K, Haile S. Demonstration and Performance Evaluation of "*Potchefstroom Koekoek*" Chicken Package at Jimma Zone, South Western Ethiopia. J Biol Agric Health Care. 2016;6(15):2224-3208.
5. Khawaja T, Khan SH, Mukhtar N, et al. Comparative study of growth performance, egg production, egg characteristics and haemato-biochemical parameters of Desi, Fayoumi and Rhode Island Red chicken. J Appl Anim Res 2012;40(4):273-283.
6. Singh R, Cheng KM, Silversides FG. Production performance and egg quality of four strains of laying hens kept in conventional cages and floor pens. Poult Sci. 2009;88(2):256-264.
7. Silversides FG, Scott AT. Effect of storage and layer age on quality of eggs from two lines of hens. Poult Sci. 2001;80(8):1240-1245.
8. Tamir S, Moges F, Tilahun Y, et al. Determinants of adoption of exotic poultry breeds among smallholder poultry producers in North Western Amahara Region, Ethiopia. Glob Sci Res J. 2015;3:162-168.
9. Tadesse DT. Management practices, productive performances and egg quality traits of exotic chickens under village production system in east Shewa, Ethiopia. (Doctoral dissertation, Addis Ababa University), 2012.
10. Cicek T, Kartalkanat A. Comparison of village eggs and commercial eggs in terms of egg quality. J Anim Vet Adv. 2009;8(12):2542-2545.