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Research Article

Comparison of Chicken Genotypes for Growth, Egg Production and Adaptability Traits Under Semi-Scavenging Condition

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Abstract

The study was conducted to evaluate the growth, egg production and adaptability performances of different chicken genotypes under semi-scavenging condition. The performance of Improved Horro (H), Cosmopolitan (C), Indigenous (L), and Koekoek (KK) chicken genotypes was evaluated in semi-scavenging condition over a 44-week period. The study utilized a completely randomized design (CRD), and the data were analyzed using the General Linear Model (GLM) in SAS software. A total of 360 chickens from the four genotypes were provided. For each genotype, around 30 chickens (with a 1:10 male-to-female ratio) were allocated to each lowland site, with each genotype placed in three replicate sites. The data for each genotype from all sites were then pooled. KK exhibited the highest body weight at hatch, followed by C and H, while L had the lowest. At eight weeks of age, KK also had the highest body weight and average daily weight gain, with C and H following, and L recording the lowest. KK had the highest body weights and weight gains, followed by C and H, while L showed the lowest body weights and weight gains at both 16 and 24 weeks of age. L and H showed significantly higher survival rates compared to KK and C. L reached the highest age at first egg lay, followed by C, KK, and H. KK had the greatest body weight at first egg lay and at the end of the experiment compared to C and H, while L had the lowest body weights at both first egg lay and 44 weeks. KK had the highest egg weight at first egg lay and throughout the experiment when compared to C and H, while L recorded the lowest egg weights at both first egg lay and 44 weeks. KK produced the highest number of eggs, followed by H and C, while L had the lowest egg count. In conclusion: The genotype differences of chickens substantially influenced growth, egg production and adaptability performances. It could also serve as reference for future growth, egg production and adaptability studies of defferent chicken genotypes.

Keywords

Genotype, Semi-scavenging, Growth, Egg Production, Trait, Chicken

1. Introduction

The Ethiopian chickens are reared under different management and production systems ranging from family poultry production to medium and large-scale intensive system [19]. The chicken population in Ethiopia is estimated to be 56.99 million of which 44.94 million are indigenous, 5.19 million exotic and 6.86 million hybrid and contributing 78.85%,

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9.11% and 12.03% of the country's poultry population, respectively [20]. The scarcity of adaptable and productive poultry breeds is one of the biggest obstacles to Ethiopian poultry production [17]. The lack of adaptable dual-purpose chicken breeds suitable for improving family poultry production systems, along with the sustainability issues linked to these challenges, are also critical considerations. [5].

Growth is defined as the change in weight of a genotype over time and significantly influences the live chicken's value for both breeding purposes and retail meat [8]. Additionally, growth is typically achieved through a systematic progression of developmental changes [11].

Egg production typically occurs in either fully confined or semi-confined housing, depending on economic conditions and climatic factors [2]. Ensuring uniform body weight among pullets and laying hens is a crucial aspect of husbandry [18]. The onset of sexual maturity during the growth phase of pullets is influenced by genotype and crossbreeding [4]. Egg production is a highly heritable trait that can vary among different genotypes [10]. It is one of the most critical parameters in poultry production, as laying performance directly impacts the production and reproductive efficiency of hens [13]. Key traits such as age at first egg, body weight at first egg, and total egg count are regulated by genetic and hormonal factors [7]. Research indicates that chicken survivability is significantly influenced by both genetic and non-genetic factors [1]. Genotypes with improved survivability can enhance the profitability of poultry producers [21].

The genetically enhanced Horro genotype from Ethiopia (H) has been reported to boost both growth and egg production [3]. Additionally, the Cosmopolitan genotype (C) is recognized as an imported chicken and is regarded as a representation of global chicken diversity [12]. Furthermore, the Koekoek (KK) dual-purpose chicken genotype was imported from South Africa [6]. The indigenous chicken (L) was utilized as a reference based on the selection and breeding studies described in the reports [9]. Reports also indicated that the H, C, KK, and L chicken genotypes exhibited significant differences in growth, egg production, and adaptability under on-station conditions [9, 21]. As the cosmopolitan breed is newly imported to Ethiopia, it is evident that this genotype also demanded initial research information and documentation on growth, egg production and adaptation traits of different chicken genotypes under semi-scavenging conditions.

1.1. General Objective

The objective of study was to evaluate the growth, egg production, and adaptability of different chicken genotypes under semi-scavenging conditions.

1.2. Specific Objectives

The specific objectives are indicated below as:

1) To evaluate the growth performance of different chicken genotypes under semi-scavenging conditions.
2) To evaluate the egg production performance of different chicken genotypes under semi-scavenging conditions.
3) To evaluate the Adaptation performance of different chicken genotypes under semi-scavenging conditions.

2. Materials and Methods

2.1. Description of the Study Areas

The experiment was conducted at selected areas of Werer Agricultural Research Center, Afar region, Ethiopia. The three selected areas namely Awash, Melka-sedi and Melka-werer and are all lowlands merely used as replica of the semi-scavenging study. The data of the three repica sites of lowland were pooled and subjected to analysis. The Werer Agricultural Research Center is found at 280 km away from Ethiopia's capital, Addis Ababa, and is also located at an altitude of 820 meters above sea level and at 9^o 55' N latitude and 40^o 40' E longitude. The annual rainfall and average minimum and maximum temperatures for Werer Agricultural Research Center ranges from 400 mm to 600 mm, and 19.3^oC and 45^oC, respectively.

2.2. Experimental Animals, Managements and Sampling Procedures

2.2.1. Experimental Chicken Genotypes

The experimental animals were namely, I = Improved Horro (H), II = Cosmopolitan (C), III = Koekoek (KK), and IV = Indigenous (L)

2.2.2. Managements and Sampling Procedures

Before the experiment commenced, the watering and feeding troughs were thoroughly cleaned, disinfected, and treated for external parasites. Each pen's floor was lined with disinfected grass hay, which was replaced as necessary. All chickens involved in the trial were hatched on the same day and were fed identical commercial rations according to the recommendations of Alema Koudjis Feed Co., Ltd., located in Debrezeit, Ethiopia. The chickens were vaccinated against Newcastle disease, Gumboro (Infectious Bursal Disease-IBD), and Fowl Typhoid using vaccines as per the manufacturer's instructions. All experimental chickens were managed under similar semi-scavenging conditions, and their health status was monitored throughout the trial. Feed from Alema Koudjis Feed Co., Ltd. was used for the entire duration of the study, and supplements were administered through their drinking water. The chickens were raised in a semi-scavenging poultry production system across three identical replicates. Prior to receiving the chickens, all participating households constructed poultry houses using locally sourced materials. The participants were trained on the importance of supplementation for optimal chicken performance and were instructed to provide a daily supplement of 60 grams of feed per chicken, approximately 50% of their daily requirements.

2.3. Sample Size

A total of 360 chickens from four genotypes were supplied. About 30 chickens of each genotype were assigned to each site, with each genotype distributed across three replicates. The male-to-female ratio was 1:10.

2.4. Data Collection

Data were collected on growth, egg production, and adaptation parameters, which included body weights, egg counts, and overall survivability. Growth data were collected up to 24 weeks, while egg production data were recorded over a 44-week period. Overall survivability was assessed up to 24 weeks. For clarity, body weights of each genotype were measured at 0, 8, 16, and 24 weeks of age using a weighing scale. In terms of egg production, the following parameters were recorded: number of eggs, age at first lay, body weight at first lay, egg weight at first lay, egg weight at 44 weeks, and final body weight of the laying hens. Egg production data were considered up to 44 weeks. Survivability data for the chickens were collected from one day old up to 24 weeks of age at eight-week intervals under semi-scavenging condition.

2.5. Statistical Analysis

The data was recorded as per the prepared sheet and was entered into excel regularly. The data collected was summarized and analyzed by GLM model using SAS software (SAS, 2004). When the GLM showed significant difference at $P \leq 0.05$, the Duncan's multiple range tests was used for mean separation.

The model used for the analysis was:

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

Where,

Y_{ij} = the response variables

μ = the overall Mean

G_i = the effect of genotype (I = 1,2,3,4)

e_{ij} = Random error

3. Results and Discussion

3.1. Growth and Egg Production Perfromarance of Different Chicken Genotypes

3.1.1. Effect of Genotype on Chick Hatch Weight

The result of the effect of genotypes on chick hatch weight (BW0) of different chickens under semi-scavenfing conditions of lowland area is indicated in Figure 1. The body weight at hatch (BW0) was significantly the highest for KK, intermidate for C and H and the lowest for L chicken genotypes [7]. Study reported that the body weight at hatch varied across genotypes [21]. In line with the study, the differences in hatch weight of the chickens could be attributed to variations among genotypes and egg sizes [15]. The combined effect of genotype and feeding might be the reasons for variations in body weight among different strain of chickens and/or birds [5].

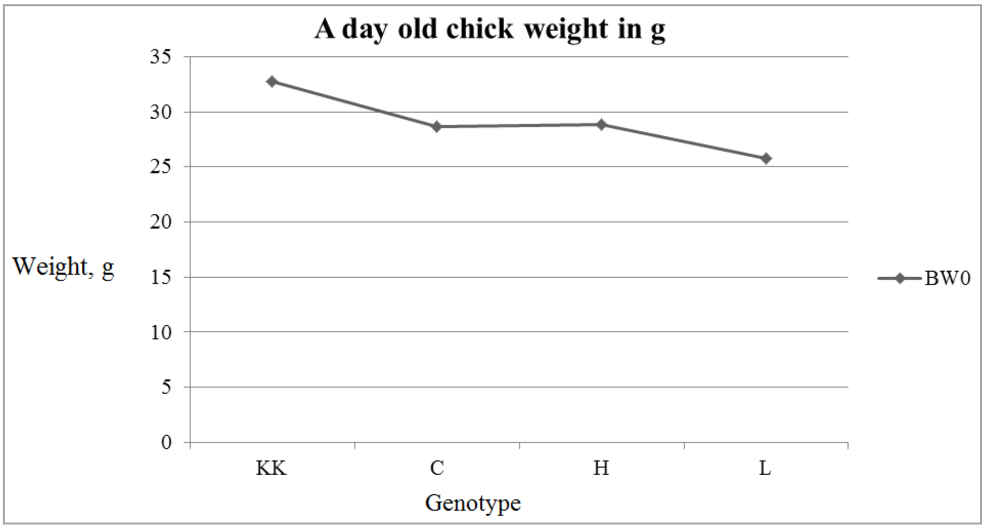

Figure 1. Effect of genotype on body weight of different chicken genotypes under semi-scavenging condition.

3.1.2. Effect of Genotype on Body Weight and Average Daily Weight Gain at 8 Weeks of Age

The result of the effect of genotype on body weight and average daily weight gain of different chicken genotypes under semi-scavenging condion at 8 weeks of age is indicated in Figures 2 and 3. Significantly heaviest body weight (BW8) was recorded in the KK genotype followed by C and H, whereas the lightest body weight at eight weeks of age was observed in the L genotype. Additionally, the daily weight gain at eight weeks of age (ADG8) was significantly the highest for KK followed by C and H, whereas the lowest daily weight gain was observed for L chickens. Agreably, the differences in BW8 and ADG8 are possibly attributed to variations in genetic potential [6]. The variations in body weight and daily weight gain observed among different strains of chickens and other birds may result from the combined influence of genotype and feeding practices [10, 14].

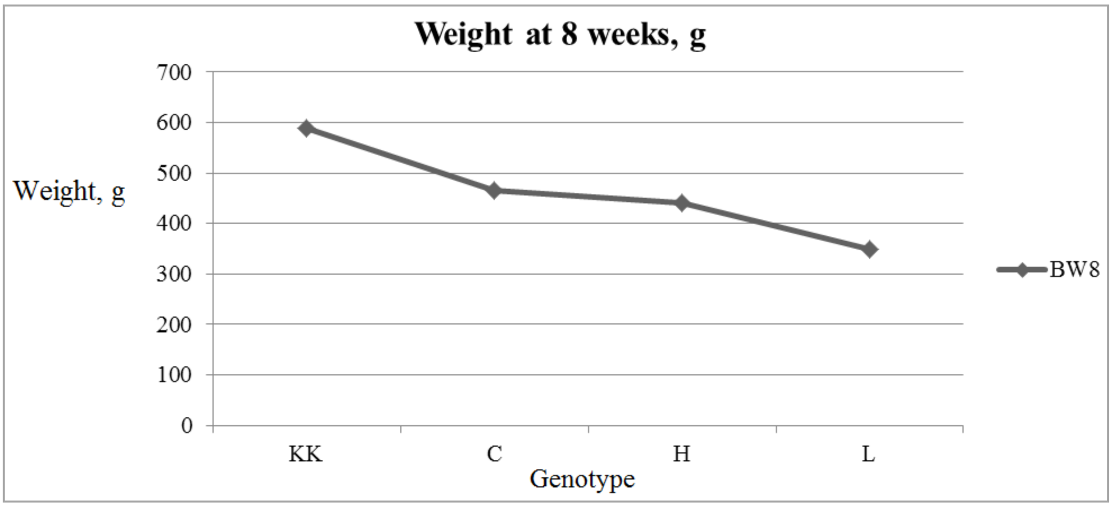

Figure 2*. Effect of genotype on body weight of different chicken genotypes under semi-scavenging conditions at 8 weeks of age.*

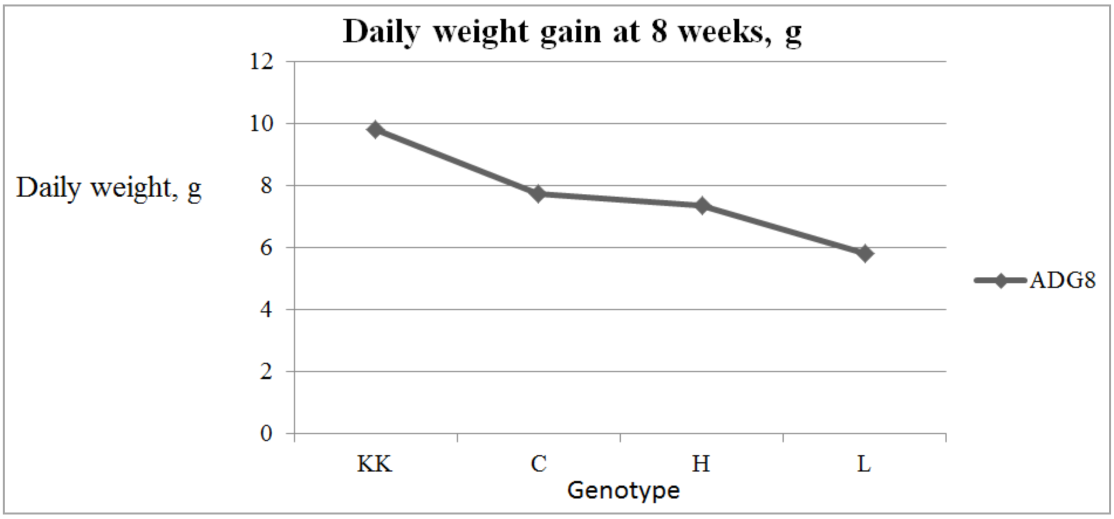

Figure 3*. Effect of genotype on daily weight gain of different chicken genotypes under semi-scavenging conditions at 8 weeks of age.*

3.1.3. Effect of Genotype on Body Weight of Different Chicken Genotypes at 16 and 24 Weeks of Age

The result of the effect of genotype on body weight of different chickens at 16 and 24 wks is presented in Figure 4. The highest body weights (BW16 and BW24) were noticed in the KK followed by C and H, whereas the lowest body was observed at 16 and 24 weeks of ages. Consistent with the study, differences in body weights may be linked to variations in genetic potential [11, 16]. The observed variations in body weight among different strains of chickens and other birds may result from the combined effects of genotype and feeding practices [5, 16].

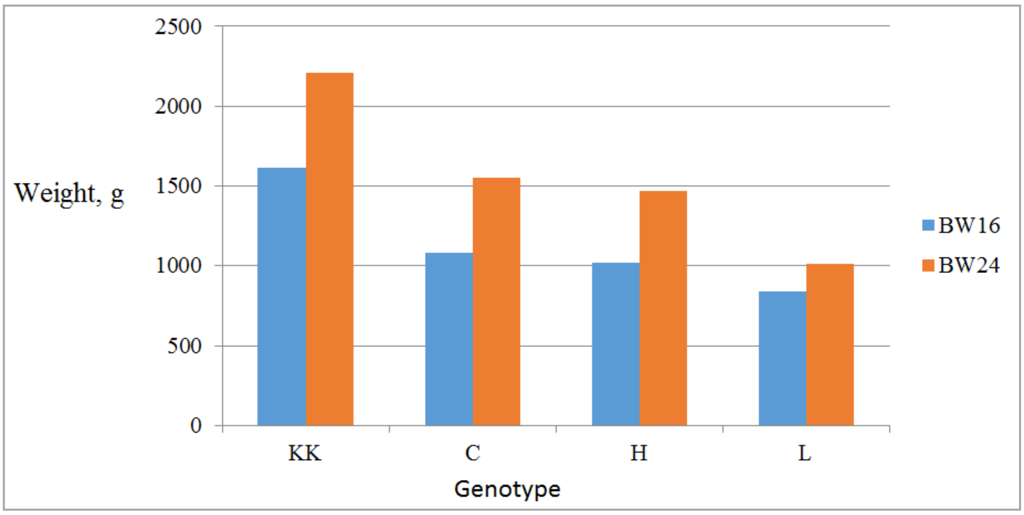

Figure 4. *Effect of genotype on body weight of different chicken genotypes under semi-scavenging conditions at 16 and 24 weeks.*

3.1.4. Effect of Genotype Average Daily Weight Gain of Different Chicken Genotypes at 16 and 24 Weeks of Age

The result of the effect of genotype on average daily weight gains of different chickens at 16 and 24 wks is presented in Figure 5. The highest average daily weight gains (ADG16 and ADG24) were indicated in the KK followed by C and H, whereas the lowest average daily weight gains were observed at 16 and 24 weeks of ages. In accordance with the study, differences in average weight gains may be attributed to variations in genetic potential [6, 17]. The variations in daily weight gain among different strains of chickens and other birds could result from the combined effects of genotype and feeding practices [1, 16].

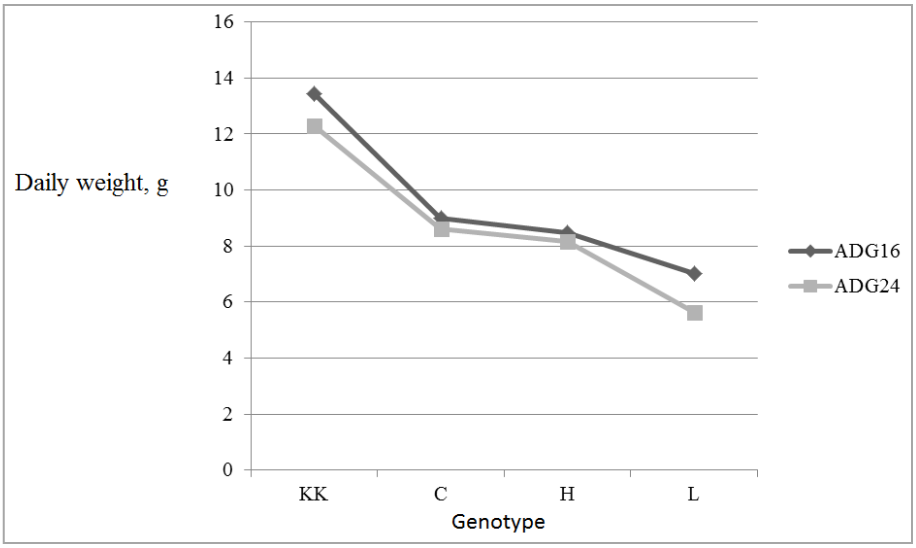

Figure 5. *Effect of genotype on average daily weight gain of different chicken genotypes under semi-scavenging conditions at 16 and 24 weeks.*

3.1.5. Effect of Genotype Survivability of Different Chicken Genotypes (0-24 Weeks)

Figure 6 shows the survivability of chicken up to 44 wks. The survivability of L (89.59%) and H (88.91%) was significantly higher compared to KK (86.19%) and C (85.96%). Study indicated that the rate of survivability affected by genotypes [8, 13]. Nevertheless, the results indicated that the survivability rate was notably affected by the different genotypes [21]. Previous research has reported that the survivability rate of birds in tropical regions during the rearing period is below 15% [19]. The variation in survivability rates may be attributed to the combined influence of genetic and non-genetic factors [1, 14].

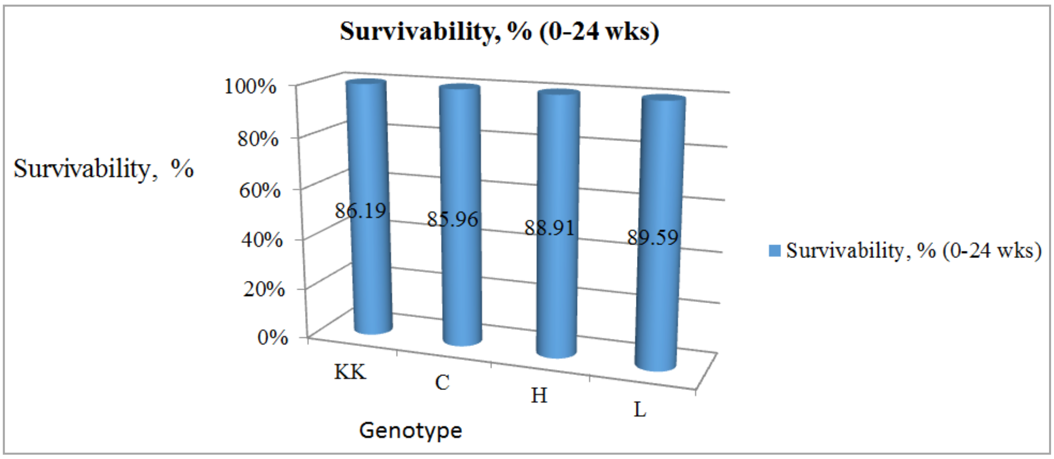

Figure 6. Effect of genotype survivability of different chicken genotypes under semi-scavenging conditions (0-24 weeks).

3.2. Effect of Genotype on Egg Production Performance

The result of the effect of genotype on egg production traits of different chickens is presented in Table 1. The age at first egg (Age at 1st egg) was significantly the higher for L comared to C, KK, and H egg laying chicken genotypes. The body weight at firs egg (Bwt at 1st egg) and the body weight at the entire experiment (Bwt at 44 wks) were significantly the highest for KK, intermidate for C and H, whereas the lowest for L egg laying chicken genotypes. The egg weight at firs egg lay (egg Wt at 1st egg lay) and the egg weight at the entire experiment (egg Wt at 44 wks) were significantly the highest for KK, intermidate for C and H, whereas the lowest egg Wt 1st egg lay and egg Wt at 44 wks were recorded for L egg laying chicken genotypes. The egg number (egg number, 44 wks) was significantly the highest for KK followed by H and C, while the lowest egg number was observed in L egg laying hen genotypes. Research has shown that egg production traits can be influenced by factors such as breed, strain, diet, and epigenetic effects in laying hens [5, 7].

Table 1. Effect of Genotype on Egg Production Performance Traits of Different Chickens.

Category	Genotype				
	KK	C	H	L	P-value
Traits	Mean ± SE				
Age at 1st egg	22.78 ± 0.15^{b}	23.84 ± 0.20^{b}	21.82 ± 0.13^{b}	28.65 ± 0.33^{a}	**
Bwt at 1st egg	1671.26 ± 10.64^{a}	1335.12 ± 4.39^{b}	1330.76^{b}	1042.84 ± 8.79^{c}	***
Bwt at 44 wks	2002.49 ± 16.28^{a}	1740.32 ± 14.91^{b}	1765.58 ± 12.09^{b}	1371.84 ± 13.61^{c}	***
Egg Wt at 1st lay	44.12 ± 0.59^{a}	40.81 ± 46^{b}	40.04 ± 98^{b}	35.47 ± 03^{c}	**
Egg Wt at 44 wks	49.53 ± 0.48^{a}	44.90 ± 0.38^{b}	44.48 ± 0.17^{b}	37.05 ± 0.28^{c}	**
Egg number, 44 wks	159.65 ± 0.53^{a}	135.11 ± 0.51^{b}	140.64 ± 0.45^{b}	29.06 ± 0.24^{c}	***

Mean under the same category bear different superscript letters are significantly different, *** = P ≤ 0.001, ***= P ≤ 0.01 SE = Standard error

4. Conclusion and Recommendation

The study evaluated the growth, egg production, and adaptability of four chicken genotypes—Improved Horro (H), Cosmopolitan (C), Indigenous (L), and Koekoek (KK)—under semi-scavenging conditions over 44 weeks. Results indicated that KK consistently outperformed the other genotypes in terms of body weight, weight gain, and egg production, while L demonstrated the lowest performance across these metrics. Notably, L and H exhibited higher survival rates than KK and C. In terms of reproductive performance, L reached the earliest age at first egg lay, but KK had the highest body weight and egg weight at both the first egg lay and throughout the experiment. In conclusion, the findings highlight significant genotype differences that impact growth, egg production, and adaptability in chickens. It could also serve as reference for future growth, egg production and adaptability studies of defferent chicken genotypes.

Abbreviations

BW	Body Weight
ADG	Average Daily Weight Gain
KK	Koekoek
C	Cosmopolitian
H	Improved Horro
L	Indigenous

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Author Contributions

Atsbaha Hailemariam Gebreslassie is the sole author. The author read and approved the final manuscript.

Data Availability Statement

Data will be made available on request.

Conflicts of Interest

The author declares no conflicts of interest.

References

[1] Kassa, B., Tadesse, Y., Esatu, W., & Dessie, T. (2021). On-farm comparative evaluation of production performance of tropically adapted exotic chicken breeds in western Amhara, Ethiopia. Journal of Applied Poultry Research, 30(4), 100194.

[2] Leta, S., Bekana, E., & Geleta, T. (2013). Production performance of Fayoumi chicken breed under backyard management condition in Mid Rift Valley of Ethiopia. Herald Journal of Agriculture and Food Science Research, 2(1), 078-081.

[3] Wondmeneh, E., Van der Waaij, E. H., Udo, H. M. J., Tadelle, D., & Van Arendonk, J. A. (2016). Comparison of different poultry breeds under station and on-farm conditions in Ethiopia. Livestock Science, 183, 72-77.

[4] Alem, T. (2014). Production and reproduction performance of rural poultry in lowland and midland agro-ecological zones of central Tigray, Northern Ethiopia. African Journal of Agricultural Research, 9(49), 3531-3539.

[5] BEDRU, B. A. (2021). Comparative performance evaluation of local and tropical adapted exotic breeds of chickens in Ethiopia (Doctoral dissertation, Doctoral Dissertation, Haramaya University, Ethiopia).

[6] Dawud, I. (2019). Comparative Study of Production and Reproductive Performance of Parent Stock and Commercial Layer Chickens under Different Management Conditions in Ethiopia. Science Journal, 10(1), 35-44.

[7] Zeleke, G., Urge, M., Animut, G., Esatu, W., & Dessie, T. (2020). Comparative Laying Performance, Egg Quality, Fertility and Hatchability of Guinea Fowl with Tilili, Horro and Potchefstroom Koekoek Chicken Breeds. Open Journal of Animal Sciences, 10(4), 665-682.

[8] Zelleke, G., Urge, M., Animut, G., Esatu, W., & Dessie, T. (2022). Comparative growth performance and carcass characteristics of guinea fowl (Numida meleagris) and three chicken genotypes. Ethiopian Journal of Science and Technology, 15(1), 81-99.

[9] Hailemariam, A., Esatu, W., Abegaz, S., Urge, M., Assefa, G., & Dessie, T. (2022). Sensory characteristics, nutritional composition, and quality of eggs from different chickens. Open Journal of Animal Sciences, 12(4), 591-615.

[10] Assefa, S., Melesse, A., & Banerjee, S. (2019). Egg production and egg quality traits of local and exotic chicken breeds reared in two agroecologies under traditional management system. Research Journal of Food and Nutrition, 3(1), 11-17.

[11] Taye, S., Goshu, G., & Abegaz, S. (2022). Effect of crossbreeding on growth performance of improved Horro crosses with Koekoek and Kuroiler chicken breeds.

[12] Stinckens, A., Vereijken, A., Ons, E., Konings, P., Van As, P., Cuppens, H.,... & Cassiman, J. J. (2015). Art meets science: The Cosmopolitan Chicken Research Project. Facts, views & vision in ObGyn, 7(3), 163.

[13] Dogara, M. U., Kalla, D. J. U., Mancha, Y. P., & Shuaibu, A. (2021). Evaluation of egg production and egg quality traits of Noiler chickens. Nigerian Journal of Animal Science, 23(2), 100-113.

[14] Chebo, C., Betsha, S., & Melesse, A. (2022). Chicken genetic diversity, improvement strategies and impacts on egg productivity in Ethiopia: a review. World's Poultry Science Journal, 78(3), 803-821.

[15] Alemneh, W., Melesse, A., & Berihun, K. Comparative Study on Egg Quality traits of Indigenous Chickens and Their F1-Crosses with the Sasso Chicken Breed in Sheka Zone, South Western Ethiopia.

[16] Tola, C. T., Abate, W. H., & Demeke, S. (2022). On-station and on-farm evaluation of three exotic breeds of chicken in Homa district of West Wollega, Ethiopia. Asian Journal of Dairy and Food Research, 41(3), 303-307.

[17] Litigebew, A., Moges, F., & Kebede, D. (2021). Growth, survival and egg production of exotic chicken breeds under small scale production system in Bahir Dar City Administration, Amhara Region, Ethiopia. Ethiopian Journal of Science and Technology, 14(2), 123-137.

[18] Hailemariam, A., Taye, A., Miglas, H., Edea, C., Amare, A., Habte, T.,... & Ibrahim, D. (2018). Evaluation and Demonstration of Potchefstroom Koekoek Chicken in and Around Mehoni areas of Southern Tigray Zone, Ethiopia. Global Journal of Science Frontier Research: D Agriculture and Veterinary, 18(3).

[19] FAO (Food and Agriculture Organization). 2019. Poultry Sector Ethiopia. FAO Animal Production and Health Livestock Country Reviews. No. 11. Rome. Italy.

[20] CSA (Central Statistical Agency). 2020/21. Report on Livestock and Livestock Characteristics (Private Peasant Holdings), Agricultural Sample Survey, Volume II Statistical Bulletin 587. Addis Ababa, Ethiopia.

[21] Abdu, M. A., & Gebreslassie, A. H. (2024). Comparison of Economic Feasibility of Different Chicken Genotypes Under On-Station Condition. International Journal, 10(1), 1-9.