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# Egg Quality Characteristics of Indigenous, Exotic and their Crosses Chicken in Ethiopia: Review

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**Abstract**

The aim of this review was to show the possibilities of using local and exotic breed chicken for production of egg for its specific quality features in the light of all-inclusive researches. The goal of this analysis was the quality of egg from exotic and local chicken raised in different production management system. The result of the studies on the quality egg from chicken (exotic and local) obtained from different management have shown that there are significant difference both the internal and external egg quality characteristics. Under village condition, local and exotic chickens have higher Hugh unit and deep yellow color. The egg qualities of chickens depend on their genotype, age of hen, quality and quantity of feed and storage condition of egg, embryonic development of the egg and production system. Therefore, the present review study suggests that exotic chicken like that of local chicken have ability to produce good egg quality which is directly favors the economic preference of consumers under extensive feeding-based production system. Similarly, internal and external egg quality variations have been observed between the indigenous and improved chicken populations; hence, a profoundly egg chemical composition evaluation is needed to show the level of egg composition differentiation and similarity between them.

## Introduction

Chicken population in Ethiopia is over 59 million out of which 50.91 million (85.7%) of chickens are indigenous and improved exotic chicken comprise about 8.51 million (14.3%) [1] and which is clustered in to 8 indigenous chickens' breeds. The estimated annual egg production of 59 million chickens is 151.47 million egg of which 69.23 million (47.7%) eggs found from the improved exotic chicken. It implies that improved exotic chicken play a great role to satisfy the egg demand of the population. The means annual egg production of indigenous chickens is estimated at 40-60 small eggs. Accordingly, the current annual per capita consumption is not greater than 2 eggs (0.06kg). Indigenous chicken production in Ethiopia is playing a vital role for livelihood of rural farmers as source of income and to raise the nutritional demand of farmers [2]. They are reared in the country mainly for social and economic requirements including cash income; hatching for replacement home consumption. Backyard chicken production is therefore important in low-income, food-deficit production systems to supply the fast-growing human population with high demand for quality protein. They play an important role in the economic development of rural communities and they are known-n to be relatively resistant to some infectious diseases, good converters of poor quality feeds and have products that are preferred by consumers.

This implies that local chickens are playing significant role as potential farm animal genetic resources in the country. The most dominant chicken types reared in Ethiopia are local ecotypes, which show a large variation in body conformation, plumage color, comb type and productivity [3]. The major production system of chickens in rural area is free range scavenging system in which they are allowed to exercise freely around the home during at day time .Egg quality could be seen in two ways; internal egg quality (yolk and albumin height and diameter, yolk color, yolk and albumin weight, Haugh unit) and external egg quality (egg weight, length and shell thickness) on the egg content and egg shell. One of the determinant factors of external and internal egg quality traits are embryonic development of an egg and the viability of the new hatched chick .Eggshell thickness and strength are very significant egg quality traits to handle egg during transportation, and egg market influence by yolk color .For better breeding strategies and reproductive parameters of chicken production valuable egg quality traits are needed [4]. Chicken management and egg handling techniques affected the internal and external egg quality and the duration of egg storage and technique also affect albumen and yolk height. The objective of this review was to demonstrate the potential of local and exotic breed chicken for production of egg for its specific quality features in the light of all-inclusive researches. The goal of this analysis was the quality of intern-al and external egg from exotic and local chicken raised in different production management system.

## Chicken egg quality traits

Egg quality traits refers that the characteristics of an egg which affect its acceptability by consumers. Chicken eggs are providing balanced source of nutrients for human and it is nutritious, economical and easily prepares food [5]. For maintain of egg quality, temperature, humidity, gas concentration and orie-ntation is also play a prime importance. The quality of egg could be categories internal and external quality of egg. External factors including cleanliness, freshness, and egg weight and shell quality are important in consumer's acceptability of shelled eggs. The internal quality of eggs including yolk weight, albumin weight, yolk color, albumin height, yolk height and Hugh unit and it decline as soon as they are laid by hens.

Feeding and management of hens have a significant impact on internal egg quality, egg handling and storage practices and influence the acceptability of the quality of eggs by consumers [6]. Production of good shell and internal quality of eggs have significant economic viability of the egg industry. External and internal characteristic of eggs

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are prerequisite for safety, soundness and wholesomeness of the eggs. The breed and age of hen is the most vital production factors affecting the quality of eggs. Different scholars have been conducted on the impact of different breed on external and internal parameters of egg quality. The egg production cycle of layers allowed to extend from 68 weeks to 90 weeks of age through genetic improvement.

## External egg quality characteristics

External egg quality characteristics are features of eggs such as egg weight, egg size, egg shape, shell thickness, shell color and shell strength [7]. The egg production potential of local chicken is 30-60 eggs/year/hen with an average of 38g egg weight under village management conditions, while exotic breeds produce around 250 eggs/year/hen with around 60 g egg weight in Ethiopia. According to the low productivity of the local scavenging hens is not only egg production potential but also, they are low producers of small sized eggs and slow growers [8]. Data of external egg quality of some indigenous, exotic and cross chickens in Ethiopian is summarized in Table 1 and 2 (Tables 1 and 2).

The average weight of eggs from local hens is 43 gm (range 34-60gm) and 47gm in Bure and Fogera woredas, respectively also reported the average egg weight 42.9gm eggs collected from seven chicken ecotypes of northwest Amhara region which is in comparable with the egg weight (43.0±2.24 mg) northern Ethiopia reported [9]. According to the egg weight obtained from midland scavenging chickens was significantly heavier than those of highland and lowland agro-ecological zones. However, egg weight obtained from highland (47.13g) was heavier than that of midland (45.43g) and lowland (44.68). Thus the average egg weight of 45.75g was reported in the Gorogutu District, Eastern Hararghe which is comparable with the average egg weight of Koekoek (48.84±6.77g) commercial chicken strains in East Shear zone. The average egg weight of Chelliya district local chicken was 41.13+1.26g, but this value was lower than the average egg weight of Isa Brown (57.92+1.26g) and their crosses (54.46+1.2g). But lower than that reported by Halima (2007) for RIR chicken breed eggs (53.4g), for Isa Brown (58.75±7.29g) and Bovas Brown (60.27±6.03g) commercial chicken strains. Egg weight variation might be due to the conditions of egg storage and temperature of the production area [10]. Studies and indicated that there was significant correlation between body and egg weight of the chickens).

In fact, egg shell quality is based on egg size, egg specific gravity, shell color, shell breaking strength, shell deformation, shell weight, percentage shell, shell thickness and shell ultra-structure. For table eggs, shells must be strong enough to prevent failure during packing and/or transportation. For hatching eggs, shells must be initially thick

**Table 1:** External characteristics of local chicken egg under different management in Ethiopia

| Area | Management | EW | Egg length | Egg width | Egg shape | Shell thickness | Shell weight |
|---|---|---|---|---|---|---|---|
| BM | scavenging | 4.7 ± 43.9 | 43.8 ± 52.1 | 2.9 ± 37.8 | 4.3 ± 72.7 | 0.03 ± 0.33 | |
| Bochira | scavenging | 40.4 ± 4.69 | 46.4 ± 5.4 | 32.4 ± 4.7 | 69.8 ± 4.6 | 0.28 ± 0.02 | |
| Amhara | scavenging | 39.6 | 51.3 | 37.5 | 73.2 | 0.296 | |
| Chelliya | scavenging | 41.13 ± 1.26 | | | | 0.27 ± 0.02 | |
| W. Tigray | scavenging | 40.6 | 55.5 | 38.03 | 68.7 | | 4.69 |
| Gorogutu | scavenging | 37.70 ± 0.7 | | | | 0.29 ± 0.01 | 3.70 ± 0.2 |
| Hawassa | scavenging | 45.20 ± 5.53 | 52.39 ± 2.43 | 39.8 ± 6.83 | | 0.24 ± 0.04 | 3.93 ± 0.78 |
| Yirgalem | scavenging | 39.30 ± 4.04 | 50.39 ± 3.83 | 37.9 ± 1.24 | | 0.19 ± 0.06 | 3.71 ± 0.44 |
| SWS | scavenging | 42.59 ± 2.64 | | | | 0.32 ± 0.05 | 7.08 ± 2.35 |
| Guragie | scavenging | 42.36 ± 5.55 | | | | 0.30 ± 0.05 | 8.34 ± 1.89 |
| Tilili | intensive | 41.75 | | | | 0.69 | 4.88 |
| Gelila | intensive | 35.93 | | | | 0.73 | 4.86 |
| D.elias | intensive | 34.11 | | | | 0.77 | 4.02 |
| M.hamusit | intensive | 34.56 | | | | 0.71 | 4.52 |
| Farta | intensive | 36.81 | | | | 0.68 | 4.52 |
| Guangua | intensive | 38.64 | | | | 0.72 | 4.82 |
| Mecha | intensive | 39.87 | | | | 0.67 | 4.61 |
| Tilili | scavenging | 37.8 | | | | | 4.75 |
| Gelila | scavenging | 31.93 | | | | | 4 |
| D.elias | scavenging | 35.6 | | | | | 4.25 |
| M.hamusit | scavenging | 41.88 | | | | | 5.25 |
| Farta | scavenging | 31.73 | | | | | 4.25 |
| Guangua | scavenging | 45.45 | | | | | 6 |
| Mecha | scavenging | 31.9 | | | | | 4.5 |
| W.Ormoia | scavenging | 42.79 ± 0.58 | 5.21 ± 0.04 | 4.12 ± 0.20 | 75.1 ± 1.08 | 0.37 ± 0.05 | 4.80 ± 0.08 |
| Gomma | scavenging | 41.73 | | | | 0.36 | 4.48 |
| HU PF | intensive | 50.66 | 51.66 | 41.61 | 80.64 | 0.32 | 5.51 |
| Haramaya | scavenging | 43.23 | 49.71 | 40.09 | 80.72 | 0.27 | 4.51 |
| Harar | scavenging | 41.16 | 49 | 39.7 | 81.01 | 0.28 | 4.42 |
| Dire Dawa | scavenging | 42.52 | 49.14 | 39.46 | 80.33 | 0.28 | 4.21 |
| Bure | scavenging | 43.2 ± 4.3 | 50.8 ± 3.9 | 37.2 ± 3.1 | 73.2 ± 4.2 | 0.26 ± 0.03 | 2.3 ± 0.2 |
| Fogera | scavenging | 46.96 ± 1.3 | | | | 0.45 ± 0.0 | 5.5 ± 0.2 |
| Fogera | scavenging | 44.8 | | | | 0.45 | 5.52 |
| Gorogutu | scavenging | 45.75 ± 1.98 | | | | 0.29 ± 0.01 | 4.95 ± 0.3 |

EW=egg weight, BM=Bench Maji, SWS=south west shewa, HUPF=Haramaya university poultry farm, W=western

**Table 2:** External egg characteristics of Exotic chicken in Ethiopia

| Breed | Management | EW | LE | WE | SI | ST | SW |
|---|---|---|---|---|---|---|---|
| RIR | intensive | 55.56 ± 1.79 | 5.65 ± 0.17 | 4.38 ± 0.11 | 77.28 ± 3.21 | 0.41 ± 0.04 | 5.20 ± 0.20 |
| BW | intensive | 50.91 ± 2.03 | 4.98 ± 0.19 | 3.91 ± 0.09 | 78.43 ± 2.88 | 0.39 ± 0.03 | 5.03 ± 0.25 |
| BB | extensive | 50.7 ± 4.58 | 55.2 ± 1.9 | 41.1 ± 1.5 | 74.5 ± 3.6 | 0.29 ± 0.02 | |
| SASO | extensive | 52.4 ± 4.80 | 55.0 ± 3.3 | 39.9 ± 2.2 | 72.7 ± 5.0 | 0.29 ± 0.03 | |
| KK | extensive | 47.3 ± 6.36 | 52.9 ± 4.4 | 38.7 ± 3.2 | 73.4 ± 4.5 | 0.28 ± 0.03 | |
| IB | extensive | 58.75 ± 7.29 | | | | 0.31 ± 0.05 | |
| BB | extensive | 60.27 ± 6.03 | | | | 0.33 ± 0.037 | |
| KK | extensive | 48.84 ± 6.77 | | | | 0.29 ± 0.026 | |
| IB | extensive | 57.92 ± 1.26 | | | | 0.27 ± 0.02 | |
| IBC | extensive | 54.46 ± 1.26 | | | | 0.29 ± 0.02 | |
| BB | extensive | 61.60 ± 0.31 | | | | 0.37 ± 0.001 | |
| RIR | intensive | 47.56 | | | | | |
| SasoT44 | extensive | 59.3 ± 5.03 | 56.7 ± 2.84 | 43.6 ± 2.17 | 76.97 ± 4.02 | 0.33 ± 0.03 | 7.18 ± 0.83 |
| IB | Intensive | 64.78 ± 3.81 | | | | 0.34 ± 0.03 | |
| BB | Intensive | 63.46 ± 4.14 | | | | 0.35 ± 0.03 | |
| KK | Intensive | 47.79 ± 4.43 | | | | 0.29 ± 0.03 | |
| IB | extensive | 58.92 ± 7.16 | | | | 0.31 ± 0.05 | |
| BB | extensive | 59.32 ± 4.78 | | | | 0.33 ± 0.04 | |
| KK | extensive | 47.53 ± 4.72 | | | | 0.29 ± 0.03 | |
| D.elias | scavenging | 35.6 | | | | | 4.25 |
| M.hamusit | scavenging | 41.88 | | | | | 5.25 |
| Farta | scavenging | 31.73 | | | | | 4.25 |
| Guangua | scavenging | 45.45 | | | | | 6 |
| Mecha | scavenging | 31.9 | | | | | 4.5 |
| W.Ormoia | scavenging | 42.79 ± 0.58 | 5.21 ± 0.04 | 4.12 ± 0.20 | 75.1 ± 1.08 | 0.37 ± 0.05 | 4.80 ± 0.08 |
| Gomma | scavenging | 41.73 | | | | 0.36 | 4.48 |
| HU PF | intensive | 50.66 | 51.66 | 41.61 | 80.64 | 0.32 | 5.51 |
| Haramaya | scavenging | 43.23 | 49.71 | 40.09 | 80.72 | 0.27 | 4.51 |
| Harar | scavenging | 41.16 | 49 | 39.7 | 81.01 | 0.28 | 4.42 |
| Dire Dawa | scavenging | 42.52 | 49.14 | 39.46 | 80.33 | 0.28 | 4.21 |
| Bure | scavenging | 43.2 ± 4.3 | 50.8 ± 3.9 | 37.2 ± 3.1 | 73.2 ± 4.2 | 0.26 ± 0.03 | 2.3 ± 0.2 |
| Fogera | scavenging | 46.96 ± 1.3 | | | | 0.45 ± 0.0 | 5.5 ± 0.2 |
| Fogera | scavenging | 44.8 | | | | 0.45 | 5.52 |
| Gorogutu | scavenging | 45.75 ± 1.98 | | | | 0.29 ± 0.01 | 4.95 ± 0.3 |

RIR=road island red, BW= bovans white, KK=koekoek, IB= Isa brown, BB=bovanus brown, IBC= Isa brown crosses, EW=egg weight, LE= length of egg, WE=width of egg, SI=egg shape index, ST=shell thickness, SW=shell weight

and strong to preserve the embryo and then it must become thin and weak later during incubation in order to allow the gas exchange as well as easier cracking when hatching [11]. reported that egg shell strength, is an important bio-economic trait that primarily breeder of egg laying flock incorporates in their breeding programmes to reduce egg shell breakages. Besides to genetic variation, the difference in egg shall quality also depend on the environmental condition and the nutritional management specially the dietary content of calcium.

The average shell thickness measurements of eggs collected from Bure district for sharp, equatorial and blunt region are 0.27 mm, 0.26 mm and 0.24 mm, respectively, with an average of 0.26 mm. Egg shell from the sharp region is relatively thicker than both the blunt and equatorial region shells [12]. Similarly, the average shell thickens of local chicken was 0.296mm. Similarly, reported that the average egg shall thickens is 0.29mmfor indigenous chicken. Likewise, the average shell thickness of the indigenous, cross and exotic chicken in Chelliya area was 0.27±0.02mm, 0.29±0.02mm and 0.27±0.02mm respectively. However, reported an average egg shell thickness of 0.35mm for Ethiopian local breed chicken eggs. On the other hand, also reported 0.71 mm and 0.69mm for eggs collected from intensively managed local chicken ecotypes of northwest Amhara and RIR chicken breeds, respectively which was higher value than other shell thickness chicken ecotypes in the country [13].According to the overall mean egg length and egg width of the local chickens in Amhara region was 51.3 mm and 37.5 mm, respectively and the overall shape index of scavenging indigenous chickens in the present study was 73.2%. Similarly, also reported the average egg length and width are 5.21cm and 4.12cm respectively and also the average shape index is 75.11% for indigenous chicken in GobuSayo, BakoTibe and Danno district of western Oromia. Chickens are not capable to consume feeds which have high crude fiber, which resulting influence their growth and egg production. The genetics of the birds might be the main cause of variation egg length and width among different chicken breeds [14]. The shell thickness of an egg could be also influenced by environmental temperature (which is frequent in the lowland) that would result in reduced blood flow through shell gland as a result of increased respiratory panting to remove excess heat from the body. In addition to this, variation might be indicates that the age and ecotype as well as the quality, quantity and the nutrient composition of feed resource availability in one area different from other area and availability of mineral calcium in the available feed material and aged hen culling practices and even it depend on the breed or strains. Other author reported that shell thickness is influenced by calcium availability in layer nutrition and ability of the hen to absorb calcium by the shell

**Table 3:** Internal egg quality characteristics of local chicken under different management system in Ethiopia

| Area | Management | Yolk index | Yolk color | Haugh unit | Albumen weight | Yolk weight | Albumen height |
|---|---|---|---|---|---|---|---|
| Bochira | Scavenging | 45.2 ± 8.54 | 10.5 ± 1.91 | 79.0 ± 6.39 | | | |
| BM | Scavenging | | 10.9 ± 1.7 | 61.2 ± 7.1 | 23.1 ± 3.2 | 15.1 ± 1.8 | 3.4 ± 0.7 |
| Amhara | Scavenging | 44 | 9.26 | 73.2 | | | 4.51 |
| Chelliya | Scavenging | 354.93 ± 1.96 | 10.69 ± 0.24 | 69.13 ± 2.21 | | | 4.37 ± 0.34 |
| W. Tigray | Scavenging | | | 78.9 | 20.8 | 15.1 | 5.5 |
| Gorogutu | Scavenging | 361.50 ± 9.1 | 11.80 ± 0.2 | 74.00 ± 1.8 | 19.40 ± 0.5 | 13.50 ± 0.5 | 4.50 ± 0.2 |
| Hawassa | Scavenging | | 9.16 ± 1.42 | 74.91 ± 15.7 | | | 5.20 ± 1.24 |
| Yirgalem | Scavenging | | 9.22 ± 1.46 | 82.55 ± 3.82 | | | 5.7 ± 0.59 |
| SWS | Scavenging | | 9.23 ± 0.99 | | 18.58 ± 3.23 | 3.43 ± 0.79 | 16.93 ± 2.22 |
| Guragie | Scavenging | | 8.86 ± 0.66 | | 17.24 ± 4.61 | 3.5 ± 1.08 | 16.77 ± 2.72 |
| Tilili | Intensive | | 3 | 64.67 | 23.52 | 13.34 | 4.92 |
| Gelila | Intensive | | 3 | 58.33 | 19.25 | 11.83 | 4.32 |
| D.elias | Intensive | | 3.33 | 65 | 19.28 | 10.81 | 4.95 |
| M.hamusit | Intensive | | 3.67 | 58.33 | 17.71 | 12.32 | 4.47 |
| Farta | Intensive | | 4 | 55 | 20.48 | 11.81 | 4.23 |
| Guangua | Intensive | | 3.33 | 61.67 | 20.95 | 12.87 | 4.73 |
| Mecha | Intensive | | 3.67 | 64.67 | 23.6 | 11.66 | 4.7 |
| Tilili | Scavenging | | 11 | 67.48 | | | 3.65 |
| Gelila | Scavenging | | 9.25 | 74.7 | | | 4.13 |
| D.elias | Scavenging | | 8 | 60.35 | | | 2.8 |
| M.hamusit | Scavenging | | 10 | 66.45 | | | 3.8 |
| Farta | Scavenging | | 11.25 | 71.2 | | | 3.65 |
| Guangua | Scavenging | | 9.75 | 67.83 | | | 4.15 |
| Mecha | Scavenging | | 10 | 67.73 | | | 3.28 |
| W.Ormoia | Scavenging | | 10.64 ± 0.22 | 55.75 ± 0.73 | 20.51 ± 0.25 | 16.1 ± 0.34 | 2.90 ± 0.24 |
| Gomma | Scavenging | | 10.16 | 50.62 | 21.37 | 14.79 | 2.49 |
| HU PF | intensive | 40.48 | 8.58 | 87.54 | 30.27 | 14.67 | 7.23 |
| Haramaya | Scavenging | 37.09 | 12.25 | 68.07 | 23.01 | 15.6 | 4.24 |
| Harar | Scavenging | 35.46 | 12.5 | 69.99 | 21.16 | 15.54 | 4.23 |
| Dire Dawa | Scavenging | 38.58 | 11.58 | 72.85 | 22.93 | 15.31 | 4.93 |
| Bure | extensive | | 8.6 ± 1.5 | 66.5 ± 7.2 | 19.6 ± 1.8 | 14.6 ± 0.8 | 4.1 ± 1.9 |
| Fogera | extensive | | 9.06 ± 0.6 | | 22.13 ± 1.1 | 16.3 ± 0.5 | |
| Fogera | extensive | | 9.06 | | 22.13 | 16.28 | |
| Gorogutu | extensive | 356.6 ± 3.9 | 11.5 ± 0.1 | 75.7 ± 1.6 | 25.1 ± 1.5 | 15.1 ± 0.4 | 5.15 ± 0.3 |

BM=Bench Maji, SWS=south west shewa, HUPF=Haramaya university poultry farm, W=western

**Table 4:** Internal egg quality characteristics of exotic chicken under different management system in Ethiopia

| Breed | Management | YH | YI | AH | YW | YC | AW |
|---|---|---|---|---|---|---|---|
| IB | extensive | 17.41 ± 1.52 | | 6.30 ± 1.85 | 16.14 ± 1.89 | 9.74 ± 3.13 | 33.37 ± 5.85 |
| BB | extensive | 17.84 ± 1.67 | | 6.92 ± 1.62 | 15.97 ± 1.77 | 7.77 ± 3.15 | 34.54 ± 5.67 |
| KK | extensive | 17.84 ± 0.81 | | 5.64 ± 1.55 | 15.90 ± 3.57 | 10.79 ± 1.98 | 25.54 ± 3.94 |
| IB | extensive | | 377.13 ± 5.96 | 6.94 ± 0.34 | | 8.62 ± 0.24 | |
| IB c | extensive | | 358.07 ± 5.9 | 5.42 ± 0.34 | | 10.35 ± 0.24 | |
| BB | extensive | 16.2 ± 0.06 | | 7.10 ± 0.08 | 16.70 ± 0.10 | 3.30 ± 0.37 | 36.1 ± 0.16 |
| LW | intensive | 17.70 ± 0.6 | 45 ± 1.8 | 7.1 ± 0.51 | | 11.2 ± 0.43 | |
| NH | intensive | 18 ± 0.67 | 47.1 ± 2.24 | 5.5 ± 0.78 | | 11.9 ± 0.50 | |
| NN*LW | intensive | 17.7 ± 0.9 | 45 ± 2.07 | 6 ± 0.72 | | 11.8 ± 0.58 | |
| NN*NH | intensive | 17.5 ± 0.59 | 46.3 ± 1.8 | 5 ± 0.70 | | 11.7 ± 0.56 | |
| RIR | Intensive | 17.34 ± 0.76 | | 7.87 ± 0.65 | 17.20 ± 1.10 | 9.25 ± 2.75 | 33.05 ± 2.77 |
| BW | intensive | 15.49 ± 0.63 | | 6.37 ± 0.54 | 15.29 ± 1.21 | 9.67 ± 2.25 | 30.48 ± 2.56 |
| BB | extensive | | 39.2 ± 4.83 | | | 10.1 ± 1.55 | |
| SASO | extensive | | 41.0 ± 4.36 | | | 10.6 ± 2.01 | |
| KK | extensive | | 40.2 ± 6.65 | | | 11.2 ± 2.22 | |
| BB | extensive | 17.48 ± 1.99 | | 8.98 ± 1.67 | | 7.26 ± 1.21 | |
| SASO | extensive | 17.19 ± 1.32 | | 7.51 ± 2.09 | | 9.24 ± 1.67 | |
| BB | extensive | 17.70 ± 2.49 | | 7.52 ± 1.06 | | 7.66 ± 1.49 | |
| SASO | extensive | 17.25 ± 1.27 | | 7.59 ± 2.11 | | 9.36 ± 1.83 | |
| RIR | | | | 6.69 | 13.13 | 4 | 28.7 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| SassoT44 | scavenging | 18.64 ± 1.12 | - | 7.69 ± 0.87 | 15.65 ± 1.96 | 12.03 ± 2.03 | 36.15 ± 3.93 |
| IB | Intensive | 17.81 ± 0.79 | | 6.17 ± 1.08 | 16.69 ± 1.83 | 6.13 ± 1.55 | 37.23 ± 4.37 |
| BB | intensive | 18.57 ± 0.33 | | 9.51 ± 1.37 | 15.39 ± 1.28 | 6.10 ± 1.73 | 35.98 ± 4.28 |
| KK | intensive | 17.59 ± 0.89 | | 5.53 ± 1.33 | 14.54 ± 1.14 | 10.3 ± 0.13 | 26.07 ± 2.69 |
| IB | Village | 17.35 ± 1.42 | | 6.34 ± 1.81 | 16.14 ± 1.89 | 9.78 ± 3.19 | 33.19 ± 5.89 |
| BB | village | 18.11 ± 0.91 | | 6.92 ± 1.62 | 15.97 ± 1.77 | 7.77 ± 3.15 | 34.54 ± 5.67 |
| KK | village | 17.80 ± 0.83 | | 5.54 ± 1.35 | 15.94 ± 3.50 | 10.72 ± 1.97 | 25.14 ± 2.65 |

RIR=road island red, BW= bovans white, KK=koekoek, IB= Isa brown, BB=bovanus brown, IBC= Isa brown crosses, NH=New Hampshire, LW=lohmann white, NN*LW= naked neck and lohmann cross, Na*NH= naked neck and New Hampshire cross, AH=albumen height, YI=yolk index=YH=yolk height, YC=yolk color, YW=yolk weight, AW=albumen weight, HU= huagh unit

gland [15]. According to showed that the deposition of calcium is closely associated with the shell thickness of chickens, which leads to metabolized from the bones of birds and the nutritional sources (Tables 3 and 4).

## Internal egg quality traits

Some of the internal egg characteristics of indigenous and improve chicken in Ethiopia is summarized in Table 3 and 4. The internal egg quality is involving the albumen quality, yolk quality and blastoderm size, good quality traits are beneficial to poultry breeding industries . According to the internal egg quality is influenced by factors such as egg storage, bird strain and age, induced moult, nutrition, ingestion of contaminants and disease [16]. The average yolk colors of eggs from local hens are 8.6 and 9.06 for Bure and Fogera districts, respectively. This is higher than the reported value of 3.5 and 4.0 for eggs collected from intensively managed local hens of northwest Amhara and RIR hens, respectively. However, this result slightly lower than the yolk color of egg from Isa Brown and Koekoek breeds under village management system in East Shewa. On the other hand, the yolk color of egg from Isa Brown and Bovas Brown breeds in intensive management slightly lower than the result found for Isa Brown and Koekoek under village condition. On the contrary, the yolk color of local, exotic and their cross chicken in Chelliya district was 10.69±0.24, 8.62±0.24 and 10.35±0.24 respectively [17]. Yolk color is a key factor in any consumer survey relating to egg quality. Consumer preferences for yolk color are highly subjective and vary widely from country to country. The determinant of yolk color is the xanthophyl (plant pigment) content of the diet consumed. Similarly, also reported that the low yolk color value observed might be attributed to the period of the experiment (dry season) and shortage of green plant materials for the scavenging chickens. According to the average yolk and albumen height of eggs collected from Bure are 15.1 mm and 4.1 mm, respectively. Similarly, also reported that the mean of albumen height is (6.17, 6.34), (9.51, 6.92) and (5.53, 5.54) mm for Isa Bovan, Bovan Brown and Potchestroom Koekoek under intensive and village production systems respectively. The same author reported that the mean yolk height is (17.81, 17.35), (18.57, 18.80) and (18.57, 18.51) mm of Isa Bovan, Bovan Brown and potchestroom Koekoek under intensive and village production systems respectively [18]. The albumen height is important criteria for analysis of internal quality of egg. Extended storage time and higher storage temperature decrease the albumen height, and thus degrade the internal quality of the egg. Reported that the average Haugh unit of local chicken is 75.69, which is higher than the value of 61.1 reported by for eggs collected from local chicken ecotypes of northwest Amhara. However, the average Haugh unit is 81.0 found by the same author for eggs collected from intensively managed RIR chicken. Eskinder A, gives an explanation for average Haugh unit value (<72) which is smaller attributed to poor handling and storage of eggs until sale, since egg Haugh unit value is highly correlated with storage condition and duration of eggs [19]. The average Haugh unit of indigenous, cross and exotic chicken breed in Chelliya district was 69.13±2.21g, 74.50±2.21g and 82.63±2.21g respectively. The same author reported that the albumin height of indigenous, cross and exotic chicken was 4.37±0.34mm, 5.42±0.34mm and 6.94±0.34 respectively. revealed that the mean albumen height, albumen weight, HU, yolk color and yolk weight of chicken under intensive management system ranged between 4.23 to 6.96 mm, 17.71 to 28.7gm,55 to 81%, 3 to 4 and 10.81 to 13.34 in Gomma district [20-22]. The main factor that changes the internal egg quality in terms of albumen height, HU and yolk index, might be due to water loss by evaporation through the pores in the shell and the escape of carbon dioxide from albumen, so the consequences of this may be progressive loss in egg weight and a continual decline in egg quality and also management difference, age of birds, quality and quantity of feed and production environment may cause of the lower value of internal egg quality traits or parameters and genetic background of chickens. Chickens which have low albumin height and HU might be due to disease like infectious bronchitis that impair synthesis of albumin proteins in magnum, low culling practice and maintaining old hens and/or poor egg handling technique, high water uptake with succulent feed items and quality deterioration during transportation [23].

These differences might be due to the duration and storage temperature as well as the age of the hens. The genetic potentials of individual chicken ecotypes may also contribute to the observed variations. High value of yolk color in the current study and in another place in the country might be attributed to the quality and availability of greenish scavengeable feeds in the free-range production system [24]. It is generally assumed that since local chickens get their feed merely by scavenging their eggs contain appreciable amounts of xanthophylls which are responsible for deep yellow color of the yolk. It would also worthwhile to note that some of the works with low yolk color might have been conducted under intensive management system [25-27]. These differences might arise from variations in nutrient composition of the available feed resources, culling practice, egg handling and storage techniques. The internal egg quality traits are influenced by the quality and quantity of the feed supplied to the chickens, pre and post-handling process as well as the way the feed is stored and the protein content of the feed.

## Discussion

This review providing information regarding internal and external egg characteristics of local and exotic and their crosses chickens in the country. Indigenous chicken not only providing good quality meat but also the source of good quality egg under extensive or scavenging system than exotic strains [28]. The egg qualities of chickens depend on their genotype, age of hen, quality and quantity of feed and storage condition of egg, embryonic development of the egg and production system. Very small sized eggs from the scavenging local chicken with deep yellow yolk color fetch much higher prices compared to larger eggs of improved strains with pale yolk [29]. Local chicken under intensive production

system has higher shell thickness value than improve chickens, but in other egg quality parameters improved chicken have higher value than indigenous chicken in the country except in yolk color.

## Conclusion

Yolk color of improved chicken under extensive feeding production system has comparable value of that of local chicken. Crosses chickens have better yolk color range than exotic strain under scavenging management system. Generally, chicken (exotic and local) breed hens, raised in free-range system have deep yellow yolk color and higher haugh unit than reared under intensive production system [30]. It is thus recommended that the improvement strategies have to consider the trait that favors direct economic importance received from such chicken population at traditional extensive environment and in-depth egg chemical composition evaluation is needed for proper exploitation to further explore the potential of this egg chemical material through improving genetic and husbandry management system of chickens.

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### Conflict of Interest

None

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