

Research Article

# Morphometric and Morphology of Indigenous Chicken Eggs Quality Parameters in East Shewa and West Arsi Zones of Oromia Regional State, Ethiopia

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## Abstract

Indigenous chicken egg was becomes very concerned food in Ethiopia as consumers were highly attractive to eat them. Egg is rich with valuable proteins, vitamins and minerals. The external and internal quality parameters were the main determinant for consumption preference and hatching egg. The egg of indigenous chicken was more preferred among local consumers due to its flavour and tastes. However, there was limited information and, gap of standardized document on egg qualities indigenous chicken ecotypes in this area. Therefore, this study was conducted with objectives of evaluating egg quality parameters of indigenous chicken eggs and characterize external and internal egg quality traits to establish a base for indigenous chicken designing breeding program under smallholder farmers in selected districts of East Shewa and West Arsi zones, Oromia regional state, Ethiopia. A total of 1200 fresh egg were used in this study. The results of study revealed that overall mean egg weight indigenous chicken in this study was  $41.28 \pm 3.4.8g$ . The overall mean egg length and egg width in this study were  $51.12 \pm 2.5mm$  and  $37.82 \pm 1.6mm$  respectively. The egg shape index in current study was  $74.15 \pm 3.6\%$ . The egg shell weight of indigenous chickens in current study was  $4.8 \pm 0.8g$  with shell ratio of  $11.8 \pm 2.6\%$ . The overall mean yolk weight and albumen weight of indigenous chickens' egg in this study area were  $15.4 \pm 2.6g$  and  $20.4 \pm 3.4g$  respectively with albumen ratio and yolk ratio of  $38.12 \pm 5.4\%$  and  $50.25 \pm 5.6\%$  respectively. The overall estimated haugh unit of indigenous chicken egg in present study was 78. The indigenous chicken egg in the current study showed a normal shape. On the other hand, egg size of indigenous of this study was categorized under small size based on standard egg quality parameters set and thus, need further improvement for better productivity of indigenous chicken under prevailing production system.

## Keywords

Egg Size, Normal Shape, Quality Traits, Egg Quality Ratio

## 1. Introduction

The chicken egg is a biological structure proposed by nature for reproduction and providing a complete diet for the

developing embryo [20]. On the other hand, it is one of poultry product used to reduce animal protein deficiency in the

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nutrition of smallholder farmers. Therefore its quality parameters were very important hatching better quality chicks and human consumption. Quality of eggs and preserving that quality is a function of physical structure and chemical composition. The quality of an egg ascertains the success of a poultry business because it is associated with the acceptability among the consumers [18]. Egg quality traits are foremost selection standard in poultry. The egg quality is one of the most important economic factor in poultry industry for both hatching and table eggs [13]. Egg quality is a factor that contributes to the better economic price of fertile and table eggs. Smallholders' farmers in village keep chicken for different purpose and the main purpose and objective was for egg production to sell in local market [23]. Therefore it crucial to evaluate its external and internal quality parameters of egg. The quality of egg determined based on both external and internal quality parameters. The external and internal egg quality traits were influenced by factors such as agro-ecology, breeding, and their interaction [19]. External and internal egg quality traits are the determinant factors for the embryonic development of an egg and latter for the viability of the new hatched chick [17]. The external quality of the egg is determined by features such as the egg weight and shape of the egg, shell thickness, and strength of the shell [5]. Egg weight is also one of the important phenotypic traits that affects egg quality and reproductive fitness of the chicken [12]. Egg shape index is defined as the ratio of width to length of the egg, and it is an important criterion in determining egg quality. The shell thickness measure shell strength mainly for reduce egg shell breakages [3, 6]. The internal quality is measured based various internal components such as weight of yolk, albumen weight and its contents ratio and yolk color. As regards the internal egg quality characteristics, thick albumen is quite an important measure for the freshness of an egg [27]. The albumen weight was influenced by the agro-ecological variation [8]. Haugh unit is one internal egg quality that was considered as a typical measure of albumen quality. Haugh unit is also dependent on management system of birds, quality and quantity of feed, production environment and also storage condition of the eggs [2]. With current increasing human population of Ethiopia, the poultry products particularly egg was considered as future food concerns, due short generation and high reproductive rate of chickens. Furthermore, in the market consumers prefer indigenous chicken's eggs over eggs from exotic chicken. The market value of eggs from indigenous chicken is also relatively higher even its size is smaller than exotic chicken's eggs. Understanding the quality of eggs laid by chickens is essential as it serves as an indicator of productivity, overall chicken care, business success and embryonic development. However, there was no research work on identifying of egg quality parameters of indigenous chicken egg in this area. Therefore, it was conducted to identify egg quality parameters of indigenous chicken ecotype for genetic improvement

of chicken genetic resources on sustainable basis for smallholder village poultry producers.

## 2. Materials and Methods

### 2.1. Description of the Study Area

The study was conducted in Bora, Adama and Lume districts from East Shewa zone and Siraro, Shashemene, Dodola and districts from West Arsi zone.

**Bora district:** The Bora district is located in the East Shewa Zone of the Oromia Region in Ethiopia within the Great Rift Valley. Its administrative center is the town of Bote. Its coordinates are roughly 8.30 °N latitude and 38.95 °E longitude. It is located about 238 kilometers South of Addis Ababa. Its features was a semi-arid climate and experiences warm, dry conditions with average daytime temperatures of 25 °C to 27 °C. The district receives an average annual rainfall of 700 mm to 800 mm and one main rainy season between June and September. The altitude of district generally ranges from 1,611 to 2,000 masl.

**Adama district:** The Adama district is found East Shewa Zone of the Oromia Region in Ethiopia. The administrative town, Adama is located 99 km southeast of the capital, Addis Ababa. The district features altitude ranges from 1,415 to 2,505 masl. The districts lies 8 °14' N to 8 °40' N and a longitude of 39 °4' to 39 °29' E. The Annual temperatures generally range from 15 °C to 28 °C. The weather is mostly hot and dry during the winter, and warm and sunny during the summer. The area receives an average of 700 to 800 mm of rain annually.

**Lume district:** The Lume district is located in the East Shewa Zone of the Oromia Region in Ethiopia. It is Located about 70 km southeast of Addis Ababa. Its latitude between 8 °24' and 8 °50' North and a longitude of 39 °01' to 39 °28' East. Its altitude ranges from 1,500 to 2,300 masl. The district is generally warm, with average highs usually ranging between 23 °C and 28 °C throughout the year. The hottest months are typically from April to June. The annual rainfall typically falls between 700 mm and 850 mm. The main wet season (Kiremt) occurs during July and August.

**Siraro district:** Siraro is a rural district in the West Arsi Zone of Ethiopia's Oromia Region. It is located about 330 km south of Addis Ababa. It lies in the Great Rift Valley, with altitudes ranging from 1,500 to 2,750 masl. The district generally characterized by a semi-arid to sub-humid tropical climate.

**Shashemene district:** The Shashamane district found in the West Arsi Zone of the Oromia Region, Ethiopia. It located 250 kilometers south of Addis Ababa. Sitting in the Great Rift Valley, its geographic coordinates are 7 °14' N latitude and 38 °36' E longitude, at an elevation of 2,053 masl. The annual average temperatures of the district is between 20 °C and 28 °C.

**Dodola district:** Dodola District is located in the West Arsi Zone of the Oromia Region, southeastern Ethiopia. It sits at

latitude and longitude 06°59' N 39°11' E and lies at an elevation of 2,362 to 2,493 masl. Dodola district experiences a mild highland climate, with average temperatures generally ranging from 9 °C to 26 °C (48 °F to 79 °F) year-round. The total

rainfall of the district generally ranges between 1,000mm and 1,200mm annually.

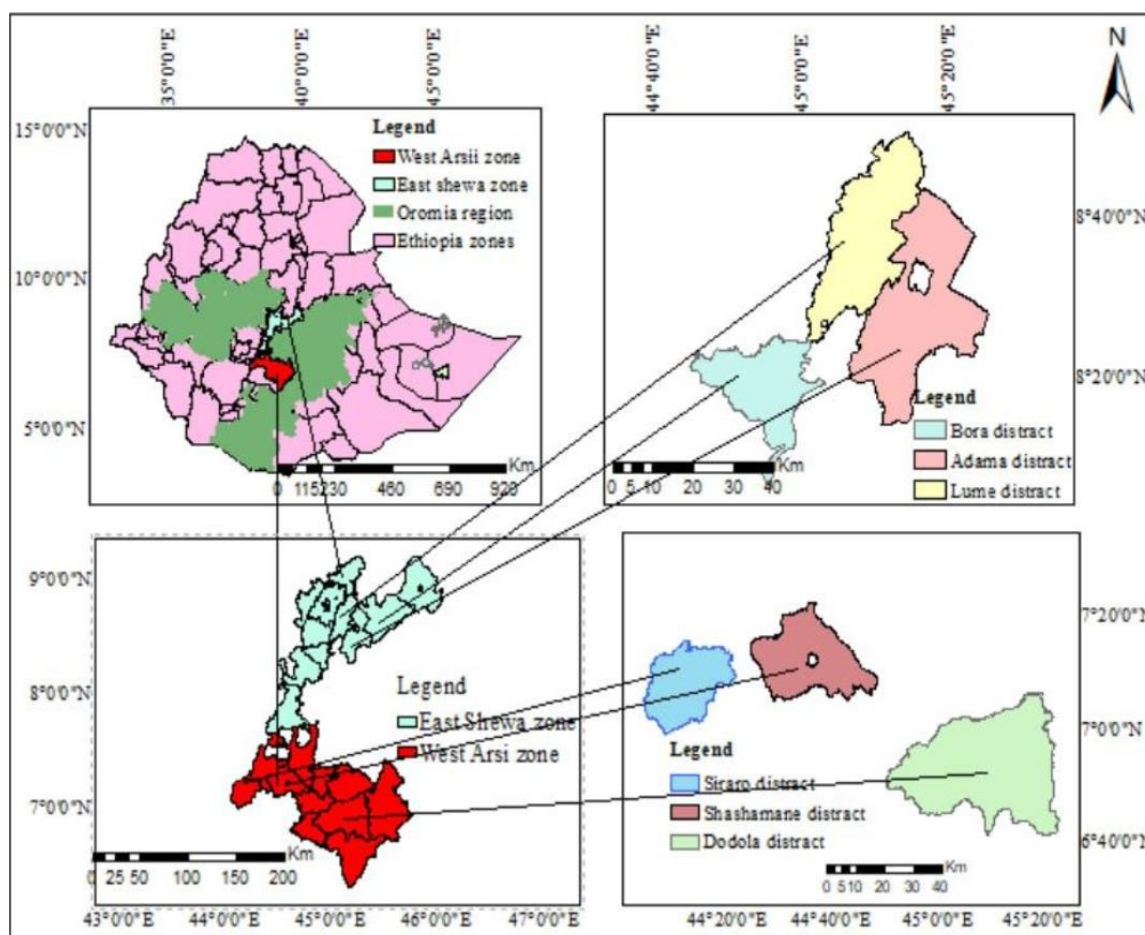


Figure 1. Map of study area.

## 2.2. Sampling and Data Collection

The egg quality parameters evaluation were taken from a total of 1200 (200 eggs purchased from six districts). A total of eight (12) Kebeles, (2) Kebeles per district were selected purposively based on potentiality of indigenous chicken population and accessibility to main road for ease data collection. The fresh eggs were purchased from village households. The households were previously informed to prepare eggs laid within few days. Then eggs were purchased and transported to Adami Tullu Agricultural Research Center for taking egg quality parameters. At time of purchasing external cleanness and surface breakage of the egg was observed before purchased. Additionally, the freshness of eggs was also checked through pointing to sun light and observation physical feature.

## 2.3. Egg Quality Trait Measurement

The weight of egg was measured using digital balance. The egg width and length was measured using digital caliper. For internal egg quality measurement traits, egg was gentle broken on flat plate and albumen and yolk was carefully separated. The albumen weight and yolk weight were measured using sensitive balance. Shell thickness was measured using digital caliper after removal of the inner shell membrane. The egg shell thickness was measured on eggs taken from middle and both end points. The averages of the three points were used as the thickness of the egg. Albumen height and yolk height was determined using tripod micrometer. Yolk color was recorded from Roche fan color (1–15) levels. Haugh unit was computed from Haugh unit calculate Table by considering albumen height (mm) and egg weight (g). The egg shape index, egg shell ratio, yolk ratio and albumen ratio were calculated using

the following formulae.

$$\text{Egg shape index} = \text{Egg width (mm)} \times (100\%) / (\text{Egg length (mm)})$$

$$\text{Shell ratio(\%)} = \text{shell weight (g)} \times (100\%) / \text{Egg weight (g)}$$

$$\text{Yolk Ratio} = \text{yolk weight (g)} \times (100\%) / \text{Egg weight (g)}$$

$$\text{Albumen ratio} = \text{Albumen weight (g)} \times (100\%) / \text{Egg weight (g)}$$

## 2.4. Statistical Analysis

The data collected from egg quality parameters were analyzed using GLM procedures (SAS, 2012 version 9.3) by adjusting zones as independent variables. The parameters expressed in terms of ratio or percentage was first converted to target parameters using Microsoft Excel 2010.

## 3. Results and Discussion

### 3.1. External Egg Quality Parameters

#### 3.1.1. Egg Weight

The results of current study revealed that the overall mean of egg weight in the study area was  $41.28 \pm 3.4$  (Table 1). This result was similar with [11, 28] who reported average egg weight of  $41.13 \pm 1.26$ g and  $41.89 \pm 3.98$ g respectively. On contrary, egg weight value of present study was lower than findings of [14, 25] who reported average egg weight of indigenous chicken  $43.9 \pm 4.7$ g and  $49.41 \pm 4.45$ g in respectively. Similarly, [27] reported egg weight higher than current study which was of  $45.20 \pm 5.53$ g for local chicken in Hawasa town. This difference might be due to management; as chicken reared in town get better management thus laid relatively larger size egg than village chicken. Based on UNESE [2010] standard, the egg less than 53g weight was considered as small size. Based this standard, the egg weight of current study was classified under small size egg.

#### 3.1.2. Egg Length

The egg length in the current study was  $51.12 \pm 2.5$ mm (Table 1). This result was slightly similar with findings of [9] who reported mean grand egg length of  $51.76 \pm 0.21$ mm in western Oromia, Ethiopia. On the other hand, the result of presented study was slightly higher than findings of [26] who reported egg length of  $49.84 \pm 2.584$ mm in Siltie zone, Ethiopia. However, the result of present study was lower than egg length of  $53.25 \pm 2.80$ mm reported by [16].

#### 3.1.3. Egg Width

The overall egg width in the current study was  $37.82 \pm 1.6$ mm (Table 1). This result was slightly lower similar with findings of [29] who reported average egg width of  $38.24 \pm$

$0.19$ mm in Northern Ethiopia. On the other hand, the result of current study was slightly higher than egg width value of  $36.74 \pm 0.14$ mm reported by [9] in Western Oromia, Ethiopia. On contrary, higher than present study result egg width of  $40.31 \pm 0.12$ mm was reported by [22] for Indigenous Free Range Chicken Eggs in Lusaka, Zambia.

#### 3.1.4. Egg Shape Index

The egg shape index in present study ( $74.15 \pm 3.6\%$ ) (Table 1). This result was similar with findings of [24] who reported  $74.10 \pm 0.45\%$  in Western Kenya. Higher than current study of  $75.21 \pm 4.276\%$  egg shape index was reported by [26] in Siltie Zone of Ethiopia. On other hand, result of current study was higher than findings of [25] and [14] who reported of egg shape index  $72.2\%$  in Southern Ethiopia and  $72.66 \pm 4.95$  in Sidama region of Ethiopia respectively. Eggs are categorized into three shape groups: Sharp ( $<72$ ), normal ( $72-76$ ) and round ( $>76$ ). Based on this classification, the eggs of indigenous chicken's current in the study classified as normal shape.

#### 3.1.5. Shell Weight

The mean egg shell weight in present study was  $4.8 \pm 0.8$ g (Table 1). This result was slightly similar with findings of [15] who reported egg shell weight of  $4.38 \pm 0.66$ g in Sidama region. On the other hand, slightly higher than current result of average shell weight of  $5.10 \pm 0.06$ g and  $5.33 \pm 0.25$ g were reported by [29] and [7] in Northern and southwestern, Ethiopia respectively. On contrary, the result of this study was slightly higher than report of [26] who reported egg shell weight of  $3.42 \pm 0.567$ g in Siltie zone, Ethiopia.

#### 3.1.6. Shell Thickness

The egg shell thickness in the present study was  $0.3 \pm 0.04$ mm (Table 1). This result was Similar with [19] who was reported average egg shell thickness of  $0.31 \pm 0.03$ mm,  $0.3 \pm 0.02$ mm and  $0.32 \pm 0.02$ mm in Highland, midland and lowland respectively in Silte zone, Southern Ethiopia. On contrary, value higher than current study of  $0.36 \pm 0.01$ mm and ( $0.37$  mm) egg shell thickness were reported by [29] and [1] in Northern Ethiopia and Ethiopian naked neck chickens reared under improved production system respectively. On other hand, the shell thickness in the present study was slightly higher than findings of [10] who reported that  $0.26$  mm in Northwestern Ethiopia.



### 3.1.7. Shell Ratio

The overall egg shell ratio in current study was  $11.8 \pm 2.6\%$  (Table 1). In normal cases the percentage of yolk ratio of egg was ranges from 8%-12% with average of 11%. Based on standard egg shell ratio indigenous chickens egg in this study area had normal egg shell percentage. The result of present study was slightly higher than egg shell ratio of 10.55% reported by [9] in western Oromia, Ethiopia. On contrary, the

result of present study was lower than findings of [22] who reported mean shell ratio of  $12.78 \pm 0.06\%$  for free range indigenous chicken in Lusaka, Zambia. On the other hand, the value in the current study was higher than findings of [8] who reported mean shell ratio of  $8.77 \pm 1.74\%$ ,  $8.30 \pm 1.20$  and  $9.15 \pm 1.685$  in lowland, midland and highland respectively agro ecology in Southern, Ethiopia.

**Table 1.** External egg quality traits of indigenous chicken in the study area.

| Parameters (Mean $\pm$ SD) | Study zones     |                 | Overall         |
|----------------------------|-----------------|-----------------|-----------------|
|                            | East Shewa      | West Arsi       |                 |
| Egg weight (g)             | 40.96 $\pm$ 4.6 | 41.5 $\pm$ 5.2  | 41.28 $\pm$ 3.4 |
| Egg length (mm)            | 51.53 $\pm$ 2.6 | 50.64 $\pm$ 2.9 | 51.12 $\pm$ 2.5 |
| Egg width (mm)             | 38.22 $\pm$ 1.8 | 37.44 $\pm$ 1.6 | 37.82 $\pm$ 1.6 |
| Shape index (%)            | 74.2 $\pm$ 3.7  | 73.9 $\pm$ 4.1  | 74.15 $\pm$ 3.6 |
| Shell weight (g)           | 5.0 $\pm$ 0.02  | 4.4 $\pm$ 0.73  | 4.8 $\pm$ 0.8   |
| Shell thickness (mm)       | 0.30 $\pm$ 0.04 | 0.31 $\pm$ 0.04 | 0.31 $\pm$ 0.03 |
| Shell ratio (%)            | 12.4 $\pm$ 1.4  | 11.4 $\pm$ 1.5  | 11.8 $\pm$ 2.6  |

mm=millimeter, g=gram, %, = percent

## 3.2. Internal Egg Quality Parameters

### 3.2.1. Yolk Weight

The overall mean yolk weight in present study was  $15.1 \pm 2.6$ g (Table 2). This result was similar with findings of [4] and [16] who reported average egg yolk weight of 15.06g and  $15.21 \pm 0.27$ g in Kutaber district, South Wollo of Ethiopia and Gena Bossa district of Dawro zone respectively. On the other hand, the result of current study was lower than findings of [15] who reported yolk of  $17.86 \pm 1.96$ g in Sidama region of Ethiopia. Similarly, higher than current study results of  $16.90 \pm 2.60$ g,  $16.80 \pm 2.00$ g and  $16.40 \pm 2.17$ g yolk weight were reported by [8] in lowland, midland and highland agroecology of southern Ethiopia respectively.

### 3.2.2. Yolk Height

The overall yolk height in this study was  $14.2 \pm 1.2$ mm (Table 2). This result was slightly similar to finding of [26] who reported yolk height of  $14.97 \pm 1.169$ mm in Siltie Zone, Ethiopia. On other hand, the result of this study was lower than mean yolk height of  $16.17 \pm 2.24$ mm in lowland,  $15.70 \pm 1.31$ mm in midland and  $16.80 \pm 1.10$ mm in highland reported by [15] in Sidama region, Ethiopia. Similarly, mean yolk height of  $15.69 \pm 1.31$ mm was reported by [14].

### 3.2.3. Yolk Ratio

The overall mean yolk ratio in this study was  $36.8 \pm 5.5$  % (Table 2). In normal cases the percentage of yolk ratio of egg was ranges from 27% -32% with average of 30%. Based on this standard, egg of indigenous chickens in the study had higher egg yolk ratio. The result of present study was similar with findings of [15] who reported yolk ratio of  $36.17 \pm 3.92\%$  in Sidama region, Ethiopia. Similarly, [8] was reported mean yolk ratio of  $36.716.90 \pm 2.60$   $16.80 \pm 2.00$   $16.40 \pm 2.170 \pm 5.84\%$  and  $36.40 \pm 4.81\%$  in lowland and highland respectively in southern Ethiopia. The same authors were reported lower present study value of  $34.90 \pm 4.46\%$  yolk ratio in midland agro ecology. On the other hand, the result of current study was higher than findings of [9] who reported yolk ratio of 34.99% in western Oromia, Ethiopia. The result of current study was slightly lower report of [26] who reported egg yolk ratio of  $38.96 \pm 3.754\%$  in Siltie zone, Ethiopia.

### 3.2.4. Yolk Color

The overall mean yolk color indigenous chickens in this study were  $5.18 \pm 1.3$  (Table 2). This result was much lower yolk color of  $9.22 \pm 0.83$  and  $8.37 \pm 0.15$  reported by [26] and [16] in Siltie Zone, Ethiopia and in Gena Bossa district of Dawro zone, South Ethiopia respectively. The difference in

yolk color might be due to availability of green feed as affected by season. In current study, there was higher yolk color value was observed in East Shewa zone than West Arsi zone. This might be due to eggs from East Shewa zone was collected where chickens more access to green feed for scavenging or at time of green feed availability in the study area.

### 3.2.5. Albumen Weight

The overall mean albumen weight in this study were  $20.4 \pm 3.4$ g (Table 2). This result was similar with finding of [28] who reported average egg white weight of  $21.45 \pm 1.71$ g for Konde chicken ecotype in Centre East in Burkina Faso. On contrary, much higher than current of study result of  $28.13 \pm 0.58$ g albumen weight was reported by [21] from indigenous chicken of India. This difference might be due to ecotype breed difference and others management aspects.

### 3.2.6. Albumen Height

The average albumen height in this study was  $5.24 \pm 2.8$ mm (Table 2). This results was slightly nearby to the results of [3] who reported (5.79 mm) albumen height for local Kei chicken raised in Guraghe zone. On the other hand, [26] and [9] who were reported albumen height of  $4.59 \pm 0.749$ mm and  $4.48 \pm 0.07$  mm which was slightly lower than this study in Siltie Zone and western Oromia of Ethiopia respectively. On contrary, the result of current study was lower than albumen height value of  $6.26 \pm 1.03$ mm reported by [15] in Sidama region, Ethiopia.

### 3.2.7. Albumen Ratio

The overall mean albumen ratio in this study was  $50.25 \pm 5.6$  % (Table 2). In normal cases the percentage of albumen ratio of egg was ranges from 51%-61 with average of 58%. Based on this standard, albumen ratio of indigenous chickens egg in present study was below set standard. The result of present study was similar to result of [8] who reported egg albumen ratio of  $50.92 \pm 5.74$  and  $50.60 \pm 6.69$ % in midland and highland of Southern Ethiopia. Similarly, [26] who also reported albumen ratio of  $50.06 \pm 4.838$ % in in Siltie Zone, Ethiopia. The result of this study was lower than finding of [9] who were reported gran mean albumen ratio of 54.71% for unimproved Horro chicken ecotype in Western Oromia.

### 3.2.8. Haugh Unit

The overall mean haugh unit this study was 78. The haugh unit value of chickens egg was ranges from 0-130. Furthermore, this value was categorized into four classes as AA, A, B and C with values of 72 and more, 71-60, 59-31 and 30 or less respectively. Based on this classification the haugh unit of indigenous chicken egg in present study was classified as AA. This was indicated a good haugh unit eggs. This result present study was slightly higher than findings of [14] who reported haugh unit of  $71.61 \pm 9.85$  for indigenous chicken in

Sidama region, Ethiopia. On the other hand, overall mean haugh unit of  $84.23 \pm 6.73$ ,  $71.86 \pm 9.79$  and were  $74.44 \pm 7.29$  were reported by [15] from indigenous chicken in highland, midland and lowland respectively in different agro-ecologies of the Sidama Region, Ethiopia. Similarly, [27] who were reported haugh unit of  $74.91 \pm 15.78$  and  $82.55 \pm 3.82$  in Hawasa and Yirgalem towns respectively.

**Table 2.** The internal egg quality traits of indigenous chicken in the study area.

| Parameters<br>(Mean $\pm$ SD) | Study zones     |                 | Overall         |
|-------------------------------|-----------------|-----------------|-----------------|
|                               | East Shewa      | West Arsi       |                 |
| Yolk weight (g)               | 16.2 $\pm$ 2.5  | 15.0 $\pm$ 2.8  | 15.4 $\pm$ 2.6  |
| Yolk height (mm)              | 14.0 $\pm$ 1.2  | 14.4 $\pm$ 1.2  | 14.2 $\pm$ 1.2  |
| Yolk ratio (%)                | 39.6 $\pm$ 5.5  | 36.5 $\pm$ 5.6  | 38.12 $\pm$ 5.4 |
| Yolk color                    | 6.4 $\pm$ 1.8   | 3.8 $\pm$ 1.3   | 5.18 $\pm$ 1.3  |
| Albumen weight (g)            | 19.8 $\pm$ 3.9  | 21.6 $\pm$ 4.0  | 20.4 $\pm$ 3.4  |
| Albumen height (mm)           | 5.23 $\pm$ 1.24 | 5.18 $\pm$ 1.26 | 5.24 $\pm$ 2.8  |
| Albumen ratio (%)             | 48.4 $\pm$ 4.3  | 52.1 $\pm$ 6.0  | 50.25 $\pm$ 5.6 |
| Haugh Unit (HU)               | 78.2            | 77.8            | 78              |

mm=millimeter, g=gram, %= percent

## 4. Conclusions

Egg quality parameters of indigenous chicken were influenced by several factors such; as production environment, time of data collection, type of scavenging feeds, management practices and chicken ecotype. The storage time might be also great influences on egg quality traits and; difficult to control particularly for indigenous chicken egg purchased from small-holder farmers; additionally, age and body weight of layer hen couldn't be controlled as farmers had no reliable data record and lack information on date of egg lay. Therefore, to get basic information on indigenous chicken eggs as possible controlling freshness egg is very important. The present study was identified major external and internal quality parameters of indigenous chicken eggs in the study area and outlined baseline for future indigenous chicken improvement on sustainable basis under village production system. In general indigenous chickens egg in the study area had a normal shape that fit for hatching, however, they were small size based on standard set. Therefore, any genetic breeding program design can be considered parameters identified in the current study as baseline. Furthermore, weight egg should be improved through systematic selection and another parameters were also simultaneously improved.

## 5. Recommendation

Since egg quality parameters of indigenous chicken in the study area were showed great variation from previous study conducted in different parts of the country or others countries on indigenous chicken eggs, in fact to identify basic information; the causes contributed for such variation should be serious considered and controlled as possible.

## Abbreviations

|      |                       |
|------|-----------------------|
| MASL | Meter Above Sea Level |
| MM   | MILLIMETER            |
| G    | Gram                  |
| SD   | Standard Deviation    |

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## Author Contributions

**Usman Abdulkadir:** Conceptualization, Data curation, Formal Analysis, Investigation, Resources, Validation, Writing – original draft

**Beshir Hussien:** Data curation, Resources, Validation

**Tesfa Geleta:** Conceptualization, Data curation, Resources, Validation

**Nebi Husen:** Data curation, Project administration, Resources, Validation

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## Data Availability Statement

The data is available from the corresponding author upon reasonable request.

## Conflicts of Interest

The authors declare there was no conflict of interest.

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