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Assessment of egg quality traits of Zambian indigenous chickens: A comparative study with Hy-Line Brown and Sasso breeds

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Abstract

The lack of a baseline for egg quality traits in Zambian indigenous chickens (ZIC) hinders improvement programs. This study compared the egg quality traits of ZIC with those of Hy-Line Brown and Sasso chicken breeds. The study used 150 eggs per breed from hens between 26 and 32 weeks of age. Egg weight, yolk weight, and shell weight were measured using a weighing scale, while egg length, width, yolk height and width, and albumen height and width were measured with vernier calipers. Shell thickness was measured with a micrometer gauge. Analysis of variance (ANOVA) and Pearson's correlation analysis were used for data analysis. Breed had a significant effect ($p < 0.05$) on most egg quality traits, with Hy-Line Brown eggs showing superior egg weight (61.66 g), egg width (43.89 mm), surface area (73.98 cm²), albumen height (8.46 mm), and Haugh unit (91.10). Sasso eggs recorded significantly greater yolk weight (19.02 g), yolk diameter (43.51 mm), and yolk-to-albumen ratio (63.62%) compared with those of the other breeds, while ZIC eggs demonstrated significantly higher yolk index (46.97%) and albumen index (0.127). Pearson's correlation analysis revealed significant positive associations between egg weight and major external egg quality traits, particularly with egg width ($r = 0.896$, $p < 0.01$) and egg length ($r = 0.747$, $p < 0.01$) in Hy-Line Brown, as well as albumen weight in ZICs ($r = 0.922$, $p < 0.01$). Strong positive correlations were also observed between Haugh unit and albumen height across all breeds, including Hy-Line Brown ($r = 0.979$, $p < 0.01$), Sasso ($r = 0.974$, $p < 0.01$), and ZICs ($r = 0.977$, $p < 0.01$), indicating association of superior internal egg quality with increased albumen height. Furthermore, ZICs eggs demonstrated significant positive relationships between egg weight and shell thickness ($r = 0.330$, $p < 0.01$), indicating that heavier eggs tended to have thicker shells. This relationship needs further investigation through evaluation of genetic parameters before selection decisions can be made.

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1. Introduction

Eggs are an important source of protein for humans, as delineated by Zhou et al. (2025). In fact, eggs are among the most commonly consumed protein source by humans in relation to other animal protein sources (Zhou et al. 2025). Eggs have a good nutritional profile deemed fit for human consumption (Onyenweaku et al. 2022). With the increasing world population, it is projected that the demand for eggs will increase (Raphulu et al. 2015). Additionally, between 2017 and 2020, egg consumption increased drastically in most parts of the world (Zhou et al. 2025). While eggs remain an important source, their quality becomes a key concern. Egg quality, which plays a key role in consumer perception perceptions and purchasing decisions, is traditionally defined as the set of traits that determine the acceptability of the eggs (Ipek and Sozcu 2017). Ukwu et al. (2017), reported that egg weight is one of the key egg quality traits which usually determines the price and classification of eggs. Egg weight is reported to be influenced by various quality characteristics, including egg width, length, shell weight, yolk weight, albumen weight, and yolk proportion (Tyasi and Çelik 2024). In this context, egg quality traits influence both consumer acceptance and price of eggs. Nonetheless, egg quality traits are influenced by multiple factors, including the age of hens age, genetics, nutrition, housing system, management, and the time of oviposition (Arulnathan et al. 2024; Abebe et al. 2023).

Several breeds have been developed for egg production, such as the Lohmann Brown and Hy-Line Brown chicken breeds. However, these breeds require special management and are usually costly to manage. For small-scale farmers like those in Zambia, these improved breeds are not so common. As a result, most eggs consumed in these communities come from indigenous chickens. Moreover, indigenous chicken breeds remain critically important in rural and backyard poultry systems, because of their strong adaptability to challenging environments, innate resistance to diseases, and ability to make effective use of low-cost feed resources (Kpomasse et al. 2023). Eggs from these indigenous breeds often have unique shell color, internal composition, and sensory characteristics, which attract niche consumers seeking organic or heritage products, which potentially tend to fetch higher market prices (Vasanthi et al. 2025).

In Zambia, indigenous chickens are the most kept domestic birds, with more than 90% of the indigenous population being raised by small-scale farmers (Liswaniso et al. 2020b). This suggests that most available eggs come from these breeds. Therefore, there is an urgent need to focus on improving egg production and productivity in these chickens, not only for preservation but also to enhance protein production for human consumption (Sirri et al. 2018). Moreover, these chickens produce meat in addition to eggs (Amao et al. 2024). Several studies have examined Zambian indigenous chickens (ZIC), focusing on characterization and the use of data mining algorithms (Liswaniso et al. 2020a; Liswaniso et al. 2021). While these studies report egg quality

traits, they do not compare these traits with those of commercially improved breeds. This information provides a baseline for potential improvements.

This study, therefore, sought to document the egg quality traits of ZIC under improved management. Secondly, it compared these traits with those of a commercially improved breed, the Hy-line Brown, and a dual-purpose breed, Sasso. To the best of our knowledge, this is the first study to explore and compare the egg quality traits of ZIC with improved breeds. The study hypothesized that breed does not affect egg quality traits. The findings present differences in egg quality traits among Zambian chickens and other breeds, making it easier for breeders to identify which traits need improvement. The correlation analysis also shows breed-specific phenotypic relationships among egg quality traits. These relationships may help identify traits to investigate further in breeding programs, but they do not establish heritability or genetic associations.

2. Materials and Methods

2.1 Study area

This study was conducted in Lusaka, which is located at a latitude of -15.4167 and a longitude of 28.2833, and has an annual rainfall of 834.933 mm. All analyses were performed at the University of Zambia Nutritional Chemistry Lab. All the hens from which eggs were collected were raised at a farm near the University research facility in Lusaka.

2.2 Hen management

Eggs were collected from Zambian Indigenous chickens (ZIC), Hy-Line Brown, and Sasso chicken breeds between 26 and 32 weeks of age. All hens were fed a commercial diet that met their nutritional requirements. These hens were managed according to standard management practices, including lighting, feeding, and vaccination against Newcastle disease**.** Hens were housed on deep litter at a stocking density of 5 birds/m², with each breed housed in a separate pen. The poultry house was open-sided, with its longer sides open for ventilation. Temperature and ventilation were not regulated, and the study was conducted under ambient temperature and humidity.

2.3 Egg collection and sampling

A total of 450 eggs were used in this study (150 eggs per breed). All eggs were collected on a single day from each breed's flock. Each flock consisted of at least 200 hens between 26 to 32 weeks of age. Because a hen normally lays at most one egg per day, it was assumed that each egg came from a different hen. No hen was sampled more than once. Eggs were randomly selected from the total number of eggs collected from each breed on that day. The sampled eggs were transported to the laboratory immediately after collection and stored at room temperature. All analyses were performed within 12 hours of collection to avoid spoilage. Individual hen identities were not recorded.

2.4 Measurement of external and internal egg quality traits

Each egg was individually examined for its quality traits. Egg weight was measured using a pocket weighing scale with an accuracy of 0.01g. A vernier caliper was used to measure egg length (EL) and egg width (EW). Albumen height and width, as well as yolk height and width, were also measured using a vernier caliper to an accuracy of 0.01 mm. Yolk weight was measured after carefully separating it from the albumen. Shell thickness at the narrow end, middle, and broad end of the egg was measured using a micrometer gauge after the removal of egg contents, and the average of the three measurements was taken as the egg shell thickness. Shell weight was measured after all egg contents were removed. The albumen weight was calculated as the difference between the egg weight and the yolk and shell weights. The remaining traits were calculated using the following formulae.

Egg Shape Index (ESI) = Egg width/ Egg length x 100

Surface area = $4.835W^{0.662}$ (Paganelli et al. 1974)

Specific gravity (SG) = Egg weight/ Egg volume (cm^3) x 100

Albumen Ratio (AR) = Albumen weight/ Egg weight x 100

Albumen index (AI) = Albumen height/ Albumen width x 100

Haugh unit (HU) = $100\log_{10}(H-1.7W^{0.37}+7.57)$

Where H is albumen height (mm) and W is egg weight (g)

Yolk ratio (YR) = Yolk weight/ Egg weight x 100

Yolk index (YI) = Yolk height/ Yolk width x 100

Yolk to Albumen (Y/A) ratio = Yolk weight/ Albumen weight x 100

Yolk weight (%) = Yolk weight/ Egg weight x 100

Shell weight (%) = Shell weight/ Egg weight x 100

Shell Index (ShI) = Shell weight/ Surface area x 100

2.5 Statistical analysis

Data were entered into and cleaned using Microsoft Excel. Statistical analysis was performed using MINITAB V21. For egg quality traits, descriptive statistics were computed, and Pearson's correlation coefficients were calculated to assess the relationships between egg weight and egg quality traits. Analysis of variance (ANOVA) was conducted to determine differences in egg quality traits among the breeds studied. Statistical significance was set at $P < 0.05$, and Tukey's honestly significant difference (HSD) test was used to separate the means with significant differences among the chicken breeds. The effects of breed on egg quality traits were estimated using the following linear models.

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

Where, Y_{ij} is the j^{th} observation of the i^{th} breed, μ is the overall mean, S_i is the fixed of i^{th} breed effect (Zambian indigenous chickens, Hy-Line Brown, Sasso), and e_{ij} is residual error.

3. Results

3.1 Effect of breed on the external egg quality traits

Table 1 shows differences in external egg traits among Hy-Line Brown, Sasso, and Zambian indigenous chickens (ZIC). The results showed that breed significantly affected ($P < 0.05$) all external egg quality traits, with Hy-Line Brown eggs being the heaviest and largest.

3.2 Effect of breed on the egg albumen traits

In the present study, breed significantly affected ($P < 0.05$) all albumen traits (Table 2). The Haugh unit values of the ZIC eggs did not differ significantly from that of Hy-Line Brown chickens, whereas the Sasso chicken eggs had significantly lower values. The albumen width of ZIC eggs (59.73 mm) was lower than that of Hy-Line Brown (79.04 mm) and Sasso (79.73 mm) eggs. This observation is consistent with the smaller size of ZIC eggs and the higher albumen index observed in this breed, since albumen index is calculated as albumen height divided by

Table 1. External egg quality traits by breed

Trait	Hy-Line Brown	Sasso	Zambian indigenous	P-value	η^2
Egg weight (g)	61.66 ± 0.42^c	56.22 ± 0.39^a	49.47 ± 0.37^b	<0.001	0.58
Egg length (mm)	55.88 ± 0.20^a	55.89 ± 0.18^a	53.57 ± 0.18^a	<0.001	0.24
Egg width (mm)	43.89 ± 0.16^c	42.81 ± 0.14^a	40.69 ± 0.14^b	<0.001	0.43
Shape index (%)	78.59 ± 0.33^b	76.68 ± 0.30^a	76.03 ± 0.29^a	<0.001	0.09
Surface area (cm2)	73.98 ± 0.35^c	69.60 ± 0.32^a	63.93 ± 0.31^b	<0.001	0.59
Specific gravity	1.09 ± 0.006^c	1.049 ± 0.005^b	1.068 ± 0.005^a	<0.001	0.09

Values are means ± pooled SEM. Mean values within a row with different superscript letters differ significantly at P < 0.05 (Tukey HSD). η^2 = eta-squared, the proportion of total variance explained by breed; $\eta^2 \geq 0.14$ indicates a large effect, ≥ 0.06 medium, and ≥ 0.01 small

Table 2. Egg albumen traits by breed

Trait	Hy-Line Brown	Sasso	Zambian indigenous	P-value	η^2
Albumen weight (g)	34.00 ± 0.39^c	30.51 ± 0.36^a	27.56 ± 0.34^b	<0.001	0.31
Albumen height (mm)	8.46 ± 0.11^c	7.10 ± 0.10^b	7.53 ± 0.10^a	<0.001	0.19
Albumen width (mm)	79.04 ± 0.62^a	79.73 ± 0.57^a	59.73 ± 0.54^a	<0.001	0.71
Albumen ratio (%)	55.07 ± 0.46^{ab}	54.21 ± 0.42^a	55.62 ± 0.40^{ab}	0.055	0.02
Albumen index	0.108 ± 0.002^a	0.090 ± 0.002^b	0.127 ± 0.002^c	<0.001	0.41
Haugh unit	91.10 ± 0.66^b	84.77 ± 0.61^a	89.58 ± 0.58^b	<0.001	0.14

Values are means ± pooled SEM. Means within a row with different superscript letters differ significantly at P < 0.05 (Tukey HSD). η^2 = eta-squared, the proportion of total variance explained by breed; $\eta^2 \geq 0.14$ indicates a large effect, ≥ 0.06 medium, and ≥ 0.01 small

albumen width.

3.3 Effect of breed on the egg yolk traits

Significant breed differences (P < 0.05) were observed in yolk traits (Table 3). Sasso eggs had the highest percentage yolk weight, whereas eggs from Hy-Line Brown hens had the lowest.

3.4 Effect of breed on the shell traits

Table 4 presents a comparison of shell quality traits across the three breeds. All shell traits differed significantly (P < 0.05) among breeds, with ZIC recording the lowest absolute egg shell thickness. Shell weight was highest in Hy-Line Brown eggs, with no significant differences between Sasso and ZIC eggs. Hy-Line Brown had the highest percentage shell weight, followed by ZIC and then Sasso. Shell index was highest in Hy-Line Brown, with ZIC being intermediate and Sasso the lowest. Since ZIC eggs were smaller, shell traits were also interpreted relative to egg size. ZIC eggs had intermediate values for

Table 3. Egg yolk traits by breed

Trait	Hy-Line Brown	Sasso	Zambian indigenous	P-value	η^2
Yolk weight (g)	14.34 ± 0.19^b	19.02 ± 0.18^c	15.69 ± 0.17^a	<0.001	0.51
Yolk height (mm)	15.99 ± 0.19^b	17.44 ± 0.18^a	18.37 ± 0.17^c	<0.001	0.2
Yolk diameter (mm)	39.96 ± 0.20^a	43.51 ± 0.18^c	39.13 ± 0.17^b	<0.001	0.5
Yolk ratio (%)	23.29 ± 0.34^b	33.94 ± 0.31^c	31.80 ± 0.30^a	<0.001	0.64
Yolk index (%)	40.04 ± 0.48^a	40.19 ± 0.44^a	46.97 ± 0.42^a	<0.001	0.32
Yolk: albumen ratio (%)	42.76 ± 0.95^b	63.62 ± 0.87^c	57.49 ± 0.84^a	<0.001	0.44
Percent yolk weight (%)	23.29 ± 0.34^b	33.94 ± 0.31^c	31.80 ± 0.30^a	<0.001	0.64

Values are means ± pooled SEM. Means within a row with different superscript letters differ significantly at P < 0.05 (Tukey HSD). η^2 = eta-squared, the proportion of total variance explained by breed; $\eta^2 \geq 0.14$ indicates a large effect, ≥ 0.06 medium, and ≥ 0.01 small

Table 4. Egg shell traits by breed

Trait	Hy-Line Brown	Sasso	Zambian indigenous	P-value	η^2
Shell weight (g)	7.98 ± 0.07^b	6.22 ± 0.06^a	6.21 ± 0.06^a	<0.001	0.6
Shell thickness (mm)	0.415 ± 0.005^a	0.407 ± 0.004^a	0.359 ± 0.004^a	<0.001	0.22
Percent shell weight (%)	12.97 ± 0.10^c	11.09 ± 0.09^b	12.57 ± 0.09^a	<0.001	0.38
Shell index	10.79 ± 0.08^c	8.94 ± 0.07^b	9.71 ± 0.07^a	<0.001	0.46

Values are means ± pooled SEM. Means within a row with different superscript letters differ significantly at $P < 0.05$ (Tukey HSD). η^2 = eta-squared, the proportion of total variance explained by breed; $\eta^2 \geq 0.14$ indicates a large effect, ≥ 0.06 medium, and ≥ 0.01 small

both percentage shell weight and shell index.

3.5 Effects of breed on the correlations between egg weight and egg quality traits

The correlations between egg weight and egg quality traits varied among the three breeds. Egg weight was positively correlated with egg length and width across all breeds, with the lowest correlations observed in ZIC (Table 5). The highest significant ($P < 0.05$) positive correlation ($r = 0.992$) between egg weight and albumen weight across breeds was recorded in ZIC eggs (Table 6). Generally, correlations between egg weight and yolk traits were higher in ZIC eggs than in the eggs of other two breeds (Table 7). In ZIC eggs, all yolk traits were significantly correlated ($P < 0.05$) with egg weight, except for the yolk index ($r = 0.118$). ZIC also had significantly higher positive correlations between egg weight and both shell thickness and shell weight (Table 8).

4. Discussion

Hlokoe et al. (2026) delineated that genotype affects external egg quality traits in the South African Potchefstroom Koekoek and Lohmann Brown chicken breeds. The findings showed that genotype significantly affected all measured external egg quality traits, except unit shell surface weight. Similarly, the present study found that genotype significantly affected all measured external egg quality traits, with Hy-line Brown eggs being the heaviest, followed by Sasso and the Zambian Indigenous chicken (ZIC) breed, respectively. These findings may be due to genetic differences among the three chicken breeds. The

Table 5. Correlation between egg weight and external egg quality traits

Parameter	Egg weight	Egg length	Egg width	Egg shape index	Surface area
Hy-line					
Egg length	0.747**				
Egg width	0.896**	0.516**			
Egg shape index	0.07	-0.561**	0.419**		
Surface area	1.000**	0.747**	0.896**	0.071	
Specific gravity	-0.042	-0.254*	-0.316**	-0.046	-0.042
Sasso					
Egg length	0.680**				
Egg width	0.613**	0.323**			
Egg shape index	-0.142	-0.663**	0.492**		
Surface area	1.000**	0.680**	0.614**	-0.141	
Specific gravity	0.135	-0.174	-0.584**	-0.302**	0.134
Zambian indigenous chicken					
Egg length	0.623**				
Egg width	0.513**	0.211*			
Egg shape index	-0.011	-0.549**	0.700**		
Surface area	1.000**	0.625**	0.513**	-0.012	
Specific gravity	0.162	-0.072	-0.691**	-0.531**	0.162

***Means significantly different ($p < 0.01$), *Means significantly different ($p < 0.05$)*

Table 6. Correlation between egg weight and Albumen properties

Parameter	Egg weight	Albumen weight	Albumen height	Albumen width	Albumen ratio	Albumen index
Hy-line						
Albumen weight	0.657**					
Albumen height	0.214*	0.019				
Albumen width	0.137	0.004	-0.064			
Albumen ratio	0.16	0.847**	-0.134	-0.096		
Albumen index	0.163	0.057	0.871**	-0.514**	-0.041	
Haugh unit	0.025	-0.13	0.979**	-0.059	-0.197	0.839**
Sasso						
Albumen weight	0.695**					
Albumen height	-0.034	-0.008				
Albumen width	0.154	0.079	0.083			
Albumen ratio	0.133	0.803**	0.012	-0.007		
Albumen index	-0.081	-0.031	0.857**	-0.395**	0.015	
Haugh unit	-0.222*	-0.149	0.974**	0.08	-0.025	0.837**
Zambian indigenous chicken						
Albumen weight	0.922**					
Albumen height	0.13	0.262**				
Albumen width	0.446**	0.391**	-0.039			
Albumen ratio	0.443**	0.754**	0.404**	0.14		
Albumen index	-0.133	-0.007	0.812**	-0.594**	0.231**	
Haugh unit	-0.062	0.089	0.977**	-0.127	0.328**	0.840**

***Means significantly different ($p < 0.01$), *Means significantly different ($p < 0.05$)*

Table 7. Correlation between egg weight and Yolk properties

Parameter	Egg weight	Yolk weight	Yolk height	Yolk diameter	Yolk ratio	Yolk index	Yolk:Albumen ratio
Hy-line							
Yolk weight	0.443**						
Yolk height	0.150	0.002					
Yolk diameter	0.134	0.198*	0.221*				
Yolk ratio	-0.193	0.793**	-0.077	0.124			
Yolk index	0.108	-0.061	0.952**	-0.084	-0.116		
Yolk:Albumen ratio	-0.268**	0.428**	-0.246*	0.168	0.648**	-0.303**	
Yolk weight (%)	-0.193	0.793**	-0.077	0.124	1.000**	-0.116	0.648**
Sasso							
Yolk weight	0.231*						
Yolk height	-0.051	-0.210*					
Yolk diameter	0.198*	0.298**	0.060				
Yolk ratio	-0.307**	0.851**	-0.178	0.188*			
Yolk index	-0.152	-0.346**	0.869**	-0.438**	-0.260**		
Yolk:Albumen ratio	-0.252**	0.832**	-0.130	0.201*	0.949**	-0.221*	
Yolk weight (%)	-0.307**	0.851**	-0.178	0.188*	1.000**	-0.260**	0.949**
Zambian indigenous chicken							
Yolk weight	0.592**						
Yolk height	0.419**	0.335**					
Yolk diameter	0.508**	0.711**	0.203*				
Yolk ratio	-0.415**	0.485**	-0.082	0.243**			
Yolk index	0.118	-0.078	0.838**	-0.364**	-0.217*		
Yolk:Albumen ratio	-0.429**	0.455**	-0.106	0.210*	0.983**	-0.220*	
Yolk weight (%)	-0.415**	0.485**	-0.082	0.243**	1.000**	-0.217*	0.983**

***Means significantly different ($p < 0.01$), *Means significantly different ($p < 0.05$)*

Table 8. Correlation between egg weight and shell properties

Parameter	Egg weight	Shell weight	Shell thickness	Shell weight (%)
Hy-line				
Shell weight	0.554**			
Shell thickness	0.165	0.266**		
Shell weight (%)	-0.311**	0.617**	0.128	
Shell index	0.011	0.838**	0.201*	0.947**
Sasso				
Shell weight	0.516**			
Shell thickness	0.008	0.014		
Shell weight (%)	-0.258**	0.691**	0	
Shell index	0.025	0.868**	0.006	0.959**
Zambian indigenous chicken				
Shell weight	0.610**			
Shell thickness	0.330**	0.622**		
Shell weight (%)	-0.176*	0.669**	0.476**	
Shell index	0.136	0.866**	0.578**	0.951**

***Means significantly different ($p < 0.01$), *Means significantly different ($p < 0.05$)*

findings suggest that ZIC may need significant genetic improvement in egg weight and quality to boost profitability and consumer acceptance, as this breed shows high adaptability and disease resistance, making it less costly to rear. In line with the results of the present study, a study on Black Olympia and Nigerian local chickens revealed significant breed influence on egg weight, shell weight, and shell index (Oleforuh-Okoleh 2016). Similarly, Tyasi et al. (2022) reported that breed influenced egg quality traits such as egg width, egg length, and shell weight, with the Hy-line Silver Brown chicken breed performing better than the Potchefstroom Koekoek chicken breed. Egg weight has been reported to vary among chicken breeds and was influenced by other egg characteristics (Alkan et al. 2013). On the other hand, Alemneh et al. (2021) reported that the average values of external egg qualities in Ethiopian indigenous local chickens were 43.23 g, 3.25 cm, 4.27 cm, 76.5%, 0.36 mm, and 34.7 for egg weight, egg width, egg length, shape index, shell thickness, and egg shell breaking strength, respectively. The present findings showed that breed significantly affected all albumen traits. Although the Haugh unit of the ZIC eggs did not differ from that of Hy-Line Brown chickens, Sasso eggs had significantly lower values. Similarly, highest yolk weight, albumen weight, and albumen ratio were reported in the Lohmnn Brown eggs than the Potchefstroom Koekoek chicken eggs (Hlokoe et al. 2026). This study also reported that Potchefstroom Koekoek eggs had higher yolk ratio and yolk/albumen than the Lohmann Brown chicken strain. On the other hand, the ZIC eggs had the highest albumen ratio, followed by the Hy-Line Brown and the Sasso chicken breed, respectively. In the current study, the albumen width of ZIC eggs was consistently lower than the other two breeds, even after accounting for egg width, suggesting a breed-specific difference in albumen spread rather than a measurement error.

In the current study, significant differences were observed between breeds for yolk traits. Accordingly, Sasso chickens had the highest percentage of yolk weight, while Hy-Line Brown eggs had the lowest. Additionally, all shell traits differed significantly among breeds, with ZIC recording the lowest absolute shell thickness. However, shell weight did not differ between ZIC and Sasso, and ZIC had intermediate percentage shell weight and shell index. These observations indicate that absolute shell measurements alone do not justify the conclusion that ZIC eggs had the poorest shell traits, and shell traits in ZIC should therefore be interpreted in relation to egg size. These findings justify the urgent need to improve the ZIC breed. The correlations between egg weight and egg characteristics differed significantly between chicken breeds. Egg weight showed a positive correlation with egg length and width across all breeds, with the lowest correlations in ZIC. Hlokoe et al. (2026) reported that the egg weight had a significantly positive correlation with egg length and egg width in Potchefstroom Koekoek chicken. Furthermore, Lohmann Brown showed a significant positive correlation between egg weight and egg length and width. Our results revealed the highest positive correlation between egg weight and albumen weight among all the studied breeds, with the highest correlation observed in ZIC.

Additionally, it was observed that the correlations between egg weight and yolk traits were higher in ZIC eggs than in the Hy-Line Brown and Sasso chicken breeds. In ZIC eggs, all yolk traits were significantly correlated with egg weight, except for the yolk index. This suggests that no relationship exists between egg weight and yolk index among the three chicken breeds. ZIC also showed a significantly higher positive correlation between egg weight and both shell thickness and shell weight. Hlokoe et al. (2026) reported that egg weight was not

significantly correlated with the shell weight in both Potchefstroom Koekoek and Lohmann Brown chicken breeds. These findings suggest that egg weight and shell weight are not phenotypically related. However, because these are phenotypic correlations, they do not indicate whether selection on shell weight would change egg weight. Genetic parameter estimates would be needed to confirm that. The studies conducted by Ukwu et al. (2017) in Nigerian Isa Brown eggs, Dzungwe et al. (2018) in French broiler Guinea fowl, and Sapkota et al. (2020) in indigenous Sakini chickens found that egg length, shell surface area, and egg width were significantly correlated with egg weight. The findings suggest that Hy-Line Brown chicken breed had better values than the Sasso and ZIC breeds for several egg quality traits. Therefore, the phenotypic differences observed in this study suggest that genetic improvement of egg quality traits in the ZIC breed could be considered, though heritability estimates would be needed to confirm this.

5. Conclusions

Overall, the study revealed notable differences in egg quality traits, with ZIC eggs the least desirable across the three breeds. The phenotypic differences observed suggest that targeted breeding programs could be considered to improve egg quality traits in these chickens, subject to further genetic evaluation.

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