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A Comparison of Laying Performance and Egg Characteristics of Nigerian Indigenous and Commercial Hens

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Abstract: This study evaluated the laying performance and egg characteristics of 36 hens over a four-week period, comprising 12 hens each of the naked neck (Na), normal feathered (N), and Isa Brown (IB) strains, which laid 46, 58, and 34 eggs, respectively. One-way ANOVA revealed that Na and N hens consumed significantly ($p \leq 0.05$) less feed (1586.11 ± 62.75 g). Notably, N hens exhibited superior feed efficiency for egg mass (24.29 ± 5.30), a higher egg number to 28 days (5.50 ± 0.58), and greater hen-day production (19.05 ± 2.19%). Conversely, IB and Na hens produced eggs with significantly ($p \leq 0.05$) better quality traits. Although total egg protein content was similarly high in the indigenous hens (Na and N) compared to IB, eggs from N hens contained significantly ($p \leq 0.05$) higher magnesium levels. Furthermore, eggs from indigenous hens were rated significantly better in terms of mouthfeel than those from IB hens. Overall, the indigenous chickens, particularly the N strain, demonstrated superior performance for most of the evaluated parameters, indicating their potential for enhancing laying performance and egg quality in poultry production.

Keywords: Chicken; laying performance; egg quality; egg nutrients; egg organoleptic properties

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1. Introduction

The naked neck (Na) and normal feathered (N) chickens are among the most prominent indigenous chicken strains in Nigeria. These chickens possess major genes that directly influence quantitative traits such as egg production and egg quality parameters [1]. The normal feathering gene (N) results in even feather distribution across the body, providing complete plumage coverage. In contrast, the naked neck (Na) gene is classified as a feather-restricting gene, which limits feather development around the lower neck region. The Na gene reduces feather coverage by approximately 20% in the heterozygous state (Na/na) and by about 40% in the homozygous state (Na/Na) [2]. This gene facilitates greater heat dissipation through the exposed neck, thereby enhancing the bird's ability to cope with heat stress [3]. The thermoregulatory advantage conferred by the NA gene is particularly beneficial during the laying phase, which imposes additional thermal stress [4]. Studies have reported that the Na gene can improve egg production traits such as egg number and age at first lay [5]. Previous research also indicates that both naked neck and normal feathered chickens have significant potential for high egg production [6] and may be valuable in genetic improvement programs aimed at developing indigenous egg-type chickens [5, 7]. The Isa Brown is a well-known laying strain known for its high egg-laying rate [8].

Over the years, research has primarily focused on egg production and egg quality in indigenous and Isa Brown chickens, either as purebreds or crossbreds [1, 5, 9], with comparatively little attention given to the nutrient composition and sensory attributes of their eggs. Analyzing the nutrient composition of eggs provides valuable information on components such as protein, lipids, and mineral content—traits essential for human health and therefore worth investigating. Bughio [10] reported on certain internal, external, and organoleptic properties of eggs from naked neck chickens raised under free-range and intensive systems. Kolawole [11] studied egg yolk cholesterol, egg quality, and productive traits in naked neck chickens, but without comparing them to other strains. Including egg yolk cholesterol and triglyceride levels in the evaluation of egg nutrient composition from naked neck, normal feathered, and Isa Brown chickens is important for understanding how dietary intake of cholesterol and fat from eggs may influence blood lipid profiles.

The objective of this study was to compare the laying performance, egg quality, nutrient composition, and organoleptic properties of eggs from indigenous naked neck, normal feathered, and commercial Isa Brown layer chickens. The findings aim to provide a basis for the selection and genetic improvement of egg-laying traits in chickens.

2. Materials and Methods

2.1. Experimental Location

The experiment was conducted at Ifite-Ogwari, Ayamelum Local Government Area, Anambra State. The town is geographically located between Latitude 6^{0} 36′ 17″ North and Longitude 6^{0} 56′ 56″ East, at an elevation of 91 meters above sea level in South-East Nigeria. Ifite-Ogwari has average annual and monthly rainfall of 5,798.78 mm and 1,739.62 mm, respectively. The minimum and maximum daily temperatures of the locality are 25.4 ^{0}C and 30.6 ^{0}C, respectively. The vegetation and climatic conditions of the area support both animal husbandry and crop production.

2.2. Experimental Animals and Their Management

A total of 36 laying hens were used in the experiment, comprising three strains: sexually mature naked neck, normal feathered, and Isa Brown chickens, with 12 hens representing each strain. All the hens were approximately one year old. The indigenous hens (naked neck and normal feathered) were procured from local markets and the households of smallholder poultry farmers, whereas the Isa Brown layers were purchased at laying stage from a commercial farm located within Anyamelum Local Government Area (LGA).

The hens were housed in three cages constructed on the floor and were used to manage the hens intensively for laying. Each cage, dedicated to a single strain, was constructed with wire gauze walls and a galvanized iron sheet roof. Each cage was subdivided into three pens, serving as replicates. The dimensions of each pen were 2.3 m in length and 0.5 m in height. Four hens were housed per pen, each equipped with a conical water fountain drinker placed on the floor and a rectangular wooden feeder measuring 1.5 m in length and 0.5 m in width, suspended approximately 0.23 m above the cage floor. Wood shavings were used as litter material and were replaced weekly. All hens were acclimatized to the housing conditions for a period of two weeks prior to the commencement of egg collection for experimental purposes.

The hens were fed and provided with water *ad libitum*. A total of 212 kg of feed was formulated, and the composition of the experimental diet is presented in Table 1. Egg production was monitored over a period of four weeks (28 days).

Table 1. Ingredients and nutrient composition of the experimental feed.

Ingredient	Percentage composition
Maize	50.00
Groundnut meal	13.00
Fish meal	2.50
Wheat bran	24.50
Bone meal	2.50
Periwinkle shell meal	7.00

Common salt	0.35
Premix	0.15
Total	100.00
Calculated composition	
Crude protein (%)	16.1
Metabolizable energy (Kcal/kg)	2500
Methionine + cysteine	0.51
Ca	3.53
Total phosphorus	0.90
Available phosphorus	0.59
Energy: protein	150:1

2.3. Experimental Design

The experiment was conducted using a completely randomized design (CRD), with strain considered as the treatment factor. The three treatment levels consisted of naked neck, normal feathered, and Isa Brown chickens. A total of 36 laying hens were used, with 12 hens allocated to each strain. Each treatment group was replicated three times, with four hens randomly assigned to each replicate. The model for the CRD is presented below:

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

where Y_{ij} is j^{th} observation made on i^{th} strain, μ is the overall mean, S_i is the fixed effect of strain (i = 1-3), ε_{ij} is the random error.

2.4. Data Collection

Eggs were collected twice daily (morning and evening), properly labelled, and stored in a cool, clean environment until analysis. Egg quality measurements were conducted twice per week, and the data were pooled on a weekly basis. Eggs intended for nutrient composition analysis were collected at the end of the 28-day experimental period.

2.4.1. Laying performance

Total feed intake (TFI) was calculated in grams per hen as the total quantity of feed consumed over the 28-day period by all hens within each strain (on a replicate basis), divided by the number of hens per replicate. Feed intake was initially recorded weekly and then summed over the four-week (28-day) period. Daily feed intake per replicate was determined by subtracting the quantity of feed remaining from the quantity provided within a 24-hour period (from morning to the next morning). Weekly feed intake was obtained by summing the daily values over seven days.

Egg number to 28 days (EN_{28}) was defined as the total number of eggs laid by all hens in a particular strain over the 28-day period. Feed efficiency for egg mass (FEEM) was calculated as the total weight of feed consumed (g) divided by the total weight of eggs produced (g).

Hen-day production (HDP) was computed as a percentage using the formula [12]:

HDP (%) = [Number of eggs laid by hens per strain / (Number of days in lay × Number of hens alive)]

2.4.2. External egg quality parameters

Egg weight (EWT) was measured in grams by weighing eggs laid by hens of the same strain on a weekly basis using an electronic weighing scale (Model: SF-400; sensitivity: 1 g). Egg length (EL) was measured in millimeters (mm) as the average of three readings taken along the longest axis of the egg using a Vernier caliper. Egg width (EW) was also measured in millimeters as the average of three readings taken at the widest part of the egg using the Vernier caliper. The egg shape index (ESI) was calculated as the ratio of the average egg width to the average egg length, expressed as a percentage.

Shell thickness (ST) was measured in millimeters as the average of three readings taken at the peripheral, central, and narrow or broad end regions of the shell (including the membrane) on a wet basis [12], using a micrometer screw gauge with a sensitivity of 0.01 mm. Shell weight (SWT) was determined by carefully breaking each egg, removing the yolk and albumen into a petri dish, and weighing the remaining shell using the electronic scale. The shell ratio (SR) was calculated as the ratio of shell weight to egg weight.

2.4.3. Internal egg quality parameters

Yolk weight (YWT) and albumen weight (AWT) were measured using a modified method of [12], wherein an electronic scale was used instead of a beam balance. Albumen height (AH) was measured by gently dipping the rod of a Vernier caliper into the petri dish containing the albumen and reading the measurement from both the main and Vernier scales in millimeters (mm). For yolk height (YH), with the yolk placed in a separate petri dish, the Vernier caliper rod was carefully inserted vertically through the top center of the yolk until it touched the base of the dish. The scale was then lowered gently until it just touched the yolk surface, and the height was recorded in millimeters. Yolk width (YW) was measured as the distance between the two ends of the chalazae using a Vernier caliper. The yolk index (YI) was calculated as the ratio of yolk height to yolk width, expressed as a percentage.

Haugh unit (HU) was calculated following the method described by [13] using the formula:

$$HU = 100 \log (H - 1.7W^{0.37} + 7.57)$$

where H was the observed AH and W was the observed weight of the egg.

2.4.4. Egg nutrients composition

Two eggs were sampled from each replicate, resulting in a total of 18 eggs across all treatments. These samples were analyzed in the laboratory for total protein, total cholesterol, total triglycerides, and mineral elements, including calcium (Ca), potassium (K), magnesium (Mg), and phosphorus (P). Total protein in the egg albumen was determined using the biuret method [14], with results expressed in grams per gram of albumen. Total cholesterol in the egg yolk was measured according to the method of [15], and results were expressed in milligrams per gram of yolk. Total triglycerides in the egg yolk were analyzed following the method described by [16], with means expressed in milligrams per gram of yolk.

Calcium, potassium, and magnesium contents of a 1:1 mixture of egg yolk and egg white were determined using atomic absorption spectrophotometry (AAS), with results expressed in milligrams per gram.

Phosphorus determination involved filtering digested samples into a 250 mL conical flask. An equal volume of distilled water, serving as a control, was placed in a separate flask. To both flasks, 1 mL of 18 M H_2SO_4 and 0.89 g of ammonium persulfate were added, and the mixtures were gently boiled for 1½ hours, maintaining a volume of 25–50 cm^3 with distilled water at 80 °C. After cooling in a desiccator, one drop of phenolphthalein indicator was added, and the solution was neutralized to a faint pink color using 2 M NaOH. The pink color was then discharged by dropwise addition of 2 M HCl, and the volume was made up to 100 mL with distilled water.

For colorimetric analysis, 20 mL of the sample was pipetted into test tubes, followed by the addition of 10 mL of combined reagent. The mixture was shaken and allowed to stand for 10 minutes before absorbance was measured at 690 nm using a spectrophotometer. Distilled water (20 mL) plus 1 mL of reagent served as the reference. The phosphorus concentration was calculated as:

$$\text{Phosphorus} = (\text{Absorbance of standard}/\text{Absorbance of sample}) \times \text{Concentration of standard}$$

Phosphorus content was expressed in milligrams per gram.

2.4.5. Assessment of the organoleptic properties of the cooked egg samples

Ten eggs were randomly collected from each strain for the assessment of organoleptic properties. Each egg was cooked, peeled, and cut into two equal portions, which were then served to 20 trained panelists. The panelists evaluated the eggs strain by strain for aroma, color, taste, texture, and mouthfeel. A seven-point hedonic scale was used to assess these sensory attributes, with the points defined as follows: (1) like, (2) extremely like, (3) somewhat like, (4) neutral, (5) dislike, (6) extremely dislike, and (7) somewhat dislike. After evaluating each replicate, panelists cleansed their palate thoroughly before assessing eggs from the next replicate.

2.5. Statistical Analysis

The research data were analyzed using one-way analysis of variance (ANOVA) through the General Linear Model (GLM) procedure in IBM SPSS Statistics software. Hypothesis testing was conducted at a 5% level of significance. Significant differences among means were further separated using Duncan's Multiple Range Test (Duncan, 1955).

3. Results

3.1. Laying Performance of Naked Neck, Normal Feathered and Isa Brown Chickens

The mean (± SE) total feed intake and egg production traits of Na, N, and IB chickens are presented in Table 2. Significant differences ($p \leq 0.05$) were observed in all measured parameters. The indigenous naked neck and normal feathered hens recorded lower total feed intake (TFI) compared to Isa Brown hens. TFI represents the average quantity of feed consumed per hen over 28 days. Among the strains, the Na hens had the lowest mean TFI, whereas the N hens exhibited the highest egg number to 28 days (EN_{28}), the most efficient feed conversion for egg mass produced (FEEM), and the highest hen-day production (HDP). The FEEM value for the N hens indicates that one hen consumed 24.09 ± 4.59 g of feed to produce 1 g of egg. The EN_{28} for the Na hens was intermediate, ranking between the two other strains.

Table 2. Feed intake and egg production parameters of naked neck, normal feathered and Isa Brown chickens (Means ± SE).

Parameters	Strain			*p* Value
	Naked neck	Normal feathered	Isa Brown	
TFI (g)	$1586.11^{b} \pm 62.75$	$1696.18^{b} \pm 54.34$	$2223.40^{a} \pm 56.76$	<0.001
EN_{28}	$4.22^{ab} \pm 0. 0.67$	$5.50^{a} \pm 0.58$	$3.55^{b} \pm 0.01$	<0.001
FEEM	$34.29^{a} \pm 5.30$	$24.09^{b} \pm 4.59$	$32.92^{ab} \pm 4.80$	<0.001
HDP (%)	$15.08^{b} \pm 2.53$	$19.05^{a} \pm 2.19$	$12.66^{c} \pm 2.29$	<0.001

$^{a-c}$ Values within the same row with different superscript letters differ significantly ($p \leq 0.05$).
TFI = Total feed intake, EN_{28} = Egg number to 28 days, FEEM = Feed efficiency for egg mass produced, HDP = Hen-day production.

3.2. External Egg Quality Parameters of Naked Neck, Normal Feathered and Isa Brown Chickens

The mean (± SE) external egg quality parameters of Na, N, and IB chickens are presented in Table 3. IB hens significantly ($p \leq 0.05$) outperformed both Na and N hens in most external egg quality traits, except for egg shape index and shell ratio, where N and Na hens exhibited superior performance. The N hens ranked second in egg weight and egg width and recorded lower values for egg length and shell ratio, which did not differ significantly from those of Na and IB hens, respectively.

Table 3. External egg quality parameters of naked neck, normal feathered and Isa Brown chickens (Means ± SE).

Parameters	Strain			*p* Value
	Naked neck	Normal feathered	Isa Brown	
EWT (g)	30.56[c] ±1.41	34.52[b] ± 1.22	57.68[a] ± 1.27	<0.001
EL (cm)	4.46[b] ± 0.08	4.40[b] ± 0.07	5.34[a] ± 0.07	<0.001
EW (cm)	3.07[c] ± 0.05	3.24[b] ± 0.05	3.83[a] ± 0.05	<0.001
ESI (%)	68.90[b] ± 0.01	73.80[a] ± 0.01	71.39[b] ± 0.01	<0.001
ST (cm)	0.28[b] ± 0.01	0.29[a] ± 0.01	0.35[a] ± 0.01	<0.001
SWT (g)	3.07[c] ± 0.21	4.19[b] ± 0.18	5.35[a] ± 0.19	<0.001
SR	0.10[b] ± 0.01	0.12[a] ± 0.38	0.10[b] ± 0.01	<0.001

[a-c] Values within the same row with different superscript letters differ significantly ($p \leq 0.05$).
EWT = Egg weight, EW = Egg width, ESI = Egg index, ST = Shell thickness, SWT = Shell weight, SR = Shell ratio.

3.3. *Internal Egg Quality Parameters of Naked Neck, Normal Feathered and Isa Brown Chickens*

The mean (± SE) internal egg quality parameters of Na, N, andIB chickens are presented in Table 4. Significant differences ($p \leq 0.05$) were observed among the strains. The IB hens had comparatively higher albumen weight and yolk weight. The Na hens demonstrated superior performance in albumen height, yolk height, yolk index, and Haugh unit. The N hens showed superior performance only in yolk width but ranked second in albumen weight, yolk weight, and yolk height.

Table 4. Internal egg quality traits of naked neck, normal feathered and Isa Brown chickens (Means ± SE).

Parameter	Strain			*p* Value
	Naked neck	Normal feathered	Isa Brown	
AWT (g)	16.59[b] ±0.90	17.74[b] ± 0.78	37.11[a] ± 0.81	<0.001
AH (mm)	1.86[a] ± 0.10	1.51[b] ± 0.09	1.51[b] ± 0.09	<0.001
YWT (g)	10.66[c] ± 0.38	12.26[b] ± 0.33	14.90[a] ± 0.34s	<0.001
YW (mm)	30.29[b] ± 1.20	34.91[a] ± 1.04	34.82[a] ± 1.09	<0.001
YH (mm)	11.30[a] ± 0.31	7.57[b] ± 0.27	11.06[a] ± 0.28	<0.001
YI (%)	37.40[a] ± 0.01	22.02[c] ± 0.01	32.80[b] ± 0.01	<0.001
HU (%)	91.36[a] ± 0.46	89.50[b] ± 0.40	88.19[c] ± 0.42	<0.001

[a-c] Values within the same row with different superscript letters differ significantly ($p \leq 0.05$).
AWT = Albumin weight, AH = Albumin height, YWT = Yolk weight, YW = Yolk width, YH = Yolk height, YI = Yolk index, HU = Haugh unit.

3.4. *Egg Nutrient Composition of Naked Neck, Normal Feathered and Isa Brown Chickens*

The mean (± SE) egg nutrient composition of Na, N and IB chickens are presented in Table 5. The Na and N eggs had the same total protein content which was significantly higher than that of the IB hens. There was no significant ($p > 0.05$) difference in mean total cholesterol and triglyceride contents of the eggs of the three chicken strains. Of the four mineral nutrients studied, a significant ($p \leq 0.05$) difference occurred only in magnesium with higher means obtained from N hens compared to the other strains.

Table 5. Egg nutrient composition of naked neck, normal feathered and Isa Brown chickens (Means ± SE).

Nutrients	Strain			*p* Value
	Naked neck	Normal feathered	Isa Brown	
Total protein (g/g albumen)	$0.30^a \pm 0.03$	$0.30^a \pm 0.03$	$0.17^b \pm 0.03$	0.002
Total cholesterol (mg/g yolk)	14.98 ± 1.33	14.98 ± 1.33	13.38 ± 1.57	0.233
Total triglyceride (mg/g yolk)	25.63 ± 1.69	25.63 ± 1.69	21.01 ± 2.00	0.226
Ca (x 10^{-3}) (mg/g)	0.78 ±0.11	1.04 ± 0.08	0.95 ± 0.11	0.211
K (x 10^{-3}) (mg/g)	0.19 ± 0.15	0.44 ± 0.11	0.56 ± 0.15	0.220
Mg (x10^{-4}) (mg/g)	$1.09^b \pm 1.07$	$3.96^a \pm 1.07$	$0.65^c \pm 0.11$	0.012
P (x 10^{-3}) (mg/g)	8.395 ± 1.56	11.13 ± 1.11	10.52 ± 1.56	0.383

$^{a-c}$ Values within the same row with different superscript letters differ significantly ($p \leq 0.05$).

3.5. Organoleptic Properties of Naked Neck, Normal Feathered and Isa Brown Chickens

The mean (± SE) egg organoleptic properties of naked neck (Na), normal feathered (N), and Isa Brown (IB) chickens are presented in Table 6. Among the sensory attributes, only mouthfeel differed significantly ($p \leq 0.05$) among the three strains, with Na and N eggs being rated as extremely liked. Although the differences in other organoleptic properties were not statistically significant, egg color was rated as extremely liked across all strains, while the aroma of Na and N eggs was also rated as extremely liked.

Table 6. Egg organoleptic properties of naked neck, normal feathered and Isa Brown chickens (Means ± SE).

Property	Naked neck	Normal feathered	Isa Brown	*p* Value
Colour	2.40 ± 0.26	2.25 ± 0.32	2.35 ± 0.27	0.931
Aroma	2.30 ± 0.28	2.30 ± 0.27	1.75 ± 0.20	0.221
Texture	1.90 ± 0.20	1.85 ± 0.20	1.90 ± 0.16	0.977
Taste	2.00 ± 0.24	2.40 ± 0.23	2.50 ± 0.38	0.447
Mouthfeel	$2.55^a \pm 0.31$	$2.60^a \pm 0.22$	$1.65^b \pm 0.13$	0.008

^{a,b} Values within the same row with different superscript letters differ significantly ($p \leq 0.05$).

4. Discussion

The smaller feed consumption observed in the indigenous hens, particularly the Na strain, reflects their smaller body size, which is positively correlated with feed intake [17]. The body size of the Na chickens may be useful in reducing the cost of feeding which constitutes about 70% of the total cost of production [18]. Similar findings have been reported by other authors, indicating that Na hens consume less feed compared to other genotypes during the laying phase [5]. The lower egg number to 28 days (EN_{28}) recorded in Isa Brown (IB) hens compared to indigenous strains may be attributed to the age of the birds and the short duration of the laying period. Feed efficiency for egg mass produced (FEEM) results indicate that normal feathered (N) hens demonstrated superior feed efficiency, consuming the least feed per gram of egg produced compared to Na and IB hens. Hen-day production (HDP), which accounts for mortality during a given period, showed that N hens achieved the highest laying percentage over the 28-day period. However, contrasting findings by [6] reported higher HDP for Na hens (28.57 ± 0.02%) than for normal feathered hens (18.67 ± 0.01%) at 4 weeks of lay. It is important to note that HDP can vary depending on factors such as hen age, flock size, duration of laying, feed quality, and genetic background.

The superior performance of the Isa Brown (IB) hens compared to the indigenous chickens in most of the external egg quality parameters highlights the genetic advantage of the IB breed, which is known to possess improved traits associated with higher egg weight and better external egg quality. These results suggest that egg number is more readily influenced by factors such as age, nutrition, and environmental conditions, whereas traits like egg weight, length, and width are predominantly governed by genetic factors. This observation aligns with the findings of [19]. Furthermore, the results imply that egg weight and other external egg quality traits are controlled by a greater number of additive genes and are thus more heritable than egg number [20]. Consequently, egg weight may serve as a more reliable selection index for improving laying performance in breeding programs.

The mean values of external egg quality traits observed in the indigenous chickens are consistent with those reported by [21], confirming their local genetic origin and indicating a need for genetic enhancement. The higher egg shape index (73%) recorded in normal feathered (N) hens supports the findings of [5] and closely approximates the acceptable egg shape index of 0.75 reported by [22]. This suggests that the eggs from N hens were not overly elongated and are of desirable shape, contributing to resistance against cracking during handling and transportation. Moreover, the shell ratio of the N hens was significantly higher than that of the Na and IB hens, although all the three strains had shell ratio values near the standard value of 0.11 (11%) [23]. Similar findings were reported by Osei-Amponsah [24], who observed significantly higher shell ratios in two Ghanaian indigenous chicken breeds (0.11 ± 0.001) compared to an imported breed (0.10 ± 0.001). Shell ratio, defined as the proportion of egg weight attributed to shell weight, is an important indicator of eggshell quality. Higher shell ratio values denote stronger shells, which are essential for egg protection. Therefore, the shell quality of the three strains, particularly the indigenous normal feathered hens, can be considered satisfactory.

The Na and N chicken strains outperformed the IB strain in most of the internal egg quality parameters, with the exception of albumen weight and yolk weight. This suggests that eggs from the indigenous strains possess good internal quality capable of supporting optimal embryonic development. The mean albumen weight recorded for the indigenous hens in this study is slightly lower than the 21.07 g and 19.77 g reported for homozygous naked neck (Na/Na) and normal feathered (na/na) hens, respectively, in Umudike, Southeast Nigeria [25]. Similarly, their mean albumen height is also considerably lower than the values of 6.25 ± 0.14 mm and 6.42 ± 0.16 mm reported for the same genotypes [25]. The mean yolk weight and yolk index of the Na and N hens are comparable to those previously reported by [25], but lower than the values observed in indigenous hens from the North-central region of Nigeria [21]. However, the Haugh unit values recorded for the Na and N hens in this study were higher than the range of 71.40–73.22 reported by [21], indicating superior albumen quality. The noticeable difference in albumen height between the current study and that of [25] may be attributed to variations in measurement techniques and mating systems. The smaller yolk width and higher Haugh unit values observed in the Na hens, relative to the N and IB hens, suggest that eggs from Na hens retain their quality and freshness for a longer duration during storage. This is particularly important for consumer preference and market demand. These findings align with those of [26], who reported variations in Haugh unit values under different storage conditions and durations.

A larger yolk width is generally indicative of egg deterioration, as the yolk tends to spread with loss of freshness. The significantly smaller yolk width observed in Na eggs, despite being stored under the same conditions as N and IB eggs, reinforces their superior freshness retention. This quality further underscores the potential of Na hens in producing eggs with longer shelf life and greater consumer appeal.

The results of the nutrient composition of the eggs indicated that the Na and N eggs contained more protein than the eggs of IB commercial layers. Despite the IB hens exhibiting a significantly greater albumen weight compared to the indigenous Na and N hens, the higher protein content in the eggs of the indigenous strains suggests that egg protein concentration does not solely depend on the quantity of albumen. Notably, the mean albumen values recorded for all the three chicken strains—especially the indigenous ones—were considerably higher than the typically reported range of 10 to 11% (0.10 to 0.11 g/g of egg white) on a weight basis in chickens [27]. Although the total cholesterol content in the yolk of eggs from the indigenous hens was slightly higher than that of the IB hens, the difference was not statistically significant. The yolk cholesterol content observed in this study (13.38 ± 1.57 to 14.98 ± 1.33 mg/g of yolk) was lower than the values reported for eight major commercial strains of laying hens in Korea (16.40 ± 0.37 to 18.18 mg/g) [28], yet remained within the normal physiological range of 11 to 15 mg/g for chicken eggs.

The mean triglyceride content (13–14 mg/g of egg yolk) observed in this study is considerably lower than the previously reported values of 51 and 38.8 mg/g in the yolks of eggs from young and old Noi Lai hens, respectively [29]. The higher total protein content found in the eggs of the indigenous chickens, compared to those of the commercial Isa Brown (IB) layers, underscores the superior nutritional quality of indigenous eggs despite their smaller size. These findings suggest that the indigenous Na and N chickens possess favorable traits for the development of layer breeds with high egg quality.

The low levels of total cholesterol and triglycerides across all the three strains indicate that the eggs are suitable for health-conscious consumers. The mineral content analysis of the albumen and yolk mixture revealed that genetic differences among chicken strains significantly influence egg quality and nutrient composition [30]. Mineral elements in eggs are essential for nutrient transport within the developing embryo and for ensuring proper bone formation in hatched chicks. Calcium and potassium deposits, in particular, contribute to shell thickness, which is a critical factor affecting hatchability.

The comparatively higher magnesium and other mineral contents in eggs from the normal feathered (N) hens suggest superior embryo development and hatchability potential, corroborating the findings of [31]. Lordelo [32] similarly reported higher potassium and phosphorus levels in the albumen, and higher sodium, potassium, and phosphorus levels in the yolk of eggs from four Portuguese indigenous breeds compared to a commercial hybrid. The commercial hybrid outperformed the indigenous breeds only in calcium content in the albumen and phosphorus content in the yolk.

There is currently a paucity of data on the mineral composition of eggs from the three strains studied, particularly the Nigerian indigenous naked neck and normal feathered chickens. Therefore, the present results provide valuable baseline information for poultry breeders, consumers, and the food and confectionery industry.

The results of the organoleptic evaluation indicated that the four sensory attributes of the eggs ranged between "like" and "extremely like." With the exception of texture, the aroma, color, and mouthfeel of eggs from the Na and N hens were rated as "extremely liked," whereas the corresponding attributes of the IB eggs were generally rated as "liked." Mouthfeel, which describes the tactile sensation perceived in the mouth during and after consumption of food [33], differed significantly among the strains. The highest mouthfeel ratings were recorded for the Na eggs, followed by the N and IB eggs. Similarly, Gao [34] reported that eggs from two Chinese indigenous chicken breeds exhibited superior texture compared to those of the commercial Hy-Line breed. These findings suggest that the eggs of the indigenous hens were more favorably perceived in terms of sensory quality than those of the commercial Isa Brown hens. This consumer preference underscores the potential market value of eggs from indigenous chicken breeds based on their superior sensory characteristics.

5. Conclusions

In conclusion, our study reveals that normal feathered chickens demonstrated superior feed efficiency and laying performance, while Na and IB chicken produced better quality eggs. Overall, the N chickens combined good production performance with acceptable egg quality, making them a valuable option for future breeding efforts. Selective breeding of normal feathered chickens could enhance poultry productivity and egg quality. Further studies focusing on the genetic basis of these traits would be useful in guiding breeding strategies for improved poultry performance.

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