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TABLE EGG QUALITY AND NUTRITIONAL COMPOSITION ASSESSEMENTS OF DIFFERENT BREEDS AND AGES OF LAYING HENS

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ABSTRACT

Table eggs collected at random from one-hundred and fifty layers (75-FUNAAB-Alpha and 75- ISA brown) kept at Breeding Unit, Teaching and Research Farm, Olusegun Agagu University of Science and Technology, Okitipupa at 31st, 33rd, and 35th weeks (WK) of age were analyzed for internal and external characteristics within 24 hours of laying. The data collected were subjected to analysis of variance to assess the effect of breed and age of the layers on egg quality. Breed had no significant effect ($p > 0.05$) on the egg weight (Ewt), egg length (EL), shell weight (SW), shell ratio (SR), albumen weight (AW), albumen ratio (AR), yolk diameter (YD) and yolk height (YH) in all the ages considered. At WK 31 breed effect was observed ($p < 0.05$) in egg width (EW), shell index (SI), yolk weight (YW), yolk ratio (YR), albumen height (AH) and haugh unit (HU), and higher values were observed in all the traits for ISA brown except yolk weight (YW) and yolk ratio (YR). Significant effect of breed (< 0.05) was observed in HU and AH at WK33. Shell thickness (ST) and yolk index (YI) experienced breed effect at WK 35. Breed and age had no effect on nutritional compositions of eggs. It can be concluded that breed and layer's age do have effects on some egg quality parameters.

Key words: Breed; age; ISA brown; FUNAAB alpha; egg quality

INTRODUCTION

Egg is one of the major products of poultry; it acts as a significant role in the food industry as a good source of high quality protein and highly nutritious profile for human diet. Eggs are one of the most known and accepted foods by consumers around the world. They are widely recognized as a source of high quality proteins, several fat-soluble vitamins (for example vitamins A, D and E), and water-soluble vitamins (for example vitamin B12, riboflavin and folate) as well as a number of micronutrients (for example Iodine, Iron, Phosphorus and Selenium). Eggs are protein-rich, low in sodium and contain a variety of vitamins and minerals. Egg protein is of such high quality, it is used as the standard by which all other protein sources are compared. The quality of proteins is based on their amino acid composition and digestibility. Eggs provide the best profile for essential amino acids; the protein-building blocks which humans cannot synthesize and must find in their diets. Combined with a digestibility of 98 %, cooked eggs have the highest biological value of any single food protein. Eggs are categorized as a low energy, nutrient-dose food that contributes to the human diet at all stages of life. One egg provides 6 g of high quality protein, and has about 75 calories and it's a good source of essential nutrients in varying amounts, including high-quality protein, choline, riboflavin, B12, folate, iron and zinc, making eggs a naturally, nutrient-dense food. At the same time,

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the many nutrient substances present in eggs create an excellent environment for the development of bacterial microflora, including pathogenic bacteria (Stepien-Pysniak *et al.*, 2010). In Nigeria, different poultry species contribute significantly to the annual animal protein supply to the human diet (Ikeobi *et al.*, 1999). Poultry eggs are good sources of income and are of particular significance in scientific research, such as vaccine production (Adebambo, 2005). The egg is a complex structure distinguished by having four different parts; the eggshell, shell membrane, albumen and yolk. Global egg consumption has tripled in the past 40 years with consumer quality expectations increasing rapidly. When eggs are for human consumption, it is important that they are suitable for this purpose (Kabir *et al.*, 2014). The main egg quality aspects considered by egg producers are egg weight and eggshell quality, whereas consumers are interested in shelf life, external appearance, and sensorial qualities, such as eggshell and yolk colour. On the other hand, processors take into account easy eggshell removal and separation of the yolk from the albumen, as well as egg functional properties (Alleoni & Antunes, 2001). This will be determined by both the internal and external quality of the egg (Smith, 1990). Quality has been defined by Kramer (1951) as the properties of any given food that has influence on the acceptance or rejection of this food by the consumer. Egg quality is composed of those characteristics that affect its acceptability to consumers such as cleanliness, freshness, egg weight, eggshell quality; yolk index, albumen index, Haugh unit and chemical composition (Song *et al.*, 2000).

Laying types of chickens in Nigeria include the exotic breeds (ISA brown, Black Harco, Sussex etc.), Nigerian indigenous chickens and the improved Nigerian indigenous chickens known as FUNAAB alpha. FUNAAB alpha is the first improved indigenous chickens selected over twelve generations in Nigeria from scavenging chickens collected all over South west, for production of egg (egg type) and meat (meat type). It was developed at Federal University of Agriculture, Abeokuta, Nigeria (FUNAAB). The egg type is a dual purpose chicken, meant for meat and egg production. The ISA Brown pullet has proven more than 40 years of excellent performance as the best brown laying hen in the world. Extensive field testing with the ISA Brown shows that the ISA Brown has exceptional feed conversion and is capable of laying up to 500 first-quality eggs. The variability in the quality and nutritional values of eggs have a significant impact on consumers' health; simultaneously, welfare and many other factors can affect egg quality. These factors include the breed and strain of layers (Kucukyilmaz *et al.*, 2012), dietary composition (Calislar and Kirik, 2009; Goldberg *et al.*, 2012), birds' health, environmental condition and storage, processing and handling of eggs and age (Ryu *et al.*, 2011; Zhang *et al.*, 2012; Khan *et al.*, 2013; Kabir *et al.*, 2014 and Adeoye, *et al.*, 2020).

Therefore, the objective of this study was to assess the quality and nutritional composition of table eggs from exotic breed (ISA brown) and improved Nigerian indigenous chickens (FUNAAB alpha) laying hens at different ages.

MATERIALS AND METHODS

The experiment was carried out at Teaching and Research Farm and Analytical Laboratory, Olusegun Agagu University of Science and Technology, Okitipupa. Ondo State. Okitipupa lies between latitude 6.25° and 6.46° N and Longitude 4.35° and 4.50° E within the tropical rainforest zone of Nigeria. Eggs were collected at random from Seventy-five (75) each of ISA brown and FUNAAB alpha breeds of layers at 31st, 33rd and 35th weeks of age. The birds were fed with commercial layers' mash diet (Top Feed, Ibadan, Nigeria) and water supplied with ad libitum feeding throughout the experimental period. The proximate composition of the feed as provided by the manufacturer is shown in Table 1. Other management activities such as vaccination, deworming etc. were done when necessary. Eggs collection was done early in the morning based on breed and age, and quality and nutritional composition of the eggs were analyzed as follows:

The eggs were numbered first and then weighed on an electronic weighing balance to determine their weight in grams. Egg length and egg width were measured with a Vernier caliper in centimeters. Eggshell thickness was measured with a micrometer screw gauge after air drying at room temperature (The mean of the narrow, broad and middle were taken as shell thickness). Egg shape indexis estimated using the equation:

$$\frac{\text{Egg width}}{\text{Egg length}} \times 100$$

Eggshell weight was measured using electronic balance (Mexler – Teledo PB 3002 with sensitivity of 0.01 g) after air- dried for 72 hours in egg trays. Eggshell ratio (%) according to (Olawunmi and Ogunlade, 2004) was gotten by using the equation:

$$\frac{\text{Eggshell weight}}{\text{Egg weight}} \times 100$$

For internal egg quality traits, individual egg sample was carefully broken open on a flat white tile around the sharp end of the egg large enough to allow the passage of both the albumen and the yolk through it without mixing their content together being cautious not to break the vitelline membrane that enclose the yolk. The content was poured on a transparent flat glass plate of dimension 45 cm x 40 cm. Yolk and albumen height were measured using a Vernier caliper and recorded in centimeters. Yolk width measured as the widest horizontal circumference with a Vernier caliper. Yolk height measured as the height of the yolk at the midpoint with a tripod micrometer. Albumen height was measured as the height of the chalazae at a point midway between thinner and outer circumference of the white with tripod micrometer. Albumen weight was determined by the difference between egg weight, yolk weight and shell weight. Yolk index was estimated from the ratio of yolk height to yolk width. Yolk weight was obtained by carefully separating the yolk using a spoon to scoop the yolk into a cup and then weighed on an electronic scale and recorded in grams. Haugh unit was determined from albumen height and egg weight using the equation as described (Haugh, 1937); $HU = 100 \log (h + 7.6 – 1.7W^{0.37})$.

Haugh unit was determined using the formula below:

$$HU = 100 \log (H + 7.5 - 1.7W^{0.37})$$

Where:
HU = Height of albumen
W = Egg weight

Albumen ratio (%) was derived by $\frac{\text{Albumen weight} \times 100}{\text{Egg weight}}$

$$\text{Yolk ratio (\%)} = \frac{\text{Yolk weight (g)} \times 100}{\text{Egg weight (g)}}$$

Nutritional analysis such as moisture, protein, fat, ash and carbohydrate were determined according to AOAC method (AOAC, 2005). Moisture of egg was determined by drying a sample at some elevated temperature approximate 105 °C and reporting the loss in weight in terms of moisture. The fat content was determined by Soxhlet method (Soxhlet, 1879). Ash in the egg was determined by incineration from dried sample at about 750 °C for 8 hours by muffle furnace. The carbohydrate content was determined by subtracting the other food value i.e. Protein, Fat, Moisture. The energy content was calculated based on the formula given by Eknayake *et al.* (1999). And the mineral content such as (Calcium, potassium, sodium, Cupper, Iron, Manganese, Phosphorus and Zinc) were calculated.

Statistical Analysis

The data collected on egg quality and nutritional compositions were subjected to analysis of variance (SPSS/24 PC Statistics 24.0 IBM) to determine the effects age and breed. Significant means were separated using Duncan Multiple Range Test, (Duncan, 1955), using the model below:

$$Y_{ijk} = \mu + B_i + D_j + Ɛ_{ijk}$$

Where Y is individual observation; μ is universal mean; B_i is effect of breed; D_j is effect of age; $Ɛ_{ijk}$ is error.

RESULTS

Table 1 shows the proximate composition of the layers' mash diet. The effect of breed on the internal and external quality of the eggs on age basis is shown in Table 2. Breed had no significant effect ($p > 0.05$) on the egg weight (Ewt), egg length (EL), shell weight (SW), shell ratio (SR), albumen weight (AW), albumen ratio (AR), yolk diameter (YD) and yolk height (YH) in the ages considered. At WK31 breed effect was observed ($p < 0.05$) in egg width (EW), shell index (SI), yolk weight (YW), yolk ratio (YR), albumen height (AH)

Table 1. Proximate composition of the commercial layers feed

Nutrients	Estimate (%)
Moisture	7.68
Ash	1.28
Protein	16.62
Fat	7.81
Fibre	0.00
Carbohydrate	56.90

Table 2. Breed effect on age basis on the quality of eggs

Age	Breed	Ewt	EL	EW	SI	SW	SR	ST	YW	AW	AR	YR	YD	YH	AH	YI	HU
WK31	ISA	59.75	5.59	4.48^{a}	80.00^{a}	8.28	13.88	0.69	14.10^{b}	37.46	62.60	23.59^{b}	40.49	15.53	6.48^{a}	38.56	79.27^{a}
	FA	59.58	5.67	4.32^{b}	76.23^{b}	7.50	12.59	0.66	15.58^{a}	36.67	61.88	26.02^{a}	41.41	15.41	5.72^{b}	37.47	73.73^{b}
	SEM	0.48	0.02	0.02	0.43	0.16	0.27	0.02	0.16	0.47	0.42	0.28	0.28	0.03	0.10	0.34	0.76
WK33	ISA	58.64	5.58	4.44	79.69	7.57	12.98	0.65	14.91	36.19	61.52	25.41	40.13	15.52	6.17^{b}	37.36	77.67^{b}
	FA	58.03	5.51	4.38	79.48	7.25	12.50	0.65	15.17	35.67	61.04	26.37	40.50	15.44	6.55^{a}	38.22	80.57^{a}
	SEM	0.61	0.02	0.02	0.45	0.11	0.23	0.01	0.17	0.63	0.53	0.34	0.23	0.29	0.07	0.35	0.53
WK35	ISA	61.00	5.67	4.51	80.34	9.35	13.78	0.58^{b}	14.41	36.69	61.61	24.62	40.52	15.66	6.34	38.58^{a}	78.36
	FA	62.57	5.63	4.36	77.19	9.14	13.85	0.76^{a}	14.29	37.14	61.66	25.68	40.29	15.33	6.09	35.07^{b}	77.30
	SEM	0.69	0.04	0.03	0.55	0.21	0.27	0.02	0.18	0.57	0.45	0.38	0.29	0.19	0.11	0.48	0.79

Ewt-egg weight (g); EL-egg length (mm); EW-egg width (mm); SI-shell index; SW-shell weight (g); SR-shell ratio; ST-shell thickness (mm); YW-yolk weight (g); AW-albumen weight (g); AR-albumen ratio; YR-yolk ratio; YD-yolk diameter (mm); YH-yolk height (mm); AH-albumen height (mm); YI-yolk index; HU-haughunit; SEM-standard error of mean; FA- Funaab Alpha. ($p < 0.05$).

Table 3. Age effect on breed basis on the egg quality

Breed	Age	Ewt	EL	EW	SI	SW	SR	ST	YW	AW	AR	YR	YD	YH	AH	YI	HU
ISA	WK31	59.75^{ab}	5.59	4.48^{ab}	80.00	8.28^{b}	13.89^{a}	0.69^{a}	14.10^{b}	37.46	62.60	23.59^{b}	40.49	15.53	6.48	38.56	79.27
	WK33	58.64^{b}	5.58	4.44^{b}	79.69	7.57^{c}	12.98^{b}	0.65^{a}	14.91^{a}	36.19	61.52	25.4^{a}	40.13	15.52	6.17	37.35	77.67
	WK35	61.00^{a}	5.67	4.52^{a}	80.33	9.35^{a}	13.78^{ab}	0.58^{b}	14.41^{b}	36.68	61.60	24.61^{a}	40.52	15.66	6.34	38.58	78.36
	SEM	0.37	0.02	0.02	0.30	0.12	0.17	0.01	0.11	0.34	0.30	0.20	0.17	0.08	0.06	0.25	0.44
FA	WK31	59.58	5.67	4.32	76.23^{b}	7.50^{b}	12.59	0.66	15.58	36.67	61.88	26.02	41.42	15.42	5.72^{b}	37.47^{ab}	73.73^{b}
	WK33	58.08	5.51	4.38	79.48^{a}	7.25^{b}	12.50	0.66	15.17	35.67	61.04	26.37	40.50	15.44	6.55a	38.22^{a}	80.57^{a}
	WK35	62.57	5.63	4.36	77.19^{b}	9.14^{a}	13.85	0.76	14.29	37.14	61.66	25.68	40.29	15.33	6.09^{ab}	35.07^{b}	77.30^{ab}
	SEM	1.00	0.04	0.03	0.49	0.25	0.36	0.03	0.27	0.85	0.72	0.58	0.42	0.06	0.14	0.56	1.04

Ewt-egg weight (g); EL-egg length (mm); EW-egg width (mm); SI-shell index; SW-shell weight (g); SR-shell ratio; ST-shell thickness (mm); YW-yolk weight (g); AW-albumen weight (g); AR-albumen ratio; YR-yolk ratio; YD-yolk diameter (mm); YH-yolk height (mm); AH-albumen height (mm); YI-yolk index; HU-haughunit; SEM-standard error of mean; FA- Funaab Alpha. ($p < 0.05$).

and haugh unit (HU), higher values were observed in all the traits for ISA brown except yolk weight (YW) and yolk ratio (YR). Significant effect of breed (< 0.05) was observed in HU and AH at WK33. Shell thickness (ST) and yolk index (YI) experienced breed effect at WK 35. Effect of age on egg quality on breed basis is shown in Table 3. In ISA brown age had significant effect ($p < 0.05$) on Ewt, EW, SW, SR, ST, YW and YR. In FUNAAB alpha, age effect was observed in SI, SW, AH, YI and HU. Age had no significant effect ($p > 0.05$) on all the nutritional components of eggs in the two breeds except in Zinc in ISA brown and fat and Zinc in Funaab alpha as shown in Table 4. Similarly, breed had no significant effect ($p < 0.05$) in most of the nutrients considered in all the ages except Na at week 31 (24245-ISA brown; 39995- FUNAAB alpha) and moisture at week 35 (77.40-ISA brown; 7592- FUNAAB alpha) as shown in Table 5.

The phenotypic correlations among the external quality traits of Isa brown and FUNAAB alpha eggs are shown in Table 6. The correlations in Isa brown eggs are shown in the upper diagonal while the FUNAAB alpha eggs are in the lower diagonal. In Isa brown eggs, egg weight had positive correlation

Table 4. Age effects on nutrients composition based on breed of chicken

Breed	Age (wks)	Ash %	Protein %	Fat %	Fibre %	CHO %	Moist %	Zn (ppm)	Ca (ppm)	Na (ppm)	K (ppm)	Fe (ppm)
Isa	31	0.83	13.31	4.89	0.00	3.08	77.89	15.00[a]	2030	2424.5	4625	24.00
	33	0.78	12.16	4.23	0.00	5.55	77.29	12.2[ab]	507	2499.5	4700	31.25
	35	0.63	12.72	3.44	0.00	5.95	77.41	13.50[b]	521	2727.0	2317	18.50
	OM	0.74	12.72	4.19	0.00	4.86	77.53	13.58	1019.50	2550.33	3880.33	24.58
	SEM	0.06	0.56	0.52	0.00	0.68	0.21	0.55	501.17	124.90	696.86	2.79
FA	31	1.01	15.42	6.58[a]	0.00	0.59	76.41	16.50[a]	531	3999.5	4700	27.25
	33	0.85	11.48	4.24[ab]	0.00	6.68	76.43	13.50[b]	527	2372.0	2277	29.75
	35	2.17	12.06	3.13[b]	0.00	6.72	75.93	12.25[b]	15323	1417.0	1827	13.50
	OM	1.34	12.99	4.65	0.00	4.66	76.35	14.08	5460.42	2596.17	2934.5	23.50
	SEM	0.49	0.99	0.69	0.00	1.50	0.23	0.81	4927.82	566.93	795.52	3.59

Moist- Moisture; CHO- Carbohydrate Ca- Calcium; Na- Sodium; K- Potassium; Fe- Iron; OM- overall mean; SEM-standard error of mean; FA- Funaab Alpha. ($p < 0.05$).

Table 5. Breeds effects on nutrients composition based on age of chicken

Age (wks)	Breed	Ash %	Protein %	Fat %	Fibre %	CHO %	Moist %	Zn (ppm)	Ca (ppm)	Na (ppm)	K (ppm)	Fe (ppm)
31	ISA	0.83	13.31	4.89	0.00	3.08	77.89	15.00	2030	2424.5[b]	4624.5	24.00
	FA	1.01	15.42	6.57	0.00	0.59	76.40	16.50	531	3999.5[a]	4699.5	27.25
	OM	0.92	14.36	5.57	0.00	1.83	77.15	15.87	1280.75	3212.0	4662.0	25.62
	SEM	0.19	0.72	0.72	0.00	0.76	0.99	0.59	737.94	777.57	191.89	2.56
33	ISA	0.78	12.15	4.23	0.00	5.55	77.29	12.25	507.25	2500	4700	31.25
	FA	0.85	11.47	4.24	0.00	6.68	76.72	13.50	527.00	2372	2277	29.75
	OM	0.81	11.81	4.23	0.00	6.11	77.01	12.87	517.12	2435.75	3488.25	30.50
	SEM	0.07	1.16	0.56	0.00	1.04	0.334	0.47	22.37	428.93	999.10	2.24
35	ISA	0.625	12.72	3.43	0.00	5.95	77.40[a]	13.50	521	2727.0	2317	18.50
	FA	2.17	12.06	3.10	0.00	6.70	75.92[b]	12.25	1823	1417.0	1827	13.50
	OM	1.39	12.39	3.28	0.00	6.33	76.66	12.89	1174	2072	2072	16.0
	SEM	0.77	0.45	0.28	0.00	0.93	0.43	0.43	642.53	452.69	929.25	2.04

Moist- Moisture; CHO- Carbohydrate Ca- Calcium; Na- Sodium; K- Potassium; Fe- Iron; OM- overall mean; SEM-standard error of mean; FA- Funaab Alpha. ($p < 0.05$).

with egg length (0.044), egg width (0.147), egg shape index (0.020) and shell weight (0.176) while the correlation with shell ratio and shell thickness were negative, -0.230 and -0.072 respectively. Egg length was negatively significantly correlated with egg shape index (-0.298). In FUNAAB alpha, egg weight was significantly correlated with egg length (0.607) egg width (0.561) shell weight (0.387). Egg length was positively significantly correlated with egg width egg shell weight, shell ratio and shell thickness while egg width was positively correlated with shell index, eggshell weight, and eggshell ratio. The correlation between eggshell ratio and eggshell width was positive and very highly significant (0.859). Table 7 shows the phenotypic correlation among internal quality traits of Isa brown and FUNAAB alpha eggs. The correlation in Isa brown eggs are shown in the upper diagonal while the FUNAAB alpha eggs in the lower diagonal. In Isa brown eggs, yolk height had positive correlation with albumen height (0.109), albumen weight (0.084), albumen ratio (0.021) yolk index (0.072) and Haugh unit (0.120) while the correlation with yolk weight (-0.007), yolk ratio (-0.044) and yolk diameter (0.041) were negative. In FUNAAB alpha yolk height was

Table 6. Phenotypic correlation among external quality of ISA brown and FUNAAB Alpha

	Ewt	EL	EW	SI	SW	SR	ST
Ewt		0.044	0.147	0.020	0.176*	-0.230**	-0.077
EL	0.607**		0.117	-0.298**	0.094	-0.024	-0.022
EW	0.561*	0.500*		0.749***	-0.003	0.003	0.004
SI	-0.081	-0.547*	0.444*		-0.002	0.037	0.057
SW	0.387*	0.277	0.352	0.023		0.466***	-0.159
SR	0.111	0.034	0.109	0.073	0.859***		-0.037
ST	0.349	0.328	0.141	-0.213	0.245	0.128	

Ewt-egg weight (g); EL-egg length (mm); EW-egg width (mm); SI-shell index; SW-shell weight (g); SR-shell ratio; ST-shell thickness. ($p < 0.05$, $p < 0.01$, $p < 0.001$).

Table 7. Phenotypic correlation among internal quality of ISA brown and FUNAAB Alpha eggs

	YH	AH	YW	AW	AR	YI	YR	HU	YD
YH		0.109	-0.007	0.084	0.021	0.072	-0.044	0.120	-0.041
AH	-0.091		0.014	-0.031	-0.091	-0.045	-0.024	0.924***	-0.009
YW	0.072	-0.063		-0.183	-0.481***	-0.032	0.565***	-0.015	0.185*
AW	-0.231	0.111	-0.295		0.812***	0.061	0.577***	-0.202*	0.063
AR	-0.112	0.146	-0.586	0.811***		0.151	-0.571***	-0.217**	0.000
YI	0.068	0.141	-0.093	0.027	0.176		-0.061	-0.112	-0.293**
YR	-0.200	-0.229	0.518	0.670***	-0.684***	-0.004		0.060	0.012
HU	0.023	0.893***	-0.118	-0.199	-0.036	0.023	-0.075		-0.038
YD	0.021	-0.119	0.386*	-0.124	-0.314	-0.147	-0.140	-0.140	

YW-yolk weight (g); AW-albumen weight (g); AR-albumen ratio; YR-yolk ratio; YD-yolk diameter(mm); YH-yolk height (mm); AH-albumin height (mm); YI-yolk index; HU-haugh unit. ($p < 0.05$, $p < 0.01$, $p < 0.001$).

significantly correlated with yolk weight (0.072), yolk index (0.068), Haugh unit (0.023) and yolk diameter (0.021) while albumen height (-0.091) was negatively correlated with albumen weight (-0.231), albumen ratio (-0.112) and (-0.021) respectively.

DISCUSSION

Egg quality traits of chickens have been investigated in several studies (Anderson *et al.*, 2004; Roberts, 2010; Kocevski *et al.*, 2011; Cath *et al.*, 2012). In this study, the non-significant effect of breed on egg weight in all the ages considered is contrary to the reports of Hanusová *et al* (2015) who reported on breed effect in egg weight of Oravka and Rhode Island Red laying hens. The reason for the non-significant effect could be attributed to the ages under consideration. The significant effect of breed observed in EW, SI, YW, YR, AH and HU and higher values in traits for ISA brown was the same for results obtained in egg qualities of the different strains of egg laying birds by Washburn (1990). Effect of breed (< 0.05) that was observed in HU and AH at WK33 was also in line with the study of Krawczyk *et al.* (2021). In ISA brown, age had significant effect ($p < 0.05$) on Ewt, EW, SW, SR, ST, YW and YR. In Funaab alpha, age effect was observed in SI, SW, AH, YI and HU. This was in line with the research of Ahn *et al.*, (1997). Authors also reported no effect of age on nutritional components of eggs. Breed had no significant effect ($p < 0.05$) in most of the nutrients considered in all the ages (Washburn, 1990). Fletcher *et al.*, (1983) also reported the same variations in the amount of Zinc and Na in egg quality components. In both Isa brown and Funaab alpha eggs, the positive correlations reported between egg weight and egg length (0.044), egg width (0.147), egg shape index (0.020) and eggshell weight (0.176) were also in line with the report of Yakubu *et al.* (2008) and Wolc, *et al.* (2012). The negative correlation observed between egg weight and shell qualities except egg shell weight in this study was in line with the report of Kul and Seker (2004). The different positive and negative correlations observed among the internal quality of egg in this study could be compared to the reports of earlier researchers like Yakubu *et al.* (2008) and Stadelman (1986).

CONCLUSION

It can be concluded that as the birds grow older the breed effect on egg qualities is more intensive. Parameters that were mostly affected were egg weight, egg shape index, yolk weight, yolk ratio, albumen height, and Haugh Unit. Age effect was also noticed on some internal and external qualities of eggs in both breeds under consideration. Both age and breed did not significantly affect the nutritional components of the table eggs. In future, eggs from more exotic breed (Noiler, Sikka brown etc.) and Nigeria indigenous breed should be assessed.

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INFORMED CONSENT STATEMENT

Not applicable.

DATA AVAILABILITY STATEMENT

The data presented in this study are available on request from the corresponding author.

CONFLICTS OF INTEREST

There is no conflict of interest with any individual or organization regarding the materials discussed in this manuscript.

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