TAS Trends in Agricultural Sciences

OPEN ACCESS

Seasonal Variation of Crossbreeding Component of Nigerian Indigenous Chickens, Rhode Island Red and Their Crossbred Progenies for Egg Quality Characteristics

[1]Amao, Shola Rasheed, [1]Oyewumi, Samuel Olusegun and [2]Hammed, Opeyemi Oladipupo

[1]Department of Agricultural Education, Emmanuel Alayande University of Education, P.M.B. 1010, Oyo, Nigeria

[2]Department of Animal Production and Health, Ladoke Akintola University of Technology, P.M.B. 4000, Ogbomoso, Oyo, Nigeria

ABSTRACT

Background and Objective: Egg components are influenced by a number of factors, including age, feed, season and genetic composition, in addition to those that directly affect the consumer's acceptance of the egg. The aim of the study is to determine the better season for egg quality among the crossbred progenies between the Nigerian indigenous chickens and Rhode Island Red. **Materials and Methods:** Data on egg quality compositions were acquired from a total of 100 birds, which included 5 cocks and 15 hens each of the following bird species: Fulani ecotype (FE), frizzled feather (FF), naked neck (NN), normal feather (NF) and Rhode Island Red (RIR) chickens. **Results:** The observed results indicated a significant (p<0.05) variation in crossbreeding components of progenies produced and egg quality traits. The results show that crossbreds of NNRIR and RIRNN displayed better external and internal egg quality components than other progenies produced. A significant (p<0.05) effect was revealed for the season and all egg quality parameters measured and early rain (autumn) was better in terms of external and internal egg components. **Conclusion:** It can be concluded that crossbreeding enhanced egg quality traits which favoured NNRIR and RIRNN crossbred chicken eggs for external and internal composition while early wet (autumn) also improved egg quality characteristics due to the moderate rate of temperature compared to other seasons.

KEYWORDS

Nigerian indigenous chickens, Rhode Island Red, crossbreeding component, seasonal variation, egg quality traits

INTRODUCTION

The qualities like growth and egg production and increases in the number of heterozygous loci, due to heterosis and crossbreeding are frequently utilized in chicken breeding programs[1]. Indigenous chickens seem to have a great deal of genetic variety, particularly in terms of adaptive features and hardiness[2] in minimal feeding schedules[3]. The primary goal of crossing is to create better crossings that will enhance

ISSN: 2957-9449 (Online)
ISSN: 2957-9430 (Print)
https://doi.org/10.17311/tas.2024.113.121

Received: 18 Mar. 2024
Accepted: 29 Jun. 2024
Published: 30 Jun. 2024

the performance of local chickens and combine various breed traits to create crosses that will perform well for growth or egg production[4,5]. Numerous research studies have found that crossbreeds outperform purebreds in terms of growth, egg production and egg quality traits[6]. Crossbreds between the top-performing parent breeds may produce birds with higher growth and egg production capabilities in tropical climates. Moreover, new hybrid strains of chickens could be created via hybrid vigor[7].

The three primary components of a chicken egg are shell, albumen and yolk as well as its internal and external characteristics all of which are extremely important to the egg industry because it determine the overall quality of the egg[8]. For acceptance and consumer appeal, the egg's physical features is crucial. Egg size, specific gravity, color, breaking strength, deformation, weight, percentage of shell, thickness and ultra-structure all contribute to the overall quality of the egg shell[8]. The shells of table eggs need to be robust enough to withstand dents and breaks during storage and/or transit[9]. In order to allow gas exchange and for easier breaking upon hatching, the shells of hatching eggs must first be thick and strong in order to preserve the embryo and then later on during incubation, they must become thin and weak[10]. The quality of the albumen, yolk and internal of the egg is determined by the presence of meat or blood stains[11].

Customers place a premium on egg quality and a producer's bottom line is largely dependent on the quantity of eggs they sell. There is a genetic basis for egg quality and different strains of hens have different egg quality standards[12]. The broken eggshells resulted in larger losses for market-egg producers and eggshell quality has significant ramifications for the chicken industry, both economically and reproductively. The albumen and yolk, two internal egg quality characteristics that customers value highly, cannot be evaluated without cracking the egg[13]. Certain common alterations in eggs occur as layers age, including an increase in the weight and proportion of the yolk[14] but reducing the percentage of albumen[15].

It has been observed that the environment has an impact on livestock animal productivity, especially in tropical environments where the weather negatively affects the wellbeing and productivity of all domestic animals[16]. Egg quality characteristics that are economically significant, like size, weight, yolk and albumin contents, are quantitative attributes that exhibit constant change. Since feed intake has been shown to have a favorable influence on egg production. Rozenboim *et al.*[17] found a drop in egg production, egg weight and shell thickness as a result of high temperatures. High temperatures have a direct but negative association with feed intake.

Nigeria has different seasons in the year such as late dry (summer), early rain (autumn), late rain (winter) and early dry (spring) which vary in respect of temperature and relative humidity[16,18,19]. The effects of seasons on the performance of chickens that have been studied previously indicated significant differences in most productive and reproductive traits from one season to another[20]. Therefore, this study aims to determine the season effects on egg quality traits of the crossbred chicken progenies obtained from Nigerian indigenous chickens and Rhode Island Red birds.

MATERIALS AND METHODS

Experimental site: The Poultry Unit of Teaching and Research Farm at Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria, was the site of the experiment. Ogbomoso is located in Nigeria's derived savanna zone at Latitude 8°08' North of the equator and Longitude 4°15' East of the Greenwich Meridian. The elevation is between 300 and 600 m above sea level and the average yearly temperature and precipitation are 27°C and 1247 mm, respectively. The experiment lasted between February and December, 2018.

Experimental birds and their management: Both local and exotic breeds of chickens were included as experimental subjects in this investigation. The Fulani ecotype, normal feather, frizzled feather and naked neck are the strains found locally. The exotic chicken, Rhode Island Red cocks and hens, were purchased at the age of eighteen weeks from a respectable farm, while the local birds were chosen from the research area's available chicken population. For the experiment, a total of one hundred birds were obtained and utilized as parents. This includes five cocks and fifteen hens each of the following breeds: Rhode Island Red, normal feathered, frizzled feather, Fulani ecotype and naked neck. Afterward, these purebred chickens were crossed with one another to produce F1 crossbreds (straight and reciprocal crosses). An industrial galvanized metal wing tag was used to accurately identify each chicken. The experimental birds were kept under stringent control within an intensive production management system. They were individually housed in a two-tiered galvanized battery cage with a spacing between cell spaces of $0.14 \times 0.14 \times 0.28$ m^2. The pen and cage were adequately cleaned with formalin® and morigard®, per the manufacturer's instructions, before the experimental parent birds arrived. Fifty two weeks were allotted to the trial.

Feeds and feeding: Commercial breeders' grower mash, with 16% crude protein and 2600 kcal/kg metabolizable energy, was fed to the cocks on an *ad libitum* basis. Additionally, commercial layers mashed with 16% crude protein and 2800 kcal/kg metabolizable energy were given to the hens. The *ad libitum* supplies of cool, clean water were also provided.

Mating technique: The sires' vents were trimmed every two weeks to remove any excess feathers and the semen was extracted using the artificial insemination (AI) method, which involves massaging the sires from 22 weeks onward by repeatedly applying pressure from the back toward the tail prior to sperm production. The retrieved semen was promptly inseminated into the shape of a doughnut in the left vent of the dams. Each time, 0.1 mL of freshly collected, undiluted semen was utilized for insemination, using an inseminator that was observed twice a week throughout the nighttime.

Mating design: To produce the F1 progenies, pure, direct and reciprocal crosses between local Nigerian chickens and Rhode Island Red were made. The adopted mating protocols are listed below:

Purebreeds:

- Rhode Island Red (Male)×Rhode Island Red (Female): $RIR_m \times RIR_f$
- Frizzled feather (Male)×Frizzled feather (Female): $FF_m \times FF_f$
- Fulani ecotype×Fulani ecotype (Female): $FE_m \times FE_f$
- Naked neck (Male)×Naked neck (Female): $NN_m \times NN_f$
- Normal feather (Male)×Normal feather (Female): $NF_m \times NF_f$

Crossbreds
Straight crossing:

- Rhode Island Red (Male)×Frizzled feather (Female): $RIR_m \times FF_f$
- Rhode Island Red (Male)×Naked neck (Female): $RIR_m \times NN_f$
- Rhode Island Red (Male)×Fulani ecotype (Female): $RIR_m \times FE_f$
- Rhode Island Red (Male)×Normal feather (Female): $RIR_m \times NF_f$

Reciprocal crossing:

- Frizzled feather (Male)×Rhode Island Red (Female): $FF_m \times RIR_f$
- Normal feather (Male)×Rhode Island Red (Female): $NF_m \times RIR_f$
- Naked necked (Male)×Rhode Island Red (Female): $NN_m \times RIR_f$
- Fulani ecotype (Male)×Rhode Island Red (Female): $FE_m \times RIR_f$

Egg collection and incubation: Every day, eggs were gathered and marked to determine which egg belonged to which hen. After being kept for a few days at room temperature, the eggs were placed in the incubator. On the fifth and eighteenth days of incubation, eggs were candled using a candler fixed with a neon fluorescent tube in a dark environment to identify viable eggs and clear eggs.

Management of the chicks: Chicks were likewise tagged with the sires at hatching and arranged at random in brooder compartments to be raised. Every chicken was raised in a rigorous manner with natural light, adhering to vaccination and medication schedules from the time they were days old.

Feed and feeding of the chicks: The commercial chick mash, which contains 18% crude protein and 2650 kcal/kg metabolizable energy, was fed to the brooding chicks *ad libitum* for the duration of their day until they were eight weeks old. The chicks were divided into feeding groups of 100 birds per tray or pan of tube feeder and one drinker with a capacity of two to four liters. Birds were fed normal commercial growers' mash, which contained 16% crude protein and 2700 kcal/kg of metabolizable energy, starting at the age of eight weeks. However, at the age of eighteen weeks, the layers were given commercial layers mash, which contained 16% crude protein and 2800 kcal/kg of metabolizable energy, along with unlimited water.

Ethical consideration: The animals were reared under hygienic conditions and were confined throughout the experimental period. The experiment was approved by the Ethical Committee of the Departments of Animal Production and Health and Animal Nutrition and Biotechnology of Ladoke Akintola University of Technology, Ogbomoso, Oyo, Nigeria.

Data collection: After the birds had been laying for 20 weeks, 30 eggs per genotype were chosen at random each week and examined for various aspects of egg quality. This was done for eight weeks at each of late dry (summer), early rain (autumn), late rain (winter) and early dry (spring). Egg weight (g), egg length (mm), egg width (mm), shell weight (g), shell thickness (mm) (external parameters) and yolk weight (g), yolk height (mm), yolk length (mm), albumen height (mm), albumen weight (g) (internal parameters) and albumen weight (mm) were all measured by the procedures described by FAO[21] including the Haugh unit.

Statistical analysis: Data obtained for egg quality traits was subjected to analysis of variance for the fixed effects of genotype and season using two-way Analysis of Variance (ANOVA) and the least significant difference was determined using the 2018 version of Duncan's Multiple Range Test while the significance level was at $p<0.05$ and GLM-general linear model procedure of SAS used.

The following model were be used:

$$Y_{ijkl} = \mu+\alpha_i+S_j+(\alpha S)_{ij}+e_{ijk}$$

Where:

Y_{ijkl} = Observed value of a dependent variable

μ = General mean

α_i = Fixed effect of the i^{th} genotype (i = 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13)

S_j = Fixed effect of the j^{th} season (i = 1, 2, 3, 4)

$(\alpha S)_{ij}$ = Interaction of i^{th} genotype and j^{th} season

e_{ijk} = Random error common to measurement in each bird and assumed to be normally and independently distributed with a mean of zero and variance δ^2

RESULTS

Significant difference ($p<0.05$) obtained in the pooled egg quality traits regarding the pure and crossbred genotypes and season as shown in Table 1 and 2. The results revealed among the external egg quality traits, RIR eggs had the heaviest egg weight (60.70 g), egg length (61.55 mm) and shell thickness (0.40 mm) than other genetic group. Among the crossbreds, NN×RIR eggs were better in egg weight (55.32 g), egg length (56.41 mm), egg width (35.01 mm), shell weight (4.99 g) and shell thickness (0.40 mm). However, the least values of egg weight (41.23 g), egg length (48.96 mm), egg width (29.73 mm) and shell thickness (0.27 mm) were recorded for crosses involving FF×RIR eggs. Meanwhile, the internal egg quality traits indicated that among the pure eggs, RIR eggs had the highest yolk height (15.25 mm), albumen height (8.65 mm), albumen weight (31.15 g) and haugh unit (89.66) than other genetic egg groups. However, among the crossbred eggs, the values recorded for yolk height (14.91 mm), yolk length (45.31 mm), yolk weight (17.65 g), albumen length (59.56 mm), albumen height (7.98 mm), albumen weight (30.02 g) and haugh unit (86.28) were superior for crosses involving NN×RIR eggs than its counterpart's eggs. Interestingly, internal egg quality traits were observed to be lowest in yolk height (10.89 mm), albumen height (5.01 mm), albumen weight (18.33 g) and haugh unit (76.69) for NF eggs while yolk length (30.40 mm), yolk weight (10.74 g) for FF×RIR eggs. However, the pooled egg quality traits results indicated that as expected RIR eggs among the pure eggs performed better in terms of egg weight, egg length, shell thickness, yolk height, albumen height, albumen weight and haugh unit than other genetic eggs while among the crossbred eggs, crosses involving the NN×RIR eggs were favoured for egg weight, egg length, shell thickness, yolk height, albumen height, albumen weight and haugh unit respectively than other crossbred eggs.

Season significantly ($p<0.05$) influenced all the egg quality traits measured and these variables were better in early wet season than early dry, late dry and late wet seasons.

Table 1: Pooled least square mean values and standard errors of external eggs quality traits as affected by different chickens' genotypes and season

Parameter	N	EW (g)	EL (mm)	EWD (mm)	SW (g)	ST (mm)
Genotype						
RIR	30	60.70 ± 2.01^{a}	61.55 ± 1.23^{a}	32.50 ± 0.28^{c}	4.40 ± 0.67^{c}	0.40 ± 0.01^{a}
NF	30	43.96 ± 0.34^{de}	50.15 ± 1.34^{de}	31.01 ± 0.45^{e}	3.68 ± 0.45^{f}	0.38 ± 0.02^{b}
FF	30	41.23 ± 0.45^{f}	52.08 ± 1.88^{c}	31.57 ± 0.78^{d}	3.84 ± 0.87^{ef}	0.39 ± 0.01^{b}
NN	30	43.28 ± 0.23^{e}	51.90 ± 2.42^{c}	31.85 ± 0.52^{d}	4.00 ± 0.63^{de}	0.38 ± 0.02^{b}
FE	30	49.20 ± 1.90^{c}	53.06 ± 2.65^{b}	32.85 ± 0.45^{c}	4.03 ± 0.56^{de}	0.41 ± 0.02^{a}
RIR×FE	30	52.95 ± 1.89^{b}	53.68 ± 2.96^{b}	33.22 ± 0.56^{b}	4.56 ± 0.32^{bc}	0.40 ± 0.01^{a}
RIR×FF	30	44.23 ± 1.56^{de}	49.01 ± 0.43^{f}	34.62 ± 0.23^{ab}	4.45 ± 0.39^{c}	0.33 ± 0.02^{b}
RIR×NF	30	43.00 ± 1.89^{e}	51.66 ± 0.56^{c}	29.73 ± 0.26^{f}	3.85 ± 0.89^{ef}	0.37 ± 0.01^{b}
RIR×NN	30	50.65 ± 0.43^{b}	50.24 ± 1.52^{c}	33.70 ± 0.59^{b}	4.80 ± 0.73^{ab}	0.33 ± 0.02^{b}
NN×RIR	30	55.32 ± 0.23^{ab}	56.41 ± 0.97^{ab}	35.01 ± 0.67^{a}	4.99 ± 0.56^{a}	0.40 ± 0.01^{a}
FF×RIR	30	44.79 ± 0.45^{d}	48.96 ± 0.63^{f}	34.58 ± 0.73^{ab}	4.67 ± 0.45^{ab}	0.27 ± 0.02^{c}
NF×RIR	30	43.40 ± 0.27^{de}	51.64 ± 2.09^{c}	27.75 ± 0.99^{g}	3.90 ± 0.45^{de}	0.37 ± 0.03^{b}
FE×RIR	30	48.07 ± 0.59^{c}	49.28 ± 1.27^{de}	33.06 ± 0.67^{b}	4.67 ± 0.55^{ab}	0.32 ± 0.02^{c}
Season						
LD	97	45.34 ± 2.21^{b}	49.02 ± 2.88^{b}	27.99 ± 1.45^{b}	3.90 ± 0.45^{b}	0.30 ± 0.03^{b}
EW	98	49.56 ± 2.89^{a}	53.89 ± 1.56^{a}	30.80 ± 2.66^{a}	4.34 ± 0.03^{a}	0.36 ± 0.01^{a}
LW	98	48.90 ± 0.99^{ab}	53.04 ± 1.66^{ab}	30.25 ± 3.89^{ab}	4.12 ± 0.10^{ab}	0.33 ± 0.03^{ab}
ED	97	45.90 ± 1.90^{b}	48.90 ± 1.45^{b}	28.89 ± 0.51^{b}	3.89 ± 0.22^{b}	0.31 ± 0.01^{b}

^{abcdefg}Means along the same column at each subclass with different superscripts are significantly different ($p<0.05$), N: Number of observation, EW: Egg weight, EL: Egg length, EWD: Egg width, SW: Shell weight, ST: Shell thickness, RIR: Rhode Island Red, FE: Fulani ecotype, NN: Naked neck, NF: Normal feather, RIR×FE: Rhode Island Red Fulani Ecotype crossbred, RIR×FF: Rhode Island Red Frizzled feather crossbred, RIR×NN: Rhode Island Red Naked neck crossbred, RIR×NF: Rhode Island Red Normal feather crossbred, FE×RIR: Fulani Ecotype Rhode Island Red crossbred, FF×RIR: Frizzle feather Rhode Island Red crossbred, NN×RIR: Naked neck Rhode Island Red crossbred, NF×RIR: Normal feather Rhode Island Red crossbred, ED: Early dry, LD: Late dry, EW: Early Wet and LW: Late wet

Table 2: Pooled least square mean values and standard errors of internal eggs quality traits pure, straight and reciprocal F_1 crosses as affected by different chickens' genotypes and season

Parameter	N	YH (mm)	YL (mm)	YW (g)	AL (mm)	AH (mm)	AW (mm)	HU
Genotype								
RIR	30	15.25 ± 1.01^{a}	43.61 ± 0.08^{c}	16.05 ± 1.21^{b}	56.62 ± 1.81^{e}	8.65 ± 0.41^{a}	31.15 ± 0.27^{a}	89.66 ± 2.21^{a}
NF	30	10.89 ± 0.12^{g}	44.98 ± 0.15^{ab}	15.98 ± 0.02^{b}	55.05 ± 0.02^{e}	5.01 ± 0.02^{h}	18.33 ± 0.25^{g}	76.77 ± 1.92^{d}
FF	30	11.31 ± 0.91^{fg}	43.78 ± 0.18^{bc}	15.92 ± 0.21^{b}	56.56 ± 0.91^{de}	5.59 ± 0.01^{g}	21.18 ± 0.37^{f}	79.10 ± 1.91^{c}
NN	30	11.90 ± 0.13^{f}	42.97 ± 0.22^{c}	15.75 ± 0.03^{bc}	57.67 ± 0.19^{d}	5.18 ± 0.10^{gh}	21.13 ± 0.43^{f}	76.69 ± 1.02^{d}
FE	30	12.80 ± 1.11^{e}	45.62 ± 0.35^{a}	17.48 ± 1.41^{a}	58.57 ± 1.41^{b}	6.68 ± 0.11^{c}	24.80 ± 0.16^{de}	84.47 ± 2.02^{b}
RIR×FE	30	14.35 ± 1.29^{de}	41.33 ± 0.16^{d}	15.10 ± 1.26^{d}	59.13 ± 1.99^{ab}	7.67 ± 0.29^{b}	30.40 ± 0.22^{b}	89.47 ± 0.91^{a}
RIR×FF	30	13.43 ± 1.06^{de}	33.96 ± 0.23^{f}	11.73 ± 1.36^{f}	55.04 ± 1.86^{e}	6.03 ± 0.06^{de}	26.78 ± 0.31^{c}	89.48 ± 0.82^{a}
RIR×NF	30	12.88 ± 1.09^{e}	43.93 ± 0.26^{bc}	15.30 ± 1.29^{cd}	58.20 ± 1.89^{c}	5.46 ± 0.09^{g}	20.85 ± 0.19^{f}	79.40 ± 0.51^{c}
RIR×NN	30	14.38 ± 0.13^{bc}	44.90 ± 0.49^{ab}	12.43 ± 0.13^{e}	57.67 ± 0.89^{d}	6.74 ± 0.03^{c}	24.80 ± 1.01^{c}	86.10 ± 0.62^{b}
NN×RIR	30	14.91 ± 0.13^{ab}	45.31 ± 0.37^{a}	17.65 ± 0.11^{a}	59.56 ± 0.53^{a}	7.98 ± 0.11^{ab}	30.02 ± 1.11^{a}	86.12 ± 2.01^{b}
FF×RIR	30	13.75 ± 0.25^{cd}	33.54 ± 0.23^{f}	11.72 ± 0.15^{f}	55.38 ± 1.89^{e}	6.35 ± 0.15^{cd}	26.80 ± 0.15^{c}	86.28 ± 0.62^{b}
NF×RIR	30	12.85 ± 0.17^{e}	43.93 ± 0.49^{bc}	15.20 ± 0.07^{cd}	56.99 ± 2.07^{de}	5.68 ± 0.11^{ef}	21.00 ± 0.49^{f}	80.72 ± 1.53^{c}
FE×RIR	30	15.40 ± 0.29^{a}	30.40 ± 0.47^{h}	10.74 ± 0.19^{g}	58.47 ± 2.99^{b}	6.37 ± 0.19^{de}	22.59 ± 0.25^{e}	86.28 ± 0.62^{b}
Season								
LD	97	11.02 ± 0.05^{b}	34.04 ± 0.89^{c}	11.09 ± 1.11^{d}	50.99 ± 0.45^{b}	5.01 ± 0.04^{c}	20.56 ± 0.99^{c}	74.09 ± 0.45^{c}
EW	98	12.89 ± 0.56^{a}	36.67 ± 1.22^{a}	13.90 ± 1.78^{a}	$54.\ 67\pm1.23^{a}$	6.54 ± 0.77^{a}	22.89 ± 0.67^{a}	83.90 ± 2.99^{a}
LW	98	12.56 ± 0.22^{ab}	35.05 ± 2.89^{ab}	13.08 ± 1.88^{b}	53.89 ± 1.56^{ab}	6.00 ± 0.45^{b}	21.99 ± 0.78^{ab}	80.67 ± 2.77^{b}
ED	97	11.09 ± 0.01^{b}	33.56 ± 1.67^{b}	12.78 ± 1.09^{c}	51.90 ± 0.99^{b}	5.99 ± 0.56^{b}	22.78 ± 1.89^{b}	75.67 ± 2.67^{b}

^{abcdefg}Means along the same column at each subclass with different superscripts are significantly different ($p<0.05$), N: Number of observation, YH: Yolk height, YL: Yolk length, YW: Yolk weight, AL: Albumen length, AH: Albumen height, AW: Albumen weight, HU: Haught unit, RIR: Rhode Island Red, FE: Fulani ecotype, NN: Naked neck, NF: Normal feather, RIR×FE: Rhode Island Red Fulani ecotype crossbred, RIR×FF: Rhode Island Red frizzled feather crossbred, RIR×NN: Rhode Island Red Naked neck crossbred, RIR×NF: Rhode Island Red normal feather crossbred, FE×RIR: Fulani Ecotype Rhode Island Red crossbred, FF×RIR: Frizzle feather Rhode Island Red crossbred, NN×RIR: Naked neck Rhode Island Red crossbred, NF×RIR: Normal feather Rhode Island Red crossbred, ED: Early dry, LD: Late dry, EW: Early wet and LW: Late wet

DISCUSSION

Quality determines the egg's acceptability to consumers and egg quality is a general terms that refers to several standards that define internal and external quality. The significant genotype variations in external and internal quality of chicken eggs showed that egg weight, egg length, egg width, shell weight, shell thickness, yolk height, yolk length, yolk weight, albumin height, albumin weight, albumin length and haugh unit were highly influenced by genetic factors and this corroborated with the reports of researchers[12,22,23]. The differences in the external egg quality traits (egg weight, egg length, egg width, shell weight and shell thickness) in all crosses involved in this study can also be associated with variations in genetic background of the chicken genotypes. The optimum performance in egg weight, egg length, egg width, shell weight and shell thickness exhibited by RIR×RIR purebred exotic birds over their pure and crossbred counterparts suggested that RIR eggs had better external egg quality traits potential than eggs from other genotypes. This observation of exotic birds exhibiting superiority over other pure and crossbred eggs agreed with the findings of researchers[24-26].

Furthermore, wider eggs and heavier shell weights exhibited by RIR×NN and NN×RIR crossbred than the pures and crossbred chicken eggs were earlier witnessed by Saleem *et al.*[27], who reported better shell thickness for NN and the production of the thicker shelled eggs may be attributed to its ability to inherit this character in the progeny. In Cameroon, Keambou *et al.*[23] found that crossbred eggs obtained from crossing between local and Hubbard rooster chicken had better external and internal egg quality traits than its pure counterpart eggs. Akinbola *et al.*[28] in Nigeria, recently reported significant effects on egg quality traits of crossbred indigenous Yoruba ecotype chickens and Lohmann Brown cocks and Khalil *et al.*[29] found that crossbred eggs obtained from crossing between Egyptian Golden Montazah (M) and White Leghorn (WL) had better external egg quality parameters than the pure eggs obtained in their study. Moula *et al.*[30] reported that crossbred eggs recorded from the crosses involving local Kebyle hen and Isa Brown had superior performance than their purebred counterpart in terms of egg weight, egg length, egg width, shell weight and shell thickness. Gupta *et al.*[31] concluded in their research involving Indian local chicken and RIR that crossbred Kadaknath×RIR eggs performed better than their purebred counterparts' eggs with respect to earlier egg quality parameters. The improved performance of NN×RIR and RIR×NN crossbreed eggs as witnessed in this study may be due to the fact to the inherent genetic make-up of RIR birds. The fact that the performance in the egg traits of the crosses that involved the improved naked neck with RIR was lower than that of the pure RIR was suggested[32].

The superiority exhibited also by RIR eggs in most of the internal egg quality traits (yolk height, albumen height, albumin weight and haugh unit) was expected from the exotic birds and this pattern of results was in line with the reports of Authors[32-34]. These researchers reported that internal egg quality traits were better for exotic birds while local Fulani ecotype eggs exhibited better yolk length coupled with yolk weight. Alewi and Melesse[25] concluded that Kei chicken eggs were significantly better in egg quality traits than pure RIR and its crossbreds. Moreover, the present results of external and internal egg quality traits that favoured the exotic breed (RIR) and the crosses involving NN×RIR and RIR×NN eggs contradicted the observations of Munisi *et al.*[35] and Khawaja *et al.*[36] observed that the non-significant variations exist among the external and internal egg traits in their various studies.

The seasonal variation on the egg traits of different genotypes in the current study showed that egg quality traits of the birds are genetically influenced and favoured the genetic components of NNRIR and RIRNN crossbred as earlier claimed by researchers[18,19,37,38]. These authors at their different studies claimed that genetic constitutions of birds influenced the egg quality characteristics. The present results that indicated seasonal effects on all external and internal egg quality traits also agreed with the observation of Raji *et al.*[39] that season significantly affected external and internal egg quality parameters. This might be due to the effects of temperature variations at each stage of summer, autumn, winter and spring. The egg quality traits reported during the winter season in and around Gannavaram, Krishna District of India were comparable with the findings in the current study and at similar seasons. Tamilvanan *et al.*[38] reported better egg quality traits during winter (early wet) for egg laying, albumen, yolk index, shell thickness and haugh unit as compared with summer season (early dry) with other traits of non-significant variation.

CONCLUSION

These results indicated that seasonal effects play a significant role in influencing both the external and internal composition of eggs and genetic composition of birds also affects the compositional characteristics of the eggs. The birds with genetic composition of NNRIR and RIRNN crossbreds displayed superior external and internal egg quality traits and haugh unit values than their counterpart birds. The significant seasonal effects on all measurements studied suggest that season has a relatively significant effect on egg compositional characteristics and early wet (autumn) season showed better external and internal egg compositions than late wet (winter), early dry (spring) and late dry (summer) seasons.

SIGNIFICANCE STATEMENT

The purpose of study is to assess the season that the egg quality characteristics are better among the set of genetic components of chickens used for this study. The different genetic components of chickens used shows that seasonal variation were significantly influenced the egg quality characteristics of crossbred chickens eggs, such impacting factors as shell thickness, yolk colour, albumen components and the results further indicated that crossbreds of NNRIR (Naked neck Rhode Island Red) and RIRNN (Rhode Island Red naked neck) displayed better external and internal egg quality components than other progenies produced. Meanwhile, Significant effect was revealed for season and all egg quality parameters measured while early rain (autumn) was better in terms of external and internal egg components.

REFERENCES

1. Amuzu-Aweh, E.N., H. Bovenhuis, D.J. de Koning and P. Bijma, 2015. Predicting heterosis for egg production traits in crossbred offspring of individual White Leghorn sires using genome-wide SNP data. Genet. Sel. Evol., Vol. 47. 10.1186/s12711-015-0088-6.
2. Amao, S.R., L.O. Ojedapo and T.A. Adedeji, 2024. Egg production characteristics of Nigerian indigenous chickens, Rhode Island Red and their crossbred progenies. Trends Agric. Sci., 3: 29-37.
3. Ramadan, S., B.B. Kayang, E. Inoue, K. Nirasawa, H. Hayakawa, S.I. Ito and M. Inoue-Murayama, 2012. Evaluation of genetic diversity and conservation priorities for Egyptian chickens. Open J. Anim. Sci., 2: 183-190.
4. Hailemariam, A., W. Esatu, S. Abegaz, M. Urge, G. Assefa and T. Dessie, 2022. Sensory characteristics, nutritional composition, and quality of eggs from different chickens. Open J. Anim. Sci., 12: 591-615.
5. Lalev, M., N. Mincheva, M. Oblakova, P. Hristakieva and I. Ivanova, 2014. Estimation of heterosis, direct and maternal additive effects from crossbreeding experiment involving two white plymouth rock lines of chickens. Biotechnol. Anim. Husb., 30: 103-114.
6. Hailemariam, A., W. Esatu, S. Abegaz, M. Urge, G. Assefa and T. Dessie, 2023. Effects of crossbreeding on growth, production and selected egg quality traits of Improved Horro crosses with Cosmopolitan chickens. J. Agric. Food Res., Vol. 14. 10.1016/j.jafr.2023.100716.
7. Amao, S.R., T.A. Adedeji, L.O. Ojedapo and T.E. Amusan, 2024. Genetic components of growth performance traits of progenies derived from crosses of four local and exotic chickens in derived savanna environment of Nigeria. Asian J. Biol. Sci., 17: 21-31.
8. Roberts, J.R., 2004. Factors affecting egg internal quality and egg shell quality in laying hens. J. Poult. Sci., 41: 161-177.
9. Abbasi, S., M.A. Abbasi and A. Noshari, 2015. Estimation of heritability and genetic and phenotypic correlation between egg quality and body weight traits in native fowls of fars. Anim. Prod., 17: 391-401.
10. Narushin, V.G. and M.N. Romanov, 2002. Egg physical characteristics and hatchability. World's Poult. Sci. J., 58: 297-303.
11. Soliman, M.A., M.H. Khalil, K. El-Sabrout and M.K. Shebl, 2020. Crossing effect for improving egg production traits in chickens involving local and commercial strains. Vet. World, 13: 407-412.
12. El-Labban, A.M., M.M. Iraqi, M.S. Hanafi and A.H. Heba, 2011. Estimation of genetic and non-genetic parameters for egg production traits in local strains of chickens. Livest. Res. Rural Dev., Vol. 23.
13. Suk, Y.O. and C. Park, 2001. Effect of breed and age of hens on the yolk to albumen ratio in two different genetic stocks. Poult. Sci., 80: 855-858.
14. Rizzi, C. and G.M. Chiericato, 2005. Organic farming production. Effect of age on the productive yield and egg quality of hens of two commercial hybrid lines and two local breeds. Italian J. Anim. Sci., 4: 160-162.
15. van den Brand, H., H.K. Parmentier and B. Kemp, 2004. Effects of housing system (outdoor vs. cages) and age of laying hens on egg characteristics. Br. Poult. Sci., 45: 745-752.
16. El-Tahawy, W.S. and W.S. Habashy, 2021. Genetic effects on growth and egg production traits in two-way crosses of Egyptian and commercial layer chickens. South Afr. J. Anim. Sci., 51: 349-354.
17. Rozenboim, I., E. Tako, O. Gal-Garber, J.A. Proudman and Z. Uni, 2007. The effect of heat stress on ovarian function of laying hens. Poult. Sci., 86: 1760-1765.
18. Ojedapo, L.O., 2013. Effect of age and season on egg quality traits of ISA brown layer strain reared in derived Savanna Zone of Nigeria. Transnational J. Sci. Technol., 3: 48-60.
19. Adebambo, A.O., C.O.N. Ikeobi, M.O. Ozoje, O.O. Oduguwa and O.A. Adebambo, 2011. Combining abilities of growth traits among pure and crossbred meat type chickens. Arch. Zootecnia, 60: 953-963.
20. Abdel-Azeem, A.F., T.A. Shamma and Y.O. Omara, 2015. Seasonal variation and performance evaluation of broiler breeder chickens reared in enclosed houses. Egypt. Poult. Sci. J., 35: 833-856.
21. FAO, 2012. Phenotypic Characterization of Animal Genetic Resources. Food and Agriculture Organization of the United Nations, Rome, Italy, ISBN: 9789251071991, Pages: 142.

22. Adedeji, T.A., S.R. Amao, A.D. Popoola and R.I. Ogundipe, 2015. Fertility, hatchability and eggs quality traits of Nigerian locally adapted chickens in the derived savanna environment of Nigeria. Biol. Agric. Healthcare, 5: 36-42.
23. Keambou, T.C., S. Mboumba, B.A.H. Touko, C. Bembide, T.M. Mezui, A.M.Y. Tedongmo and Y. Manjeli, 2015. Growth performances, carcass and egg characteristics of the local chicken and its first generation reciprocal crossbreds with an exotic strain in Cameroon. Adv. Anim. Vet. Sci., 3: 507-513.
24. Isidahomen, C.E., A.A. Njidda and E.A. Olatunji, 2013. Egg quality traits of indigenous and exotic chickens as influenced by specific genes. J. Biol. Agric. Healthcare, 3: 53-57.
25. Alewi, M. and A. Melesse, 2013. Evaluating the growth performance of local Kei chickens and their F1-crosses with rhode island red and fayoumi breeds in watershed areas of Guraghe Administrative Zone, Southern Ethiopia. Trop. Subtrop. Agroecosyst., 16: 39-50.
26. Bekele, F., T. Adnoy, H.M. Gjoen, J. Kathle and G. Abebe, 2010. Production performance of dual purpose crosses of two indigenous with two exotic chicken breeds in sub-tropical environment. Int. J. Poult. Sci., 9: 702-710.
27. Saleem, F., B.H. Ahmad, S. Zahid and B. Kabeer, 2014. Comparative productive performance of indigenous naked neck and naked neck crossbred layer chickens. Pak. J. Agric. Res., 27: 265-344.
28. Akinbola, E.T., O.O. Ojebiyi, B.O. Olugbade, O.L. Olawale and S.R. Amao, 2023. Growth performance traits and egg quality of indigenous Yoruba ecotype chickens crossbred with Lohmann brown cocks. Slovak J. Anim. Sci., 56: 12-20.
29. Khalil, M.H., M.M. Iraqi and M.M. El-Atrouny, 2013. Effects on egg quality traits of crossing Egyptian Golden Montazah with White Leghorn chickens. Livest. Res. Rural Dev., Vol. 25.
30. Moula, N., M.T. Diaw, A. Salhi, F. Farnir, N. Antoine-Moussiaux and P. Leroy, 2013. Egg production performance of the local Kabyle hen and its crossbreeds with ISA-brown strain in semi-intensive conditions. Int. J. Poult. Sci., 12: 148-152.
31. Gupta, C.S., A. Kumar, R. Arya, M. Patel, A.K. Ghosh and J. Palod, 2007. Evaluation of egg quality of crossbred chickens reared under backyard farming in Tarai areas of Uttaranchal. Indian J. Anim. Res., 41: 216-219.
32. Islam, M.S. and R.K. Dutta, 2010. Egg quality traits of indigenous, exotic and crossbred chickens (*Gallus domesticus* L.) in Rajshahi, Bangladesh. J. Life Earth Sci., 5: 63-67.
33. Schiavone, A., E. Mellia, G. Salamano, V. Raccone and M. Tarantola *et al*., 2009. Egg quality and blood parameters of “Bianca di Saluzzo” and Isa Brown hens kept under free range conditions. Ital. J. Anim. Sci., 8: 772-774.
34. Tadesse, D., H. Singh, A. Mengistu, W. Esatu and T. Dessie, 2013. Study on productive performances and egg quality traits of exotic chickens under village production system in East Shewa, Ethiopia. Afr. J. Agric. Res., 8: 1123-1128.
35. Munisi, W.G., A.M. Katule and S.H. Mbaga, 2016. Comparisons of egg production and quality traits of parental and crosses of broiler and Black Australorp chickens in Tanzania. Livest. Res. Rural Dev., Vol. 28.
36. Khawaja, T., S.H. Khan, N. Mukhtar, A. Parveen and G. Fareed, 2013. Production performance, egg quality and biochemical parameters of three way crossbred chickens with reciprocal F1 crossbred chickens in sub-tropical environment. Ital. J. Anim. Sci., 12: 127-132.
37. Veena, D., R.B. Eswara, M.E. Naga and S.A.K. Azad, 2015. A study on quality traits of chicken eggs collected in and around Gannavaram, Krishna District in different seasons. Int. J. Recent Sci. Res., 6: 6487-6489.
38. Tamilvanan, S., V. Kumar and R.A. Rajini, 2014. Seasonal variations in egg quality and yolk cholesterol in backyard and cage rearing chicken. South Asian J. Life Sci., 2: 1-3.
39. Raji, A.O., J.U. Igwebuike and M.T. Usman, 2009. Zoometrical body measurements and their relation with live weight in matured local Muscovy Ducks in Borno State Nigeria. ARPN J. Agric. Biol. Sci., 4: 58-62.