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Effect of Strain on External and Internal Egg Parameters of Exotic, Indigenous Chicken and Crossbreds

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Authors' contributions

This work was carried out in collaboration between both authors. Author UUAH helped in vetting the article. Both authors read and approved the final manuscript.

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ABSTRACT

Examining effect of Strain on External and Internal Egg Parameters of Rhode Island Red (RIR), two Nigerian indigenous chicken strain:-(Pure naked neck (NNK); pure Normal feathered (NF)); Crosses were:- RIR x naked neck (RNK) cross; RIR x Normal feathered (RNF) cross. Matured 100 birds reared intensively for 10 weeks at Teaching and Research farm, University of Uyo in a Completely Randomized Design in standard management practices. Feed (16.0% crude protein, 2800 Kcal/Kg Metabolize-able energy) and water given *ad libitum*. 10 eggs per strain were cracked every Mondays and Fridays every week to examined External (egg weight(Ewt), egg length(El), shell weight (Swt) and Internal (yolk height (Yht), yolk weight(Ywt), albumen weight(Awt) albumen height (Aht) and Haugh unit (HU)) egg parameters. All data were subjected to one-way Analysis of Variance of SAS Statistical Software Package Version 9.2. Results indicated significant (P<0.05) effect of strain on external egg parameters studied. For Ewt, RNK (46.38±0.79 g) and RNF (45.54±0.96 g) were statistically (*P*<.05) higher than NF (42.42±0.85 g). For Swt, RNF(4.71g±0.09 g) was statistically (*P*<.05) higher than NF (4.36±0.11g) but similar in other strains. Result indicated significant (P<0.05) effect of strain on all the internal egg parameters measured. For Hu (RNK) 79.08±1.23% and (RNF) 77.83±1.88 were statistically (*P*<.05) higher than (NF) 73.84±1.10%. The same trend followed in other internal egg parameters among the strains. Generally, the trends

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placed were exotic birds first, then Crossbreds and Purebreds last in the parameters. In conclusion, RNK and SNF crossbreds performed better in both External and Internal egg parameter than purebred strains studied. Hence, crossbreeding should be adopted to improve Nigerian Chickens.

Keywords: External; internal; egg parameters; exotic breed; indigenous; crosses.

1. INTRODUCTION

The rapid increase in population in Nigeria has led to high demands of protein by Nigerians. Meats and eggs from indigenous hens are available in smaller quantities and cannot meet the demands. The smaller size can be due to the genetic make-up of the parent stock used for breeding which reflects largely on the eggs laid to progenies of the breeding stock. Indigenous chickens are hardy and resistant to harsh weather conditions and laid small egg sizes, its meat and eggs taste better than exotic but Nigerians prefer large eggs [1] and [2]. It is pertinent to assess chicken eggs quality as it's important to give insight of fertility, hatchability, nutrients contents, suitable development breeding programmed and proffers information on the genetic make-up of progenies of parent stock [3]. Egg quality characteristics include freshness, cleanliness, egg colour, egg weight, shell weight, albumen height which are indices for consumer's acceptability of eggs [4]. External quality (egg shell) in laying hens is influenced by a range of factors including genotype, age, nutrition, housing, standard production system [5]. Egg weight as an important phenotypic traits, influenced egg quality and reproductive fitness of the chicken parents [6]. The knowledge of strain with good quality egg is very essential as a guide to the farmers in breeding programmed and egg production system. Hence, this study examined the external and internal egg quality parameters of Exotic, Indigenous and crossbred chickens.

2. MATERIALS AND METHODS

The experiment was conducted in the poultry unit of the Teaching and Research farm of University of Uyo, Nigeria. It lies within latitude 4º32'N and 5º33'N, and longitudes 7º25'E and 8º25E with annual rainfall of between 800 mm to 3200 mm from March to October. Annual temperature varies between 26ºC–28ºC. Its soil type is sandy loam soil with the soil pH of 4.5-6.5 [7].

2.1 Experimental Chickens and Management

Chicken used for the egg production were Exotic breed (Rhode Island Red cock x Rhode Island Red hen (RIR) as a Control), pure Nigerian indigenous chicken strains:- pure naked neck cock x pure naked neck hen (NNK) and pure Normal feathered cock x pure Normal feathered hen (NF) and Crossbreds were:- RIR cock x pure Normal feathered hen (RNF cross) and RIR cock x naked neck hen (RNK cross). The 5 strains of chicken used in this study is regarded 5 treatments (RIR Treatment 1 (Control), NNK-Treatment 2, NF- Treatment 3, RNF- Treatment 4 and RNK-Treatment 5). The Exotic breed used in the study were purchased from Songhai farms and two Nigerian indigenous strains used were purchased from Uyo at a matured age of 16 weeks. 100 birds of 36 hens per pure Nigerian indigenous strain and 25 exotic hens with 2 pure Nigerian cocks of one per each strain and one exotic cock. The experimental birds were allowed to acclimatize for 2 weeks, followed by semen collection on the 3rd week till termination of the research at 10 weeks.

All birds were reared in intensive management system in 6 replicates in a completely Randomized Design with same standard management practice given. Wood shavings was used for bedding. The experimental birds were fed with commercial layer mash and water *ad libitum. L*ayer mash contained 16.0% crude protein, 2800 Cal/Kg Metabolize-able Energy, Table 1.

Table 1. Chemical composition of the dietary treatment

Composition	Layers mash
Crude Protein	16.8%
Fat	3.6%
Crude Fibre	4.2%
Calcium	4.2%
Available Phosphorus	0.5%
Methionine	0.45%
Lysine	0.85%
Metabolizable Energy	2800 Kcal/kg

Source: Vital feed

2.2 Semen Collection and Artificial Insemination of Birds

Semen were collected from the Rhode Island Red (RIR) breed and Indigenous cocks thrice a

week: Monday, Wednesday and Friday, respectively by the abdominal massage method of Peter, et al. [8]. Each cock was massaged at the back and stroked close to its tail with a slight finger pressure around the base of the tail. The phallus then becomes erected. Pressure was applied around the cloaca and the tail flattened upwards, the phallus protrude from the cloaca. Finger was then pressed on the birds' abdomen under the vent. The semen was released from the ducts deferens immediately and the inseminator gently squeezed the semen from the swollen papillae at the base of the phallus into Eppendorf tube. Immediately, inseminator equipment was used to pick up semen for insemination.

Artificial insemination: Hen's cloaca was bent up and applied a little pressure to open up the vent, the semen with the aid of inseminator aids to deposit the semen in oviduct via infundibulum where fertilization occurred. After the collection of the required number of eggs from each sire strain for data analysis, one week gap was allowed for semen evacuation in sperm host glands before the hens were used inseminated with another sire strain till all data were collected for analysis.

2.3 Data Collection

The eggs laid by these hens were collected and labelled based on the sire's strain at least 30 eggs per strain per day and 10 freshly collected eggs per strain were cracked on Mondays and Fridays every week and analyzed for external and internal egg parameters throughout the study period of 10 weeks at Animal Science Laboratory.

2.3.1 Measurement of external egg parameter

Egg weight (Ewt) was individually determined to 0.01 g accuracy using sensitive electronic scale in grams. Egg length (El) (along the longitudinal axis) was measured with Venire caliper and was measured in millimeters. Shell weight (Swt) was determined by rinsing the emptied shell with water and dried before weighing scale in grams [9].

2.3.2 Measurement of the internal egg parameter

Components were obtained by carefully breaking open around the posterior end of the egg, large enough to allow free passage of both the albumen and the yolk. The content was poured on a transparent flat glass plate of 45 cm x 40 cm. Yolk weight (Ywt) was gotten by separating the yolk from albumen and weighed on an electronic scale in grams. Yolk height (Yht) and albumen height (Aht) were measured using a venire caliper and micrometer in mm. The albumen weight was calculated from the difference between the egg weight, and the yolk and shell weight in grams [9].

Haugh unit (Hu)(%) was determined according to the formula of Haugh [10].

$$Hu=100 \log (h +7.5-1.7w^{0.37})$$

where, H=height of the thick albumen in mm
W=weight of the eggs in grams

Data collected were submitted to analysis of variance using Statistical Analysis System software package [11]. The significance differences between the strains were tested by the Duncan's Multiple Range Test at the levels of 0.05%probability.

3. RESULTS AND DISCUSSION

3.1 Effect of Strain on External Egg Parameters of Exotic and Indigenous Chicken and their Crosses

3.1.1 Effect of strain on egg weight (Ewt) (g)

The results of the analysis of variance revealed that strain significantly ($P < .05$) affected all the external egg parameters measured in this study.

The results obtained in Table 2 showed that Ewt of Rhode Island Red (RIR) was 55.96±0.82 g followed by RNK with 46.38±0.79 g and RNF with 45.54±0.96 g while NNK had 44.50±0.62 g then NF with 42.42±0.85 g. RIR had highest mean Ewt of 55.96±0.82 g statistically ($P<.05$) higher than the crossbreds of RNK (6.38±0.79 g) and RNF (45.54±0.96 g) and purebreds of NNK (44.50±0.62 g) and NF (42.42±0.85 g). Ewt of RNK and RNF crossbreds were statistically ($P > .05$) similar but were statistically ($P < .05$) difference from the purebreds of NNK (44.50±0.62 g) and NF (42.42±0.85 g) which came last. RIR as control had the highest mean EWT followed by the crossbreds and purebreds was last.

Generally, the trend observed in the Ewt measurement showed that the eggs of RNM and RNK crossbreds had the values next to eggs of

exotic breed indicating improvement through crossbreeding. Results of crossbreds (45.54±0.96 g) and RNK (46.38±0.79 g) showed higher means than eggs of indigenous purebred strains this agrees with [12] and [13] which reported that crossing exotic with indigenous improves the indigenous traits. This result showed a significant effect of the strains on Ewt which agrees with findings of Kejela, et al. [14] that genotype affects Ewt and Swt traits. The heaviest eggs of RIR (55.96±0.82 g) studied agrees with the findings of Weis and Hrnčár [15] that RIR eggs are between 55 and 66g. Results for Ewt of indigenous Normal feathered (42.24g±0.85 g) and naked neck (44.50±0.62 g) chickens agree with the work of Tumova, et al. [1] and [16] which reported of lower Ewt (43.04 g) in Naked neck chicken from Nigeria under free range conditions.

3.1.2 Effect of strain on egg length (El) (cm)

The result of El as indicated in Table 2 showed that the mean El of RIR breed was the highest with 56.60±0.03 mm followed by RNF cross with 53.36±0.05 mm, next was RNK cross with 52.29 ±0.07 mm while pure NNK had 50.06 ±0.04 mm and NF with 47.71±0.07 mm. RIR breed had mean El of 56.60±0.03 mm statistically (P < .05) higher than crossbreds of RNF (53.36 ±0.05 mm) and RNK (52.29±0.07 mm) as well as purebreds of NNK (50.06±0.04 mm) and NF (47.71±0.07 mm). Mean El for the crossbreds of RNK and RNF were statistically (P>.05) similar but statistically (P<.05) higher than the purebreds of NNK and NF strains which came last.

This result agrees with findings of Isidahomen, et al. [17] who reported of similar trend that exotic breed had highest El followed by the crosses and lastly the local strains. This result collaborate with the study of Zita, et al. [18] which observed that egg components are improved when exotic breeds are crossed with indigenous breeds.

3.1.3 Effect of strain on shell weight (g)

Mean Swt of RIR breed was 6.92±0.15 g, crossbreds RNF strain had 4.71 g±0.09 g, RNK (4.59±0.10 g), NNK (4.49±0.09 g) and NF (4.36±0.11 g) pure bred. RIR. RNF (4.71 g±0.09), and RNK (4.59±0.10 g) and NNK (4.49±0.09 g) had mean values statistically (P > .05) similar. RNF strain with 4.71 g±0.09 g was statistically (P < .05) higher than NF (4.36±0.11 g) strains. Swt of the RIR breed was higher than the pure bred indigenous and the crossbred strains as shown in Table 2. This result showed a significant effect of the strains on Swt which agrees with findings of Kejela, et al. [14] that genotype affects Ewt and Swt traits. This results collaborates with the previous reports by several researchers that crossbred chickens overall performance in all traits were better than local chickens [12] and [5]. Swt of naked neck (4.71 g±0.09 g) in this study was higher than that obtained in the findings of Islam, et al. [6] and [1] whose Swt for NNK was 4.48 g.

3.2 Effect of Strain on Internal Egg Parameters of Exotic and Indigenous Chicken and their Crosses

Results of analysis revealed that strain significantly (P < .05) influenced all the internal egg parameters measured in this study.

3.2.1 Effect of strain on yolk weight (Ywt) (g)

The result in Table 3 showed that RIR breed (control) had the heaviest yolk with 17.67±0.33 g while the crossbreds Ywt were next with 16.13± 0.33 g (RNK) and 15.96±0.30 g (RNF) and the purebred NNK with 15.00±0.32 g followed while NF purebred (13.80±0.36 g) was the least in mean Ywt. This result agrees with the observation of Islam, et al [6] who reported significant differences for the yolk weight and other egg quality traits in their study. Ywt in this study which ranged between 13.80 g and 15.00 g corresponds with the findings of Isidahomen, et al. [17] which reported on Ywt for NNK (14.72 g) and NF (14.20 g) for (NF) in their study.

3.2.2 Effect of strain on yolk height (Yht) (mm)

RIR breed had mean Yht of 16.66±0.03 mm as the highest while RNK with 15.59±0.02 mm followed by RNF strain with 15.54±0.02 mm, next by NNK with 15.51±0.05 mm and NF had 14.43±0.03 mm Table 3. Mean Yht for RIR breed (16.66±0.03) was significantly (P < .05) higher than RNK (15.54±0.02 mm), NNK (15.51±0.05 mm) and NF (14.43±0.03 mm) strains but statistically similar to RNK strain. Yht for RNK, RNF and NNK were statistically (P > .05) similar but (P < .05) higher than that of NF (14.43±0.03 mm) strain.

This results in this study is in agreement with the findings of Several authors [17,19,20] which recorded higher Yht in exotic breeds followed by the crossbreds and lastly by local breeds in their

studies on egg quality. However, the mean values obtained in this study is not in agreement with the observation of Hanusova, et al. [5] who recorded higher Yht in their study.

3.2.3 Effect of strain on albumen weight (Awt) (g)

The result in Table 3 showed that RIR had Awt of 31.38±0.61 g followed by 23.58±0.58 g (NF) then 25.42±0.58 g (RNK) while 25.04±0.51 g (NNK) and 25.00±0.74 g (RNF). RIR breed with Awt of 31.38±0.61 g was significantly (P < .05) higher than 25.42±0.58 g (RNK) and 23.58±0.58 g (NF) while RNF and NNK were statistically (P > .05) similar. The result for RIR (31.38±0.61 g) in this study is similar to the value observed by Hanusova, et al. [5] which had Awt to be 32.78±0.73 g.

3.2.4 Effect of strain on albumen height (Aht) (mm)

RIR breed had mean Aht of 6.65±0.03 mm, RNK (5.58±0.02 mm) and RNF (5.55±0.03 mm), NNK had 5.51±0.01 mm and NF 4.48±0.01 mm, Table 3. Mean Aht for RIR breed was statistically (P < .05) higher than the crossbreds of RNK (5.58±0.02 mm) and RNF (5.55±0.03 mm) as well as the purebreds of NNK (5.51±0.01 mm) and the least was NF with mean value of 4.48±0.01 mm. The crossbreds were statistically (P > .05) similar but different (P < .05) from purebreds of NNK (5.51±0.01 mm) and NF (4.48±0.01 mm). The existing difference between strains is in accordance with the findings of Islam, et al. [6] which observed significant differences for albumen height in the Nigerian indigenous naked neck and Normal feathered. The results in this study are in agreement with the findings of Alewi, et al. [12] and [21] for local Kei chicken (5.79 mm) raised in Guraghe zone and also native chickens (5.74 mm) from Cameroon, respectively. However, the naked neck genotypes had higher estimates compared to the normal feathered birds and it agrees with findings of Niranjan, et al. [22] of similar observation in the study.

3.2.5 Effect of strain on haugh unit (Hu) (%)

The mean Hu for RIR was 80.06±1.75% followed by RNF with 77.83±1.88% next by NNK (74.98±1.00%) while NF (73.87±1.10%) and RNK (79.08±1.23%) were measured, Table 3. RIR had the mean Hu (80.06±1.75%) statistically (P < .05) higher than the RNF crossbred with 77.83±1.88%, Purebreds NNK (74.98±1.00%) and NF (73.87±1.10%) but statistically similar. Crossing of exotic breed with the indigenous strain improved the indigenous strain to a higher Hu compared to purebred indigenous strain as revealed in this study. Hu of crossbreds were (RNK) 79.08±1.23% and (RNF) 77.83±1.88 and

Table 2. Effect of strains on external egg parameters (LSM± SE)

Parameters	N	Strains				
		RIR	NNK	NF	RNK	RNF
Ewt(g)	240	55.96± 0.82^{a}	44.50±0.62^{bc}	42.42± 0.85^{c}	46.38 ± 0.79^{b}	45.54 ± 0.96^{b}
El(mm)	240	56.60± 0.03^{a}	50.06± 0.04^{c}	47.71± 0.07^{c}	52.29 ± 0.07^{b}	53.36 ± 0.05^{b}
Swt(g)	240	6.92 ± 0.15^{a}	4.49 ± 0.09^{bc}	4.36 ± 0.11^{c}	4.59 ±0.10^{bc}	4.71±0.09^{b}

a, b, c means on each row with different superscript on the parameters are significantly different (P<.05) = probability of .05.N = number of observations, LSM = least square mean, SE= standard error,RIR = rhode island red, NNK = naked neck, Nf= Normal feathered, RNK = rhode island red x naked neck,RNF = Rhode Island Red x Normal feathered. Ewt= egg weight; Ew= egg width; El= egg length; Swt= shell weight

Table 3. Effect of strain on internal egg parameters (LSM± SE)

Parameters	N	Strains				
		RIR	NNK	NF	RNF	RNK
Yht (mm)	240	16.66± 0.03^{a}	15.51±0.05^{bc}	14.43± 0.03^{c}	15.54± 0.02^{b}	15.59±0.02^{ab}
Ywt (g)	240	17.67± 0.33^{a}	15.00± 0.32^{c}	13.80± 0.36^{d}	16.13± 0.33^{b}	15.96± 0.30^{b}
Aht(mm)	240	6.65 ± 0.03^{a}	5.51 ± 0.01^{cd}	4.48 ±0.01^{d}	5.58 ± 0.02^{b}	5.55 ± 0.03^{b}
Awt(g)	240	31.38± 0.61^{a}	25.04± 0.51^{b}	23.58± 0.58^{b}	25.42± 0.58^{b}	25.00± 0.74^{b}
Hu (%)	240	80.06± 1.75^{a}	74.98±1.00^{bc}	73.87± 1.10^{c}	77.83± 1.88^{b}	79.08± .23^{ab}

a, b, c means on each row with different superscript on the parameters are significantly different (P<.05) = probability of .05.N = number of observations, LSM = least square mean, SE= standard error,RIR = rhode island red, NNK = naked neck, Nf= Normal feathered, RNK = rhode island red x naked neck,RNF = Rhode Island Red x Normal feathered. Hu= haugh unit; Ywt= yolk weight; Yht= yolk height; Awt= abumen weight; Aht= albumen height

purebred NNK (74.98±1.00%) were statistically (P < .05) difference from (NF) 73.84±1.10%. This is in line with the observation by Hanusova, et al. [5] who stated that Aht and Hu measure the viscosity of the thick albumen. However, RIR (80.06±1.75%) had a better egg quality followed by the crossbreds while the purebreds were last. The results of this study agrees with the findings of Hanusova, et al. [5,21,22] where Hu of pure bred and crossbred's eggs were above 70% in their studies. The average Hu values were 75.94% (NaNa), 76.36% (Nana) and 73.99% (nana) with positive effect of naked neck gene in either single or double condition.

4. CONCLUSION AND RECOMMENDATION

Considering, external egg parameters, RNK and RNF crossbreds were the best in Ewt and Swt, respectively while in internal egg parameters RNK and RNF crossbreds had higher percent Haugh units, Albumen height than indigenous which qualifies these strains best in the production of good quality eggs than the Pure Indigenous strains. "Good egg shell protects egg content while Haugh unit confirms good quality of the eggs". Therefore crossbreeding has impacted positively to the egg quality of Nigerian Indigenous chicken strains. Hence, farmers should introduce exotic blood into the Nigerian Indigenous chicken strains for rapid improvement.

CONSENT

We write to inform the Editorial Board of British Journal of Applied Science and Technology that, this article titled "Effect of strain on external and internal egg parameters of Exotic and Indigenous Chicken and crossbreds*"* is a fresh paper article which is not in anywhere published. All contributing authors in this study have given consent for publication.

ETHICAL APPROVAL

Both authors have declared that, "principle of laboratory animal care" (NIH publication 85-23 revised 1985) were followed as well as the University law. All the experiment have been examined and approved by the University law.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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