Post-hatching growth potential of Dominant Black and Yaffa Brown pullet chicks from different egg weights

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ADDITIONAL KEYWORDS

Egg weight.
Dominant Black post-hatching.
Pullet.
Yaffa Brown.

SUMMARY

The study was conducted to determine the effect of egg size on post-hatching performance of pullet chicks obtained from Dominant Black (DB) and Yaffa Brown (YB) strains of pullet. A total of eight hundred and ten hatching pullet eggs (405 eggs per strain) were grouped into three egg sizes (small, medium and large) per strain resulting in six treatment groups which were replicated three times with forty-five eggs per replicate. Post-hatching performance of one hundred and sixty two pullets from both strains was monitored till first egg was laid. Feed and water were supplied *ad libitum* throughout the period. Three eggs per replicate were used to determine both internal and external egg qualities. Data obtained were subjected to analysis of variance in a 2 x 3 factorial experimental design. The results showed that average body weight, feed and protein intake of the birds during starter phase of pullet chicks significantly ($p<0.05$) increased with egg size, while all the growth performance parameters at growing phase were not influenced ($p>0.05$). Age at first lay, weight of bird at first lay and egg quality parameters were not affected ($p>0.05$) by egg size and strain. The egg size also increased ($p<0.05$) with age in lay. The effect of strain of bird had no ($p>0.05$) influence on all the parameters measured throughout the study. It was concluded that egg size could only be beneficial if the target is to sell chicks at the end of growing phase. However, setting of different egg sizes could be encouraged since the effect at maturity (laying) is not significant.

Potencial de crecimiento post-eclosión de pollitas *Dominant Black* y *Yaffa Brown* con huevos de diferentes pesos

RESUMEN

Se realizó este estudio para determinar el efecto del tamaño del huevo sobre el rendimiento posterior a la incubación de pollos de las líneas Dominant Black (DB) y Yaffa Brown (YB). Un total de ochocientos diez huevos para incubación (405 por línea), fueron agrupados en tres tamaños (pequeños, medios y grandes) para cada línea, lo que resultó en seis grupos experimentales que fueron replicados tres veces (48 huevos por repetición). El rendimiento posterior a la incubación fue controlado sobre 162 pollos de ambas cepas hasta la puesta del primer huevo. El agua y los alimentos fueron suministrados *ad libitum* durante todo el periodo experimental. Se emplearon tres huevos por repetición para determinar su calidad externa e interna. Los datos fueron sometidos a análisis de varianza en un esquema factorial 2 x 3. Los resultados mostraron que los valores medios de peso corporal, ingestión de alimento y proteína durante la fase de iniciación aumentó significativamente ($p<0,05$) con el tamaño del huevo, mientras que los parámetros de rendimiento durante toda la fase de crecimiento no fueron influidos ($p>0,05$). La edad a la primera puesta, el peso del ave al primer huevo y los parámetros de calidad del huevo tampoco fueron afectados ($p>0,05$) por el tamaño del huevo o la línea. El tamaño del huevo aumentó con la edad al entrar en puesta. La línea aviar no afectó ($p>0,05$) a ninguno de los parámetros estudiados. Se concluyó que el tamaño del huevo puede ser beneficioso, solamente si el objetivo es vender los pollos al final de la fase de crecimiento. Sin embargo, la puesta de huevos de diferentes tamaños puede ser aceptada ya que el efecto a la madurez (puesta) no es significativo.

PALABRAS CLAVE ADICIONALES

Peso del huevo.
Post eclosión.
Dominant Black.
Yaffa Brown.
Pollos.

INFORMACIÓN

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INTRODUCTION

The weight of an egg is controlled by many factors. Among these factors include individual genetic markers (Lacin *et al.*, 2008), stage of sexual maturity, age, drugs and some dietary nutrients available to the bird (Wu *et al.*, 2005). The most important nutritional factors known to affect egg size are protein and amino acid adequacy of a diet and linoleic acid (Najib and Al-Yousif, 2014). Early sexual maturity leads to increased egg number but the size of eggs will be small. In contrast, if sexual maturity is delayed large eggs will be produced but the total mass of eggs produced will be reduced. Egg weight has great effect on the hatchability. Egg weight is one of the major factors influencing the weight of day-old chicks (Farooq *et al.*, 2001). This has been confirmed in broiler chickens (Abiola *et al.*, 2008), quail (Garip and Dere, 2011; Egbeyale *et al.*, 2013) and turkey (Anandh *et al.*, 2012). The positive correlation between the egg weight and weight at day-old of the bird showed the benefit of setting heavier eggs. Many researches has been carried out on the early growth performance of chicks from various egg weights which resulted in a better performance of quail (Farooq *et al.*, 2001), chicks (Witt and Schwalbach, 2004) from bigger or heavier eggs. However, there is little or paucity of information on the influence of egg weights on the post-hatching performance of egg type chicken up till the point of laying. Therefore, based on the most common strain of chickens in the study area, this study is designed to determine the post-hatching performance of pullet chicks of Dominant Black and Yaffa Brown from different egg size from day-old to point of lay.

MATERIALS AND METHODS

EXPERIMENTAL SITE

The experiment was carried out on deep litter (starting and growing phases) in the layer's unit of the Teaching and Research Farm, Federal University of Agriculture, Abeokuta, Ogun State. It falls within the rain forest vegetation zone of South-Western Nigeria on latitude 7º13′49.46″N, longitude 3º26′11.98″E and altitude of 76 meters above sea level. The climate is humid with a mean annual rainfall of 1037 mm. The annual mean temperature and humidity is 34.7ºC and 82 % respectively (Egbeyale *et al.*, 2011).

EXPERIMENTAL EGG AND BIRDS AND MANAGEMENT

A total of eight hundred and ten (810) hatching eggs of different sizes from Dominant Black and Yaffa Brown strains of pullet (i.e. 405 eggs per strain) were bought from a reliable breeder farm in Ogun State. The eggs from each strain were weighed and arranged into three (3) groups i.e small (41.09 g - 50.97 g), medium (50.98 g - 57.39 g) and large (57.40 g - 69.64 g). Each treatment group contained one hundred and thirty five (135) eggs which were sub-divided into three (3) replicates of forty (45) eggs each in a 2 x 3 factorial design. A total of one hundred and sixty-two pullet chicks (twenty-seven chicks from each group) were used for this study. The birds were intensively managed on deep litter for 16 weeks, and then transferred to battery cage at point of cage for acclimatization before laying. Chick mash was given to the chicks for the first eight weeks while growers mash was supplied as from ninth week till onset of the egg laying **(table I)**. Water and feed were provided *ad libitum*. The experiment lasted for six months under thirteen hours illumination regime (06:30 - 19:30 hrs).

DATA COLLECTION

Growth performance: The chicks were weighed at the commencement of the experiment and subsequent weeks to determine the weight gain which was calculated by subtracting initial weight from final weight. The feed intake was determined by deducting the left over feed from feed supplied. Other growth parameters calculated were feed efficiency, protein intake and protein efficiency ratio. Feed efficiency was calculated by dividing daily feed intake by daily weight gain protein intake was calculated by % crude protein in the diet multiply by feed intake protein efficiency was calculated by daily weight gain divided by daily protein intake (Abiola *et al.,* 2008).

Table I. Composition (%) of diets (Composición de las dietas).

Ingredients	Chick mash	Growers mash
Maize	40.00	50.00
Fish meal (65 %)	2.00	—
Soybean meal	18.00	12.00
Palm kernel cake	10.00	—
Wheat offal	25.00	33.00
Bone meal	2.00	2.00
Oyster shell	2.00	2.00
Lysine	0.25	0.25
Methionine	0.25	0.25
Chicks vitamin/mineral premix*	0.25	
Growers vitamin/mineral premix**		0.25
Salt	0.25	0.25
Total	100.00	100.00
Calculated analysis (%)		
Crude protein	18.71	15.09
Ether extract	5.09	4.95
Crude fibre	4.56	4.22
Ash	3.58	3.60
Calcium	1.62	1.87
Phosphorus	0.93	0.97
Lysine	0.73	0.62
Methionine	0.28	0.24
Energy (MJ/Kg)	10.32	10.17

*Premix (Univit. 15 Roche) contained: B_1=1 g; B_2= 6 g; B_{12}= 0.02 g; K_3= 3 g; E= 30 g; Biotin= 0.05 g; Folic acid= 1.5 g; Choline chloride= 250 g; Nicotinic acid= 30 g; Ca-pantothenate= 15 g; Co= 0.4 g; Cu= 8 g; Fe= 32 g; I= 0.8 g; Zn= 40 g; Mn= 64 g; Se= 0.16 g; BHT= 5 g. **Vit./Min. Premix contained: Premix (Embavit Nº 90) contained: Vit. A= 10 000 000 iu; D3 = 2 000 000 iu ; E= 12 500 iu; K= 1.30 g; B_1= 1.30 g; B_2= 4 g; D Calcium-pantothenate= 1.30 g; B_6= 1.30 g; B_{12}= 0.01 g; Nicotinic acid= 15 g; Folic acid= 0.05 g; Biotin= 0.02 g; Co= 0.20 g; Cu= 5 g; Fe= 25 g; I= 0.06 g; Mn= 48 g; Se= 0.10 g; Zn= 45 g; Choline chloride= 200 g; BHT= 50 g.

EGG PRODUCTION PARAMETERS

Age at first lay was number of days from hatch to the day the pullet (hen) lay her first egg, Body weight of hen at first lay was measured as weight of pullet on the day first egg was laid while weight of first egg was measured with the use of a balance sensitivity of 0.01 g. External egg quality analyses: Egg weight was measured using Mettler top-loading weighing balance. Egg length and width each egg were measured using vernier calipers. The width was measured as the distance between two ends of the egg at the widest cross sectional region using vernier calipers. The length was measured as the distance between the broad and narrow ends of the eggs. Egg shape index (ESI): This was calculated as the percentage of the egg breadth (width) to the egg length (Panda, 1996). Egg shells were air-dried in the crates. The relative shell weight was calculated by relating the shell weight to the weight of the egg. Shell thickness of individual air-dried shells was measured to the nearest 0.01 mm using micrometer screw gauge (Kul and Seker, 2004).

Table II. **Effect of egg size and strain on growth performance of pullets in starter phase** (Efecto del tamaño del huevo y la línea sobre el crecimiento de los pollos en fase de iniciación).

	Egg size			Strain	
Parameters	Small	Medium	Large	Dominant Black	Yaffa Brown
Av. initial weight (g)	32.78±1.06[b]	37.43±0.73[b]	44.25±2.30[a]	38.43±2.37	37.26±1.08
Av. final weight (g)	526.94±25.98[b]	552.16±7.82[ab]	601.33±10.24[a]	562.52±14.77	553.92±18.13
Av. weight gain (g/day)	8.82±0.47	9.19±0.14	9.94±0.16	9.36±0.23	9.22±0.32
Av. feed intake (g/day)	43.81±1.80[b]	45.00±0.77[ab]	47.90±0.54[a]	46.35±0.91	44.79±1.21
Feed efficiency	0.20±0.01	0.21±0.01	0.21±0.01	0.20±0.01	0.20±0.00
Av. protein intake (g)	8.19±0.34[b]	8.42±0.14[ab]	8.92±0.10[a]	8.67±0.17	8.38±0.23
Protein efficiency ratio	1.08±0.05	1.09±0.02	1.10±0.02	1.08±0.03	1.10±0.02
Mortality (%)	7.50±4.79	3.18±2.02	0.33±5.27	3.89±2.86	8.79±3.80

[a,b]Means in the same row with different superscripts differ significantly ($p<0.05$).

Table III. **Effect of interaction between egg size and strain on growth performance of pullets in starter phase** (Efecto de la interacción entre el tamaño del huevo y la línea, sobre el crecimiento de pollitos en fase de iniciación.

	Dominant Black			Yaffa Brown		
Parameters	Small	Medium	Large	Small	Medium	Large
Av. initial weight (g)	32.03±0.82[c]	37.42±0.76[bc]	45.83±4.23[a]	33.53±2.10[c]	37.42±1.45[bc]	40.83±1.50[ab]
Av. final weight (g)	523.87±23.24	555.10±0.64	607.78±16.81	530.00±53.16	548.42±17.08	583.33±9.62
Av. weight gain (g/day)	8.78±0.40	9.26±0.02	10.04±0.26	8.86±0.96	9.12±0.33	9.68±0.15
Av. feed intake (g/day)	45.13±2.12	45.73±1.56	48.19±0.61	42.48±3.14	44.27±0.22	47.61±21.00
Feed efficiency	0.20±0.02	0.21±0.01	0.21±0.01	0.21±0.01	0.20±0.01	0.20±0.01
Av. protein intake (g)	8.44±0.39	8.56±0.29	9.01±0.11	7.95±0.59	8.28±0.04	8.91±0.18
Protein efficiency ratio	1.05±0.10	1.09±0.04	1.11±0.02	1.11±0.04	1.10±0.04	1.09±0.03
Mortality (%)	0.00±0.00	3.33±3.33	8.33±8.33	15.00±7.64	3.03±3.03	3.33±3.33

[a,b,c]Means in the same row with different superscripts differ significantly ($p<0.05$).

Internal egg quality analyses: Three eggs per replicate were taken for the evaluation of egg quality characteristics at point of lay. Yolk weight was measured in grams using Mettler top-loading weighing balance while yolk weight percentage was calculated as the percentage of the yolk weight to the egg weight (Kul and Seker, 2004). Albumen height was determined by gently broken and the maximum albumen height was measured with tripod micrometer (Doyon *et al.*, 1986). Albumen weight was measured as the difference between the egg weight and the sum of weight of yolk and dry egg shell. Albumen weight percentage was calculated as the percentage of the albumen weight to the egg weight. Haugh Unit (HU) was calculated using the values obtained for the egg weight and albumen height as expressed by Haugh (1937) and enunciated by Asuquo *et al.* (1992) in the formula shown below:

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

where,

H= Albumen height in mm,

W= Egg weight in gram.

Statistical analysis: All data collected in each of the experiments were subjected to analysis of variance (ANOVA) in a 2×3 factorial design (SAS, 2010) while means significantly ($p<0.05$) different were compared using Duncan's multiple range test of the software package.

RESULTS

The effect of egg size and strain on growth performance of pullets at starter phase is presented in **table II**. Egg size had significant ($p<0.05$) effect on the initial weight, final weight, feed intake which also in turn affect protein intake. The means of initial weights of the chicks was in accordance with the egg size and this was observed throughout the chick phase. The initial weight ranged from 32.78 - 44.25 g. The final weights of chicks from small, medium and large eggs were 526.94, 552.16 and 601.33 g respectively. Chicks from large-sized eggs had the highest feed intake of 47.90 g/day while the least value (43.81 g/day) was from small-sized eggs, medium-sized egg chicks recorded 45.00 g/day. The protein intake was highest in birds from large eggs thereby resulting in the best protein efficiency ratio. Though, the effect of strain was not significant ($p>0.05$) on any of the parameters, DB had highest values in all the parameters except protein efficiency ratio and mortality.

Table III showed the effect of interaction between egg size and strain on the post-hatching performance of pullet at chick phase. The only parameter that was significantly ($p<0.05$) influenced was initial weight of the chicks. The initial weight varied from 32.03 - 45.83 g, the highest value was obtained from Dominant Black large egg (DBL) while the least value was from Dominant Black small egg (DBS). Though both Dominant Black medium egg (DBM) and Yaffa Brown medium

Table IV. Effect of egg size and strain on growth performance of pullets in growing phase (Efecto del tamaño del huevo y la línea sobre el crecimiento de los pollos en fase de crecimiento).

	Egg size			Strain	
Parameters	Small	Medium	Large	Dominant Black	Yaffa Brown
Av. initial weight (g)	526.94±25.98[b]	552.16±7.82[ab]	601.33±10.24[a]	562.52±14.77	553.92±18.13
Weight of bird at point of cage (g)	1124.88±45.92	1213.89±38.07	1187.92±0.01	1212.24±35.20	1138.89±34.21
Av. weight gain (g/day)	10.68±0.56	11.82±0.70	10.58±0.73	11.60±0.44	10.45±0.60
Av. feed intake (g/day)	81.76±2.45	80.80±3.32	87.95±2.55	84.27±2.62	82.73±2.29
Feed efficiency	0.13±0.01	0.15±0.01	0.12±0.01	0.14±0.01	0.13±0.01
Av. protein intake (g)	12.34±0.87	12.19±0.50	13.27±0.39	12.71±0.40	12.48±0.35
Protein efficiency ratio	0.87±0.04	0.97±0.05	0.80±0.05	0.91±0.03	0.84±0.05
Mortality (%)	0.00±0.00	6.39±3.29	4.86±3.12	4.17±2.20	3.33±2.36

[a,b]Means in the same row with different superscripts differ significantly ($p<0.05$).

Table V. Effect of interaction between egg size and strain on growth performance of pullets in growing phase (Efecto de de la interacción entre el tamaño del huevo y la línea sobre el crecimiento de los pollos en fase de crecimiento).

	Dominant Black			Yaffa Brown		
Parameters	Small	Medium	Large	Small	Medium	Large
Weight at point of cage (g)	1096.43±54.38	1261.11±14.19	1279.17±15.02	1153.33±73.74	1166.67±69.39	1096.67±49.10
Av. weight gain (g/day)	10.22±0.77[ab]	12.59±0.25[a]	11.99±0.41[a]	11.13±0.87[ab]	11.04±1.33[ab]	9.17±0.72[b]
Av. feed intake (g/day)	79.91±4.45	85.15±5.36	87.75±4.28	83.61±2.65	76.44±2.68	88.14±3.79
Feed efficiency	0.13±0.01[ab]	0.15±0.01[a]	0.14±0.01[a]	0.13±0.01[ab]	0.14±0.01[a]	0.10±0.00[b]
Av. protein intake (g)	12.06±0.67	12.85±0.81	13.24±0.64	12.61±0.40	11.53±0.40	13.30±0.57
Protein efficiency ratio	0.85±0.06[ab]	0.98±0.04[a]	0.91±0.03[a]	0.88±0.07[a]	0.95±0.10[a]	0.68±0.03[b]
Mortality (%)	0.00±0.00	2.78±2.78	9.72±5.01	0.00±0.00	10.00±5.77	0.00±0.00

[a,b]Means in the same row with different superscripts differ significantly ($p<0.05$).

egg (YBM) had the same initial weight of 37.42 g, DBM had higher value of final weight of 555.10 g while YBM recorded 548.42 g. Results obtained for weight gain ranged from 8.78 - 10.04 g/day while feed intake varied from 42.48 - 48.19 g/day. The mortality value (15.00 %) recorded in Yaffa Brown small egg (YBS) was highest among the treatment while there was no mortality in DBS.

At the end of growing phase, the effect of egg size and strain was not significantly ($p>0.05$) different on any of the parameters measured **(table IV)**. It was observed that birds from both small and medium-sized eggs catch up with their counterpart from large eggs at the end of the phase. The final weight ranged from 1124.88 - 1213.89 g. The chicks from medium eggs recorded the highest value while the least value was obtained for birds from the small-sized egg. The birds from large eggs had 1187.92 g. The feed intake values did not follow the same trend as observed in the chick phase **(table II)**. Here, least value for feed intake (80.80/day) was obtained from medium eggs while birds from large eggs exercised their superiority by recording 87.95 g/day. The corresponding value of feed intake for the birds from small eggs was 81.76 g/day. There was no mortality among birds from small-sized eggs while medium and large-sized eggs recorded 6.39 and 4.86 % mortality respectively. Though, the effect of strain did not significantly ($p>0.05$) influence growth parameters, the same trend that occurred during the chick phase repeated itself. The DB also recorded higher values than YB in all the parameters determined.

The effect of interaction between egg size and strain on the growth performance of pullets during growing phase is presented in **table V**. Though the final weights of the birds were statistically ($p>0.05$) comparable across the treatments, the value ranged from 1096.43 - 1279.17 g. The highest value was obtained from DBL while the least was recorded from DBS. The corresponding values of DBM, YBS, YBM and Yaffa Brown large egg (YBL) were 1261.11, 1153.33, 1166.67 and 1096.67 g, respectively. A significant ($p<0.05$) effect was seen on the weight gain. The highest daily weight gain (12.59 g/day) was obtained from DBM while YBL had the least value of 9.17 g/day. The feed intake values ranged from 76.44 - 88.14 g/day. Highest means of feed intake (88.14 g) was obtained from YBL while least value of 76.44 g was from YBM. The values of feed efficiency ($p>0.05$) for DBM, DBL and YBM were 0.15, 0.14 and 0.14, respectively while DBS and YBS recorded the same value (0.13) and YBL had the least value (0.10). Protein efficiency favoured DBM, DBL, YBS and YBM ($p<0.05$).

The results of the effect of egg size and strain on the egg quality characteristics at first lay **(table VI)** showed significant ($p<0.05$) difference only in albumen percentage. The age of the birds from large-sized eggs was earlier (153.40 days) than those from small and medium-sized eggs which started laying on the same day (159.67 days). The weight at first lay did

Table VI. Effect of egg size and strain on egg quality at first lay (Efecto del tamaño del huevo y la línea sobre la calidad del huevo en la primera puesta).

	Egg size			Strain	
Parameters	Small	Medium	Large	Dominant Black	Yaffa Brown
Age at 1st lay (day)	159.67±7.69	159.67±5.52	153.40±2.77	150.33±2.53	166.25±5.08
Bird weight at 1st lay (g)	1665.00±75.94	1784.17±50.01	1710.00±39.62	1743.30±46.54	1683.80±48.62
Egg weight (g)	41.78±1.67	43.61±1.87	44.98±2.61	41.38±1.05	45.53±1.93
Egg length (cm)	3.47±0.06	3.65±0.13	3.66±0.08	3.56±0.06	3.62±0.01
Egg width (cm)	2.24±0.06	2.20±0.12	2.32±0.10	2.21±0.05	2.36±0.06
Egg shape index	64.69±0.77	62.72±2.14	63.53±2.46	62.10±1.36	65.19±1.55
Shell thickness (mm)	0.44±0.02	0.42±0.22	0.43±0.02	0.42±0.01	0.44±0.02
Shell weight	4.09±0.09	4.03±0.16	4.34±0.23	4.11±0.11	4.20±0.17
Shell (%)	9.86±0.35	9.25±0.17	9.72±0.45	9.96±0.27	9.26±0.25
Albumen weight (g)	25.39±1.41	27.79±1.37	28.18±1.71	25.27±0.92	28.97±1.23
Albumen (%)	60.62±1.40^{b}	63.67±0.83^{a}	63.09±0.93^{ab}	60.95±0.93	63.67±0.73
Albumen height (cm)	1.42±0.92	0.58±0.04	0.56±0.03	1.11±0.61	0.60±0.04
Yolk weight (g)	9.71±0.68	9.30±0.42	10.38±0.83	9.22±0.37	10.37±0.62
Yolk (%)	23.15±0.91	21.34±0.46	23.02±0.93	22.26±0.60	22.74±0.77
Haugh unit	77.21±2.27	80.95±2.61	79.08±1.52	77.05±1.29	81.11±1.97

^{a,b}Means in the same row with different superscripts differ significantly (p<0.05).

Table VII. Effect of interaction between egg size and strain on egg quality at first lay (Efecto de la interacción entre el tamaño del huevo y la línea, sobre la calidad del huevo en la primera puesta).

	Dominant Black			Yaffa Brown		
Parameters	Small	Medium	Large	Small	Medium	Large
Weight of bird at 1st lay (g)	1621.67±66.23	1875.00±14.43	1733.33±72.65	1708.33±150.23	1693.33±63.60	1650.00±28.87
Egg weight (g)	41.06±2.70^{ab}	42.81±1.87^{ab}	40.27±0.85^{b}	42.50±2.49^{ab}	44.40±3.66^{ab}	49.69±3.35^{a}
Egg length (cm)	3.45±0.10	3.60±0.11	3.63±0.12	3.48±0.09	3.71±0.26	3.69±0.13
Egg width (cm)	2.23±0.11^{b}	2.26±0.06^{ab}	2.13±0.07^{b}	2.25±0.08^{ab}	2.30±0.08^{ab}	2.52±0.07^{a}
Egg shape index	64.61±1.56^{ab}	62.93±1.77^{ab}	58.77±2.73^{b}	64.76±0.72^{ab}	62.51±4.44^{ab}	68.29±0.45^{a}
Shell thickness (mm)	0.42±0.01	0.39±0.01	0.44±0.00	0.46±0.03	0.44±0.04	0.43±0.05
Shell weight	4.19±0.18	3.91±0.24	4.23±0.15	4.00±0.05	4.14±0.23	4.45±0.47
Shell (%)	10.24±0.40^{ab}	9.12±0.21^{b}	10.51±0.36^{a}	9.48±0.57^{ab}	9.37±0.30^{ab}	8.93±0.52^{b}
Albumen weight (g)	24.39±2.63^{b}	26.58±1.33^{ab}	24.84±0.26^{b}	26.40±1.42^{ab}	29.00±2.48^{ab}	31.52±1.83^{a}
Albumen (%)	59.07±2.55^{b}	62.06±0.65^{ab}	61.71±0.95^{ab}	62.18±1.02^{ab}	65.27±0.09^{a}	63.57±1.62^{ab}
Albumen height (cm)	0.58±0.18	0.53±0.02	0.52±0.02	0.55±0.05	0.63±0.04	0.60±0.06
Yolk weight (g)	9.04±0.82	9.24±0.74	9.38±0.63	10.38±1.08	9.35±0.59	11.37±1.42
Yolk (%)	21.99±1.07	21.53±0.86	23.27±1.26	24.30±1.28	21.14±0.53	22.77±1.64
Haugh unit	74.92±3.29	77.96±1.89	78.28±1.41	79.49±3.13	83.95±4.64	79.88±2.99

^{a,b}Means in the same row with different superscripts differ significantly (p<0.05).

not follow any particular trend. Birds from medium-sized eggs had heaviest weight among the three egg sizes with average body weight of 1784.17 g while birds from small and large eggs weighed 1665.00 and 1710.00 g, respectively. The egg weight, egg length, albumen and yolk weight increased according to the size of the egg while albumen did not follow a particular trend. Egg weight and length ranged from 41.78 to 44.98 g and 3.47 to 3.66 cm, respectively. Shell weights (%) for small, medium and large-sized eggs were 9.86, 9.25 and 9.72 %, respectively. The albumen percentage of the egg laid by birds from medium was heaviest (63.67 %) while birds from small-sized eggs recorded the least value (60.62 %). The highest yolk percentage value (23.15 %) was from birds from small eggs while those from medium and large egg recorded 21.34 and 23.02 %, respectively. The main effect of strain did not show significant (p>0.05) differences on all the parameters. The results showed that DB came into lay earlier than YB but it was recorded that YB had numerically higher values of egg weight, egg length, egg width, egg shape index, shell thickness, shell weight (g), albumen weight (gram and percentage) and yolk weight (gram and percentage).

The effect of interaction between egg size and strain on egg quality at first lay as shown in **table VII** revealed significant (p<0.05) differences in the age at first lay, egg weight, egg width, egg shape index, % shell, albumen weight, and % albumen. Birds from DBS were the first to come into lay at age of 145.67 days while those from YBS were the last set of birds to come on lay (173.67 days). Weight at first lay ranged from1621.67g in DBS to 1875.00 g in DBM. The weight of egg laid by bird from YBL was heaviest (49.69 g) while the smallest egg (40.27 g) was from DBL. The egg weights from DBS, DBM, YBS and YBM were statistically (p>0.05) comparable to one another. Their corresponding mean values were 41.06, 42.81, 42.50 and 44.40 g, respectively. The mean of egg width varied from 2.13 cm in DBL to 2.52 cm in YBL. The egg shape index ranged from 58.77 - 68.29 and it followed the same trend with egg weight. Percentage shell was more in DBL with a value of 10.51 % while the least value was obtained for YBL which was comparable with DBM. Highest value of percentage albumen (65.27 %) was recorded for YBM, the least (50.07 %) was from DBS while the others were similar to one another. Shell thickness as well as percentage yolk value though not significantly (p>0.05) different had their means ranged from 0.39 mm in DBM to 0.46 mm in YBS and 21.14 % in YBM to 24.30 % in YBS, respectively.

DISCUSSION

The results presented on the performance of pullet chicks from different egg size indicated that all the growth parameters increased with increasing egg weight. High daily feed consumption in the heavy group throughout the chick phase could be explained with higher live weight and higher daily weight gain. Wyatt *et al.* (1985) reported that the advantage of initially higher weight attributable to a larger egg diminishes rapidly after hatching while food intake is the main factor that affected final body weight. Higher protein intake during the starter phase stimulated early body weight gain and skeletal growth but these effects tend to dissipate with age (De Beer and Coon, 2006). The final weights of the birds at the end of growing phase were similar. The birds from small egg group showed the best growing performance especially in the growing phase. This observation corroborates the results reported in the similar study on cockerel chickens (Egbeyale *et al.,* 2011). This could be explained by compensatory growth and this was similar to the results of Sinclair *et al.* (1990) and Pinchasov (1991) who reported that there is a decline in the magnitude of correlation between egg size and chick body weight with the advancement of age of the chick. The mortality at both phases was not significantly (p>0.05) affected by the effect of both egg size and strain.

Pullet age on attaining maturity in term of egg laying is of interest. The results of the effect of egg size and strains of bird showed that all the birds attained maturity at the same time. This could be attributed to the ability of birds with lower hatching weight to catch up with the birds from large eggs during the growing phase. Similar result was also observed for strains. The results of the effect of interaction between eggs and strains showed that birds from small-sized eggs of Dominant Black matured earlier (145.67 days), than birds on other treatments. The reason for the early maturity of this bird could not be explained.

The overall quality of an egg can be discussed under two broad categories namely *external* and *internal* qualities (Monira *et al.,* 2003). The external quality of the egg is determined by features such as the size and shape of the egg as well as the structure, thickness and strength of the shell (Bain, 2005). The significant increase in egg weight with the age of hen (i.e at the first in lay and 8th week in lay) is consistent with earlier reports (Rustad *et al.*, 2006; Hasan and Aylin, 2009). Egg length and egg breadth also increased with age. This is expected since egg weight also increased with hen age. The increase in the shell thickness could be attributed to the increase in calcium content as a result of gradual changing of diet from grower's mash to layer's mash after the first lay and the capacity of the bird to deposit calcium in the shell (Butcher and Miles, 2003). The increase in values of egg shell weight with increase in age of the laying pullets corroborated the findings of Roberts (2004) and Yasmeen *et al.* (2008). The reason for heavier egg shells might be attributed to the production of heavier eggs as they advance in age. The higher values of shell weight and shell thickness obtained in Yaffa Brown also corroborate the findings of Jones (2006) who stated that both egg and shell weight were greater for thick shelled eggs. The values obtained for shell thickness in this study are higher than the findings of Ojedapo *et al.* (2009) who reported lower value for Nera Black. This difference could be attributed to the level of calcium in the diet as the hens have a finite capacity to deposit calcium during the production of shell (Coutts and Wilson, 1990). The result also supports suitability of Dominant Black as egg-type chicken in tropical environment (Sogunle *et al.*, 2009). These differences between Dominant Black and Yaffa Brown could be due to differences in the genetic origins of the hens. Egg shape index mean value recorded is similar to the observation made by Sakunthala and Reddy (2004) who reported shape index value of 0.72. The egg produced therefore are said to be of good quality.

The increase in the value of yolk and decrease in albumen value supports the findings of Ajayi and Kumokuo (2007) who reported decreased albumen weight with hen age but negates the report of Hasan and Aylin (2009) who observed increase in both yolk and albumen value with hen age. The difference may be as a result of the period of laying and the strain of chicken used in the experiment (Peters *et al.,* 2007). The high values of Haugh unit (HU) obtained in this study fall within the range documented by Hasan and Aylin (2009) but the values were higher than the report of Sogunle *et al.* (2009) the difference could be attributed to the freshness of the egg (Tona *et al.*, 2004) and the feed quality given to the birds. The higher value of HU corresponds to better quality of eggs if other characteristics are good (Adamiec *et al.*, 2002). The egg quality in terms of albumen weight, yolk percentage, shell thickness and shell weight showed no significant effect of the main effect of the treatment from onset of lay until the 8th week of the study. The effect of egg size and strains of bird on hen day production was statistically similar throughout the period of the study. Therefore, hatching egg weight did not impose any effect on the laying performance of birds.

CONCLUSION

For commercial purpose, setting of large eggs may likely increase profitability if the target is to sell the chicks at the end of starter phase but its effect is not significant towards the end of growing phase. It is also worth noted that both Dominant Black and Yaffa Brown strains of layers are good strains of chicken for egg production.

BIBLIOGRAPHY

Abiola, S.S.; Meshioye, O.O.; Oyerinde, B.O. and Bamgbose, M.A. 2008. Effect of egg size on hatchability of broiler chicks. *Arch Zootec,* 57: 83-86.

Adamiec, J.; Dolezal, M.; Mokova, K. and Davidek, J. 2002. Changes in eggs volatiles during storage. *Czech J Food Sci,* 20: 79-82.

Ajayi, F.O. and Kumokuo, E.G. 2007. Effect of age on egg quality traits in a strain of commercial layer. *Trop J Anim Sci,* 10: 17-21.

Anandh, M.A.; Jagatheesan, P.N.R.; Kumar, P.S.; Rajarajan, G. and Paramasivam, A. 2012. Effect of egg weight on egg traits and hatching performance of turkey (*Meleagris gallopavo*) eggs. *Iran J Appl Anim Sci,* 2: 391-395.

Asuquo, B.O.; Okon, B. and Ekong, A.A. 1992. Quality parameters of Isa Brown and Nigeria local chicken eggs. *Nig J Anim Prod,* 19: 1-5.

Bain, M.M. 2005. Recent advances in the assessment of eggshell quality and their future application. *World's Poult Sci J,* 61: 268-277.

Butcher, G.D. and Miles, R.D. 2003. Concepts of egg shell quality. University of Florida. https://edis.ifas.ufl.edu/vm013 (24/02/2015).

Coutts, J.A. and Wilson, G.C. 1990. Egg quality handbook. Queensland Department of Primary Industries. Australia. pp. 121-130.

De Beer, M. and Coon, C.N. 2006. The effect of increased protein intake during the starter and prebreeder periods on reproductive performance of ultra high yield broiler breeder hens. *Int J Poult Sci, 5*: 812-821.

Doyon, G.; Bernier-Cardou, M.; Halmiton, R.M.G.; Eastaigns, F. and Ramdald, C.T. 1986. Egg quality. 2. Albumen quality of egg from five commercial strains of White Leghorn hens during one year of lay. *Poult Sci,* 65: 63-66.

Egbeyale, L.T.; Abiola, S.S.; Sogunle, O.M. and Ozoje, M.O. 2011. Effect of egg size and strain on growth performance of cockerel. *Agric Biol J N Am*, 2: 1445-1453.

Egbeyale, L.T.; Fatoki, H.O. and Adeyemi, O.A. 2013. Effect of egg weight and oviposition time on hatchability and post hatch performance of Japanese quail *(Cotutnix coturnix japonica). Nig J Anim Prod,* 40: 102-108.

Farooq, M.; Aneela, K.; Durrani, F.R.; Muqarrab, A.K.; Chand, N. and Khurshid, A. 2001. Egg and shell weight, hatching and production performance of Japanese broiler quail. *Sarhad J Agric,* 17: 289-293.

Garip, M. and Dere, S. 2011. The effect of storage period and temperature on weight loss in quail eggs and the hatching weight of quail chicks. *J Anim Vet Adv,* 10: 2363-2367.

Hasan, A. and Aylin, A.O. 2009. Effect of storage time, temperature and hen age on egg quality in free-range layer hens. *J Anim Vet Adv,* 8: 1953-1958.

Haugh, R.R. 1937. The Haugh unit for measuring egg quality. U.S. *Egg Poult Mag*, 43: 552-553; 572-573.

Jones, D.R. 2006. Conserving and monitoring shell egg quality. Proceedings of the 18th Annual Australian Poultry Science Symposium. University of Sydney. Sydney, Australia. pp. 157-165.

Kul, S. and Seker, I. 2004. Phenotypic correlations between some external and internal egg quality traits in the Japanese quail *(Coturnix coturnix japonica). Int J Poult Sci,* 3: 400-405.

Lacin, E.; Yildiz, A. Esenbuga, N. and Macit, M. 2008. Effects of differences in the initial body weight and groups on laying performance and egg quality of Lohmann laying hens. *Czech J Anim Sci,* 53: 466-471.

Monira, K.N.; Salahuddin, M. and Miah, G. 2003. Effect of breed and holding period on egg quality characteristics of chicken. *Int J Poult Sci,* 2: 261-363.

Najib, H. and Al-Yousif, Y. 2014. egg size of saudi local layers as affected by line of the bird (body weight at sexual maturity) and dietary fat level. *Int J Poult Sc,* 13: 442-448.

Ojedapo, L.O.; Adedeji, T.A.; Ameen, S.A.; Olayemi, T.B.; Amao, S.R.; Ige, A.O.; Rafiu, T.A.; Ojediran, T.K. and Akinniran, T.N. 2009. Effect of strain and age on egg quality characteristics of two different strains of layer chicken kept in cages in derived savanna zone of Nigeria. In: Proceedings of the 14th Annual Conference of Animal Science Association of Nigeria. Lautech. Ogbomoso. Nigeria. pp. 41-43.

Panda, P.C. 1996. Shape and Texture. In: Textbook on egg and poultry technology. Panda, P.C. (Ed.). Vikas Publishing House Pvt. Ltd. New Delhi, India. p. 57.

Pinchasov, Y. 1991. Relationship between the weight of hatching eggs and subsequent early performance of broiler chicks. *Br Poult Sci,* 32: 109-115.

Roberts, J.R. 2004. Factors affecting egg internal quality and egg shell quality in laying hens. *J Poult Sci,* 41: 161-177.

Rustad, M.E.; Robinson, F.E.; Zuidhof, M.J. and Renema, R.A. 2006. Factors affecting egg properties of broiler breeder hens: egg colour, egg quality, egg shape. *Poult Sci Abs,* 23: 26.

Sakunthala, D.K. and Reddy, P.M. 2004. Phenotypic and genetic response in primary and various correlated traits in White Leghorn layers. *Ind J Poult Sci,* 39: 190-192.

SAS Institute. 2010. SAS User's Guide: Statistics. Inc. Cary. N.C. 923 pp.

Sinclair, R.W.; Robinson, F.E. and Hardin, R.T. 1990. The effects of parent age and posthatch treatment on broiler performance. *Poult Sci,* 69: 526-534.

Sogunle, O.M.; Egbeyale, L.T.; Adeniran, K.A. and Fanimo, A.O. 2009. Comparison of internal and external qualities of eggs from strains of egg-type chickens. In: Proceedings of the 14th Annual Conference of Animal Science Association of Nigeria. Lautech. Ogbomoso. Nigeria. pp. 30-32.

Tona, K.; Bruggeman, V.; Onagbesan, O.; Bamelis, F.; Gbeassor, M.; Mertens, K. and Decuypere, E. 2004. Day-old chick quality: relationship of hatching egg quality, adequate incubation practices and prediction of broiler performance. *Avian Poult Biol Rev,* 16: 109-119.

Peters, S.O.; Ikeobi, C.O.N.; Ozoje, M.O.; Famakinde, Y.S. and Adebambo, O.A. 2007. Egg quality of the Nigerian local chickens as influenced by some major genes. *Nig J Anim Prod,* 34: 25-31.

Witt, F. De and Schwalbach, L.M.J. 2004. The effect of egg weight on hatchability and growth performance of New Hampshire and Rhode Island Red chicks. *South African J Anim Sc,* 34: 62-64.

Wu, G.; Bryant, M.M.; Voitle, R.A. and Roland Sr, D.A. 2005. Effect of dietary energy on performance and egg composition of Bovans White and Dekalb White hens during phase 1. *Poult Sci,* 84: 1610-1615.

Wyatt, C.L. ; Weaver, W.D. and Beane, W.L. 1985. Influence of egg size, egg shell quality and post hatch holding time on broiler performance. *Poult Sci,* 64: 2049-2055.

Yasmeen, F.; Mahmood, S.; Hassan, M.; Akhtar, N. and Yaseen, M. 2008. Comparative productive performance and egg characteristics of pullets and spent layers. *Pakistan Vet J,* 28: 5-8.