Effect of egg size on hatching quality and post-hatch performance of indigenous chickens

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Abstract
The experiment was designed to evaluate the effect of egg size on hatching quality and post-hatch growth performance of normal feathered indigenous chickens. Hatchable eggs, grouped into three sizes: medium/control, small and large, were incubated to obtain day-old chicks. One hundred and eighty (180) day-old chicks were allotted to three treatment groups according to the egg sizes from which they were hatched. Egg size significantly (p<0.05) influenced chick hatching weight. Chicks hatched from large eggs were the heaviest (36.89g) while those obtained from small ones were the smallest (31.02g). Daily growth rate (DGR) was progressive and uniform in both cockerels and pullets in the first 8 weeks of life across the treatment groups. It was concluded that egg size, though could determine chick hatching weight, but not a good predictor of post-hatch growth performance in normal feathered indigenous chickens.

Keywords: Egg size, hatching quality, post-hatch performance, indigenous chickens

Introduction

Poultry production in tropical countries is based on the traditional scavenging system and chickens are the most important poultry species. In Nigeria, the chicken constitutes about 85% of the 120 million poultry birds (Fayeye, *et al.*, 2005). The development of these chickens, which are noted for their adaptation superiority in terms of their resistance to endemic diseases and other harsh environmental conditions, can be a useful way of helping to meet the nutritional, income, employment and gender needs of the rural populace.

Avian eggs have evolved to protect embryos and allow their development to the point at which they are able to hatch. Hatching quality has an overbearing effect on post-hatch performance in chicken. According to Molenaar *et al.* (2008), hatching quality reflects the development of the embryo during incubation and might predict the latter performance of the bird in the field as well. The same authors affirmed that hatching weight has a predictive value for performance in male broilers. Shanawary(1988) and Tona *et al*, (2005) have also shown that egg weight is correlated to hatching weight and sometimes also to subsequent performance. However, according to Joseph *et al.*(2006) hatching weight may not be a good predictor for subsequent performance, because it includes an unknown amount of residual yolk. Wolanski *et al.* (2006) found that the amount of residual yolk can vary between 0.8 and 10g.

Indigenous fowl, like exotic breeds, has a sigmoid growth pattern (Ismail, 1997). In pullets, the most rapid growth or weight gains occurred when the chick is young. The heavier the day-old chick, the heavier the pullet at 12 to 18 weeks, but the correlation is less at older ages (Mignon-Gasteaus *et al*., 2001). Chemjor (1998) reported a significant effect ($p<0.05$) on growth rates between male and female indigenous chickens from 13 to 21 weeks of age. Fayeye *et al*. (2005) also indicated that growth rate in Fulani ecotype chicken increased between hatch and 3 weeks of age and subsequently declined. The same authors posited that chicks were able to increase their body weight 4 times within 4 weeks of life and by more than 11 times within 8 weeks of life. Although animal's growth is thought to follow a generalized sigmoidal response, the actual shape of the curve can be influenced by numerous factors such as nutrition, environment, health, gender and genotype (Norris *et al*., 2007). Egg size has been widely reported to impact strongly on hatchability and post-hatch performance of exotic chicken but information on its effect on post-hatch growth performance of indigenous chickens is scanty. Therefore, the present study was conceived to evaluate the effect of egg size on hatching quality and post-hatch performance of normal feathered indigenous chickens.

Materials and Methods

Experimental birds and management

One hundred and eighty (180) unsexed day-old chicks, obtained from hatchable eggs of normal feathered indigenous hens were grouped into 3 treatments in accordance to 3 egg sizes: medium/control (45.01-55.00g), small (38.01-45.00g) and large (55.01-65.00g) from which they were hatched. Each treatment group comprising of 60 chicks was replicated thrice with 20 chicks per replicate. The chicks were brooded in a deep litter pen measuring 3.2m x 1.4m per replicate. The pen and implements used were thoroughly washed and disinfected prior to the arrival of the chicks. Upon arrival, hatching weights of the chicks were taken (using electronic weighing scale) on replicate basis as initial body weights and subsequently on weekly basis. Chicks and growers mash (Table 1) were fed *ad libitum* from 0-8 and 9-16 weeks respectively. Birds were also allowed unrestricted access to clean water. All routine medications and vaccinations were strictly administered. The experiment lasted for 16 weeks

Determination of Daily Growth Rate (DGR)

For the purpose of DGR determination, body weight of chicks was taken every four weeks by first separating birds in each replicate into both sexes. Body weight of the unequal cockerel: pullet ratio in each replicate was recorded at every stage of body weight determination on the 4^{th}, 8^{th}, 12^{th} and 16weeks'

DGR was calculated using the formula described by Msoffe *et al*. (2004).

DGR =W2-W1/28 where W1 was the initial weight in the month, W2 was the final weight in the month and 28 was the number of days in the month.

Data collection and analysis

Feed intake and body weight were taken for each replicate weekly and were used to calculate the average feed intake, weight gain, feed efficiency, average protein intake and protein efficiency ratio. Data obtained on growth performance were subjected to analysis of variance (ANOVA) in a completely randomized design (CRD) while Microsoft Excel was used to draw the growth curve. Significant means were separated using Duncan Multiple Range Test as contained in SAS (1999).

Results and Discussion

Effect of egg size on growth performance of normal feathered indigenous chickens

Table 1: Gross Composition ($^0/_0$) of diets

Ingredients	Chicks mash	Growers mash
Maize	50.50	45.00
Soybean meal	16.40	9.00
Groundnut cake meal	10.00	8.00
Fish meal	3.00	-
Palm kernel cake	6.00	
Wheat offal	10.00	33.30
Bone meal	2.00	2.50
Oyster shell	1.00	1.50
Lysine	0.10	0.10
Methionine	0.25	0.10
Chick's vit./mineral premix	0.50	-
Grower's vit./mineral premix	-	0.25
Salt	0.25	0.25
Total	100.00	100.00
Determined analysis ($^0/_0$)		
Dry matter	87.00	87.00
Crude protein	19.90	16.50
Ether Extract	4.20	4.50
Crude fibre	6.30	7.00
Total Ash	10.30	7.90
Nitrogen Free Extract (NFE)	46.30	51.10
Energy (MJ/Kg)	16.50	13.16

*Premix (Univit. 15Roche) contained B1,1.00g; B2,6g; B12, 0.02g; K3,3g; E,30g; biotin, 0.05g; folic acid, 1.5g; choline chloride, 2.50g; nicotinic acid, 30g; Ca-Pantothenate, 15g; Co, 0.4g; Cu, 8g; Fe, 32g; I, 0.8g; Zn, 40g; Mn, 64g, Se, 0.16g; BHT,5g. *Vit./Min.Premix contained: Premix (Embavit No 90) contained Vit. A, 10,000,000iu; D3, 2,000,000iu; E, 12,500iu; K, 1.30g; B11.30g; B2, 4.00g; D Calcium-Pantothenate, 1.30g; B6, 1.30g; B12, 0.01g; nicotinic acid, 15.00g; folic acid, 0.05g; biotin, 0.02g; Co, 0.20g; Cu, 5.00g; Fe, 25.00g; I, 0.06g; Mn, 48.00g; Se, 0.10g; Zn, 45.00g; choline chloride, 200.00g; BHT, 50.00g.

(Starter phase)

Results of post-hatch growth performance during the starter phase are shown in Table 2. Egg size significantly ($p<0.05$) influenced the chick weight. Mean chick weight were 31.02, 34.15 and 36.89g in small, medium and large-sized eggs respectively.The results of the present study revealed that egg size significantly ($p<0.05$) influenced chick hatching weight. This observation could be premised on the optimum development of the embryo and hatching quality of the chicks with its attendant overbearing influence on post-hatch performance. This occurrence is in agreement with the findings ofShanawary (1988),Tona *et al*, (2005), Abiola *et al.* (2008) and Malago and Baitilwake (2009) who reported a close correlation between egg and chick hatching weights of broiler and other chickens. Other parameters investigated were not significantly ($p>0.05$) affected by egg size. However, values obtained for final body weight, daily weight gain, daily feed intake, feed efficiency, protein intake, protein efficiency ratio and percent mortality were similar in medium/control and small but lower than those recorded for large-sized eggs. This occurrence contradicted the position of Hullet *et al.*, (2007) who indicated that an optimal development of the bird's body at hatch may also include better development of the digestive tract which can be reflected in a better utilization of nutrients and subsequently improved feed conversion ratio. On the other hand, the trend in the performance indices, as recorded in this study conforms to that reported by Joseph *et al.* (2006) who observed that hatching weight may not be a good predictor for subsequent performance, because it includes an unknown amount of residual yolk.

Effect of egg size on growth performance of normal feathered indigenous chickens (Grower phase)

Growth performance of normal feathered indigenous chickens during the growing phase is presented in Table 3. None of the parameters investigated was affected ($p > 0.05$) by egg size. The values recorded for final body weight, daily weight gain, protein intake and percent mortality were similar in chicks hatched from medium/control and large eggs but higher than those obtained for small-sized ones. Daily feed intake was numerically highest in chicks hatched from large eggs and lowest in those obtained from small ones with corresponding values of 101.41 and 97.75g. Feed efficiency and protein efficiency ratio were comparable among chicks hatched from medium/control and small eggs but slightly better ($p>0.05$) than those obtained from large ones. This development further corroborates earlier position on the hatching quality of the chicks and the findings of Joseph *et al.*, (2006) on the impropriety of predicting performance of chicks from their hatching weights.

Daily Growth Rate (DGR) of chicks hatched from different egg sizes

DGR of chicks is presented in Figures 1 and 2. DGR was progressive and uniform in the first 8 weeks of life in both sexes across the treatment groups. While DGR declined steadily from 8-16 wheels among the pullets, the reverse was the case with the cockerels within the same period. Generally, it could be observed from the Figures that chicks hatched from large eggs had slightly superior DGR from the 8th week to those obtained from medium and small ones. The disparity observed in DGR between the two sexes from the 8th week could be responsible for the heavier body weight and earlier sexual maturity which the cockerels exhibited over the pullets. The trend in DGR recorded in the present work corroborated the report of Msoffe *et al.* (2004) which indicated that while some free-range local chicken ecotypes in Tanzania decreased their mean DGR between the second and third month of age,

Table 2: Effect of egg size on post-hatch growth performance of indigenous chickens (starter phase)

	Egg size		
Parameters	**Medium**	**Small**	**Large**
Av. Egg Weight (g)	47.37±0.54[b]	41.40±0.82[c]	56.37±0.90[a]
Av. Initial Weight (g)	34.15±0.26[b]	31.02±0.04[c]	36.89±0.50[a]
Av. Final Weight (g)	734.33±22.33	733.33±28.48	791.67± 43.81
Av.WeightGain (g/day)	12.50±0.39	12.54±0.51	13.48±0.77
Av. Feed Intake (g/day)	48.98±0.53	48.40±1.03	50.74±1.57
Feed Efficiency	0.26±0.01	0.26±0.02	0.27±0.01
Av. Protein Intake (g)	9.75±0.10	9.63±0.20	10.10±0.31
Protein Efficiency Ratio	1.28±0.04	1.31±0.08	1.33±0.05
Mortality (%)	1.67±1.67	1.67±1.67	3.33±1.67

a,b,c means on the same row with different superscripts differ significantly ($p<0.05$)

Table 3: Effect of egg size on post-hatch growth performance of indigenous chickens (grower phase)

	Egg size		
Parameters	**Medium**	**Small**	**Large**
Av. Egg Weight (g)	47.37±0.54[b]	41.40±0.82[c]	56.37±0.90[a]
Av. Initial Weight (g)	734.33±22.33	733.33±28.48	791.67±43,81
Av. Final Weight (g)	1601.03±11.23	1572,77±28.62	1641.00±66.37
Av.WeightGain (g/day)	15.48±0.29	14.99±0.15	15.17±0.70
Av. Feed Intake (g/day)	97.75±1.68	95.50±2.59	101.41±1.17
Feed Efficiency	0.16±0.00	0.16±0.00	0.15±0.01
Av. Protein Intake (g)	16.13±0.28	15.76±0.43	16.73±0.19
Protein Efficiency Ratio	0.96±0.00	0.95±0.02	0.91±0.05
Mortality (%)	1.00±0.58	0.67±0.33	1.00±0.38

a,b,c means on the same row with different superscripts differ significantly ($p<0.05$)

others showed reduction between the third and fourth month of age. In specific terms, the mean DGR of 10.70g/day reported by Safaloah (1998) for the Malawian local domestic fowls was within the range of 8.00 and 13.76g/day recorded for normal feathered indigenous pullets and cockerels respectively used in this study. Cockerel chicks were able to increase their body weight 7 times within 4 weeks of life while pullets increased theirs 5 times within the same period. The growth pattern exhibited by normal feathered indigenous chickens used in this study was superior to that of Fulani chicken ecotype which increased their body weight 4 times within 4 weeks of life (Fayeye *et al.*., 2005) Such superiority was not uncommon where chicks were

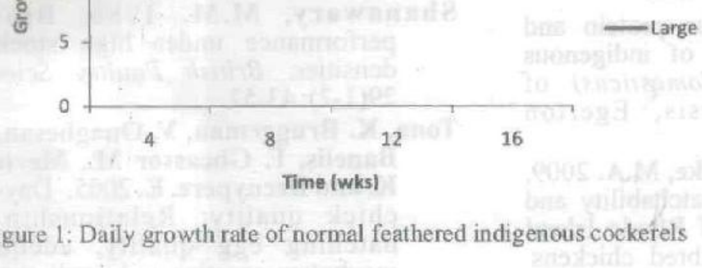

Figure 1: Daily growth rate of normal feathered indigenous cockerels

managed under improved conditions to actualize their full genetic potentials.

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