Nig. J. Anim. Prod. 2007, 34(1): 25 - 31
Nigerian Society for Animal Production

Egg Quality of the Nigerian Local Chicken as Influenced by Some Major Genes

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Abstract

An investigation was carried out to determine the effect of the major genes of frizzling and naked neck on the external and internal egg quality traits of the Nigerian local chicken. Egg weight significantly (P<0.01) favoured the frizzled local chicken and the naked-necked local chicken over the fully feathered (normal) local chicken. The frizzling gene, F, caused an increase of 8.13% in weight while the naked neck gene Na, increased egg weight by 5.85%. The Na gene caused the production of better egg shape index (0.73) when compared to F and nana, ff genotypes. Eggs of frizzled and naked-neck locals also had significantly (P<0.05) better Haugh unit, percent shell, percent albumen and percent yolk than the normal feathered counterpart. It is therefore reasonable to incorporate the major genes frizzling and naked-neck in producing a locally-adapted commercial egg strain.

Keywords: Nigerian local chicken, frizzling gene, Naked neck gene, egg quality.

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Introduction

The Nigerian local chicken has been characterized as hardy and highly adapted to the harsh hot and humid native environment. It is to be expected that under the conditions prevailing in the local environment and the generally scavenging nature of rearing, the productivity of the birds will be greatly reduced. However, in an age when a great demand is being made on farm animals to produce more and cheaply to satisfy the yearnings of the human population, the Nigerian local chicken can and is, in fact, playing a unique role especially for the rural populace.

Several workers have reported on the unique adaptive features of the Nigerian local chicken predisposing it to adapt to the local environment (Adebambo *et al.*, 1999 Ikeobi *et al;* 1996, 1998, 1999, 2001; Ikeobi and Godwin, 1999; Ozoje *et al.*, 1999, and Ikeobi, 2003). They include the relatively small adult size, their generally flighty nature, tolerance to some diseases and parasites, relatively thick egg shells, some rare and fancy conditions, some fancy colour patterns of mottling, extension and spotting, the grey or black skin colour, and the presence of some major genes affecting feather structure and feather

distribution. Among these features, the major genes of frizzling and naked neck are important as they enhance the thermoregulatory activities of the birds.

In two previous studies (Ikeobi *et al.*, 1996, and Peters *et al*; 2002), it was reported that the adult frizzled local chickens were generally heavier than the non-frizzled ones but the non-frizzled chicken laid more eggs. The naked-necked local chickens were intermediate in weight but laid more eggs than the frizzled chickens. A recent study (Peters *et al.*, 2004) also highlighted the effects of Naked neck and frizzled genes on fertility and hatchability of eggs of the local chicken.

Efforts to characterize the Nigerian local chicken should entail assessing the productive traits of the birds including the egg quality traits. The quality of eggs of the chicken can be influenced by many factors, which may be genetic and environmental. The present study was undertaken to investigate the influence of the major genes of frizzling and naked neck on the egg quality parameters of the local chicken.

Materials and Methods

The study was conducted at the Poultry Breeding Unit of the Teaching and Research farm of the University of Agriculture, Abeokuta, Ogun State, Nigeria. Average ambient temperature and relative humidity were 34°C and 82% respectively while the vegetation of the site was an inter-phase between the rainforest and the derived Savannah. The local hens studied were the frizzled, the naked-necked and the fully feathered (normal) birds and they arose from a stock of local chickens selected and maintained at the Poultry Breeding Unit. They were housed singly in the battery cages providing a floor space of $0.4m^2$ per bird. They had *ad libitum* access to station-compounded layers' mash and clean water. The birds were also wing-tagged for easy identification and eggs were collected on daily basis.

A total of 380 fresh eggs belonging to the three genetic groups (normal, frizzled and naked neck) were collected comprising of 133, 120 and 127 eggs for normal, frizzled and naked neck respectively. The eggs were weighed immediately after oviposition with an electronic scale to the nearest 0.01g and the other external egg parameters such as egg length and width were measured with a vernier caliper in centimeters. Egg shape indexes were calculated as a ratio of the egg width to the egg length. The eggs were collected over a four week period. The internal egg quality was carried out within 24 hours post oviposition. Individual egg sample was broken out on a flat transparent glass plate of dimension 45cm by 40cm using a table knife to cautiously crack the shell without breaking the vitelline membrane that enclosed the yolk. The parameters measured include:

Albumen Height (mm) – This was taken as the height of the thick white of the chalazae at a point about the midway between the inner and outer circumference of thick white with tripod micrometer (P6085 spherometer) having an accuracy of 0.01mm. The yolk weight was expressed as a percentage of the egg weight recorded as percent yolk for individual egg sample.

Yolk weight (g) – the yolk was carefully separated from the albumen using a plastic egg separator and was weighed individually with an electronic sensitive scale to the nearest 0.01g.

Yolk width (cm) – the yolk width was measured around the widest horizontal circumference using vernier caliper.

Yolk colour – the colour of the yolk was graded with the Hoffman-la-Roche (R)

yolk colour fan with colour intensity ranging from pale yellow (scored 1) to deep orange (score 15).

Shell weight (g) – eggshells were air dried for 72 hours in egg trays and then weighed to the nearest 0.01g. The shell weight was expressed as a percentage of the egg weight and recorded as percent shell (% shell) for individual egg sample.

Shell thickness (mm) – the thickness of the individual dry eggshell was measured with a micrometer screw gauge to the nearest 0.01mm. The mean of three measurements at three different points (the narrow, broad ends and mid point) was taken as the shell thickness.

Albumen weight (g) – the albumen weight was taken as the difference between the egg weight and the combined weight of yolk and dry eggshell for individual egg sample. The albumen weight was expressed as a percentage of the egg weight and recorded as percent albumen (% albumen) for individual egg sample.

Haugh Unit (H.U) – egg weight and albumen height were used to compute the Haugh unit for individual egg sample using the simplified formula of Haugh (1937) as cited by Asuquo *et al.*, (1992)

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

Where H.U = Haugh unit

H = Height of thick albumen in millimeter

W = Weight of eggs in grams

Albumen pH – This was measured with a calibrated pH meter to a two decimal point.

Data obtained were subjected to one-way analysis of variance using week of collection as a covariate. The mixed model used is stated below

$$Y_{ij} = \mu + G_i + bW + \text{“}_{ij}$$

Where

Y_{ij} = Observed on the j-th egg of the ith genotype

μ = overall mean

G_i = effect of i-th genotype (i = 1, 2, 3)

bW = regression coefficient

“_{ij} = random residual error $(0, \delta^2)$

Significant differences between means were assessed using Duncan's multiple range test (Gomez and Gomez, 1984)

Results

The effect of the major gene studied were found to be significant ($P<0.05$) for egg weight and egg shape index. It was also found to be significant ($P<0.05$) for Haugh unit, yolk width, yolk colour, percent shell, percent albumen, percent yolk and albumen pH. The other traits studied (egg width, egg length, albumen height and shell thickness) were not significantly affected ($P>0.05$) by the major genes of frizzling and naked neck in the Nigerian local chicken.

Table 1 show the least-square means and standard errors for the external egg quality traits for the three genetic groups. The weights of the eggs laid by the frizzled and naked neck local chickens were significantly heavier compared to those of the fully feathered (that is, non-frizzled, non-naked-necked) local chicken. Least-squares

Table 1. Least square means and standard error for external egg quality traits in relation to major genes.

Major gene	N	Egg weight, g	Egg width, cm	Egg length, cm	Egg shape index
Naked neck, NaNa	127	50.00+ 0.71[a]	4.62+0.06	6.34+0.08	0.73+0.02[a]
frizzled, ff	120	51.07+0.77[a]	4.91+0.08	6.21+0.06	0.79+0.03[b]
Normal nana, ff	133	47.23+0.65[b]	4.90+0.09	6.25+0.09	0.78+0.03[b]

Means in the same column with different superscripts are significantly different (P<0.01).

means were 51.07 grams, 50.00 grams and 47.23 respectively. There were no significant differences in the mean values of egg weight for frizzled and naked-necked local chickens. The mean value for egg shape index for Naked-necked local chicken was lower and significantly (P<0.01) different from the mean values obtained for frizzled and normal feathered local chicken. There was no difference (P<0.05) between the means obtained for egg shape index for frizzled and normal feathered locals.

Least squares means and standard errors for internal egg quality in relation to major genes are presented in table 2. Mean values for Haugh unit, percent shell, percent albumen and percent yolk were in favour of the Naked necked and frizzled feather local chicken when compared to their normal feathered counterpart. The frizzled-feathered bird had the highest mean value for yolk width while the Naked-necked local had the highest value for yolk colour when compared with the other two genotypes. The Naked neck and frizzled local chickens had a lower mean value than that of the normal feathered local chicken.

Discussion

The greater weights of the eggs of frizzled and Naked neck local hen might be as a result of the greater adaptation of the frizzled and naked-neck hen to the hot humid local environment especially in terms of body temperature regulation. The potential usefulness of the naked neck and frizzle gene in the tropics were extensively reviewed by Merat (1986) and Horst(1988). The frizzling condition is caused by a major gene, the frizzling gene, F, the action of which is manifested in the follicle of the chicken feathers. This gives the feathers a ruffled appearance. The effects of the frizzling gene in this study were increases in the egg weight (8.13%) when compared to the non-frizzled, and fully covered (normal) local chicken. The naked neck gene, Na, on the other hand causes bare skin on the chicken neck, leading to 30 – 40% reduction in the plumage. It is associated with pronounced heat tolerance of the chicken and this might probably account for the significantly heavier eggs of the naked necked local birds when compared to the na/na (fully feathered) local chickens. Increases in egg weight due to the naked neck gene were about 5.86% in this study. These results were similar to the results obtained by Peters *et al.*, 2002.They reported that frizzle and naked neck hen's laid heavier eggs when compared to their normal feathered counterpart.

The eggs from Naked neck and frizzled local hens had higher mean value for Haugh unit than

Table 2. Least square means and standard error for internal egg quality traits in relation to major genes

Major gene	N	Haugh unit (%)	Albumen Height (cm)	Yolk width (cm)	Yolk colour	Percent shell	Percent albumen'	Percent yolk	Shell thickness (mm)	Albumen pH
Naked neck, NaNa	127	65.68+0.12^{a}	3.35+0.08	3.17+0.01^{a}	9.88+0.03^{a}	10.07+0.05^{a}	59.13+0.27^{a}	35.24+0.25^{a}	0.40+0.06	8.64+0.04^{a}
Frizzled, ff	120	65.04+0.13^{a}	3.33+0.06	3.32+0.01^{b}	9.03+0.04^{b}	10.05+0.05^{a}	58.37+0.29^{a}	36.59+0.26^{a}	0.42+0.01	8.68+0.03^{a}
Normal nana, ff	133	62.96+0.12^{b}	3.38+0.07	3.22+0.01^{a}	8.96+0.03^{b}	9.28+0.05^{b}	55.63+0.12^{b}	30.05+0.23^{b}	0.41+0.02	8.95+0.02^{b}

Means in the same column with different superscripts are significantly different ($P<0.05$)

normal feathered ones. These results confirmed major gene effect of frizzling and naked neck on egg quality. The average Haugh unit observed for the three genotypes indicated that they are of good quality since they have values higher than 40% which depicts that the egg is of inferior quality (Ayorinde *et al.*, 1999)

Eggs from the naked neck local chicken had the lowest value in egg shape index which is the closest to an index of 0.75 which was regarded as the most satisfactory when eggs are to be packed in specialized containers for transportation (Smith, 1990).

Effects of major gene was evident in the values obtained for yolk width as the width of the yolk from Naked necked hens had the least value when compared to their frizzled and normal feathered counterpart.

The mean value of yolk colour for Naked neck was higher than frizzled and normal feathered in this study but lower than 10.83, 10.30 and 10.35 obtained for three exotic strains (Yaffa, Lohmann and Harco) in the same tropical environment (Sowunmi, 2000). Egg yolk had been reported to be more affected by environmental factors than genetic (Oluyemi and Roberts, 1979)

Percent albumen, also an indicator of egg quality was significantly ($P<0.05$) affected by major gene. This is also reflected in the Haugh unit of the three genotypes presented. Eggs containing a large proportion of thick white are regarded as being of high quality (Harms and Hussein 1993). There is therefore an association between thick white and egg quality. Albumen weight had been reported to be more closely associated with egg

weight than yolk weight (Harms and Hussein, 1993).

Major gene effects were observed for percent yolk of eggs from the three genetic groups. Normal feathered local hen was inferior to the other two. This observation agrees with the report of Valido *et al.*, (1992) that genotype was important for percent yolk in strains of chickens. Percent shell from eggs of normal feathered hen was lower than those from frizzled and naked neck counterpart. Influence of major gene is also implicated here. The naked neck and frizzling gene may influence the amount of egg shell being deposited during the egg formation.

The albumen pH of eggs from normal feathered hen was higher than those from frizzled and naked neck hen. It appears that the albumen pH is under genetic influence. Though all eggs albumen were alkaline (pH>7.00), there was an appreciable variation in the degree of alkalinity between the hens carrying the major genes of frizzling and naked neck and their normal feathered counterpart.

Conclusion

The frizzled local chicken and the naked necked local chickens have shown appreciable superiority over the non-frizzled, non-naked-necked (ff, nana) local chickens especially in some external and internal egg quality traits. This implies that the two genes from the Nigerian local chicken can be utilized in a breeding programme to produce a highly adapted commercial egg strain.

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(Received 5th July 2006; Accepted 19th Oct. 2006)