



Effect of strain on some production and reproductive traits of chickens in Nigeria

Ochai, D. E.¹, Kalla, D. J. U.¹, Mancha, Y. P.¹ and Saleh, B.²

¹Department of Animal Production, Abubakar Tafawa Balewa University Bauchi, Nigeria

²Department of Animal Science, Faculty of Agriculture, University of Maiduguri, Borno State, Nigeria

Abstract

An experiment was carried out at the poultry unit of the Federal College of Land Resources and Technology, Vom, Plateau State to compare the egg production performance and fertility of three strains of chickens. A total of 85 sexually mature chickens from three strains were used for the study as follows; FUNAAB-alpha – 15 cocks and 15 hens, ISA Brown – 15 cocks and 15 hens, Bantam – 15 cocks and 10 hens. The birds were fed a commercial diet (17% CP and 2800 kcal/kg ME) and water ad libitum throughout the six months experimental period. Hens were inseminated twice a week with pooled semen from cocks of same strain to obtain fertile eggs. Data on hen day egg production, external and internal egg qualities, fertility and hatchability were recorded. All data obtained were subjected to analysis of variance in a Completely Randomized Design using the linear model of Statistix 9.0. The FUNAAB-alpha strain had the highest ($P<0.05$) hen day egg production (68.95%) followed by ISA brown (58.85%) while the Bantam had the least (47.50%). Strain significantly ($P<0.05$) affected egg weight, height and width, and shape index. Eggs of the ISA Brown were heaviest followed by FUNAAB-alpha. Albumen weight and height were higher ($P<0.05$) for the ISA brown hens. Similarly, egg shells were heavier ($P<0.05$) for the ISA brown. Shell percentage and thickness were higher ($P<0.05$) for the Bantam compared to others. Fertility and hatchability were highest ($P<0.05$) (34.00 and 53.33%) for the FUNAAB alpha followed by the Bantam (33.00 and 26.53%) while the Isa Brown had the least ($P<0.05$) (19.75 and 8.33%). It was concluded that the FUNAAB- alpha compared favourably with the ISA brown but was superior to the Bantam in egg production. Fertility and hatchability were best for the FUNAAB alpha and bantam and hence they can be recommended for adoption by farmers in Nigeria.

Key Words: Bantam, FUNAAB alpha, Isa brown, egg quality, fertility, hatchability

Introduction

The importance of native birds for rural economy is immense in different countries. Though these birds are been used for rural backyard poultry production, their genetic potential has not been fully exploited. Improvement of native breeds through selection is being carried out, though the attention has been inadequate (Padhi, 2016).

In commercial poultry production, the exotic breeds of chickens are usually preferred due to high productivity. There is therefore, a dire need to make the Nigerian breed more commercially viable and economically lucrative by examining its reproductive potential considering its huge adaptive

potentials compared to the exotic breeds. In Nigeria, efforts have been geared towards the development of indigenous chicken breeds with improved meat and egg production and also introduction of exotic breeds with potentials to adapt to the Nigerian environment. These efforts have led to the development of the Shika brown chicken by the National Animal Production Research Institute (NAPRI), Zaria and the FUNAAB – alpha by the Federal University of Agriculture Abeokuta (FUNAAB) (Saleh *et al.*, 2017).

Poultry, particularly chickens are genetically diverse. Thus it is important to compare their production and reproductive performance in

order to identify populations and individuals of particular merit. Hence, information on the influence of Strain on reproduction in chickens provides a useful guide for farmers and researchers for improved reproductive performance.

This study was therefore designed to compare the performance of three strains of chickens (FUNAAB-alpha, Isa Brown and the Indian Bantam) found in Nigeria.

Materials and Methods

Experimental Site

The experiment was carried out at the poultry unit of the Federal College of Land Resources and Technology, Vom, Plateau State. Vom is located between latitudes 9° 43' and 44.76" and longitudes 8°47' and 28.97" East of the equator and situated 1,285 metres above sea level. The community is primarily agrarian and agriculture contributes about 75% to the State's economy. The climate is characterized by two well defined seasons: The rainy season (usually May to October) and the dry season (usually November to April).

Experimental Birds and their management

A total of 85 sexually mature chickens from three strains were used for the study as follows; FUNAAB-alpha – 15 cocks and 15 hens, ISA Brown – 15 cocks and 15 hens, Bantam – 15 cocks and 10 hens. The FUNAAB-Alpha chickens were procured from the poultry unit of the Federal University of Agriculture, Abeokuta. The Bantams were obtained from the poultry unit of the National Veterinary Research Institute, Vom, Plateau State while the Isa Brown chickens were from Amo Byng hatchery in Awe, Oyo state, Nigeria. The hens were inseminated twice a week with pooled semen from cocks of same strain to obtain fertile eggs.

The birds were fed a commercial layer diet (17% CP and 2800 kcal/kg ME) and water *ad libitum* throughout the six months experimental period.

Egg Production

Eggs were collected twice a day (morning and evening). Egg number and weight were recorded daily per strain. Egg weights were recorded individually to the nearest gram using an electronic scale (SF – 400).

Hen-day egg production (HDEP) was calculated daily using the following expression:

$$HDEP = \frac{\text{Total number of eggs produced on a day}}{\text{Total number of hens present on that day}} \times 100$$

Egg quality Measurement

The length and width of each egg was measured using a digital Vernier Caliper to the nearest 0.01mm. Shape index was calculated according to the following expression:

$$\text{Egg shape index (\%)} = \frac{\text{Egg width (mm)}}{\text{Egg length (mm)}} \times 100$$

The shell of each egg was washed free of all remaining albumen and then air dried for 24 hours after which they are individually weighed to the nearest gram to obtain the shell weight. Shell percentage was calculated according to the following expression:

$$\text{Egg shell percentage (\%)} = \frac{\text{Egg shell weight (g)}}{\text{Egg weight (g)}} \times 100$$

Shell thickness was measured with a micrometre screw gauge to the nearest millimetre using the average of three points (narrow, broad and equatorial). Shell membrane thickness was obtained by measuring shell thickness, after which the shell was moistened and the membrane carefully removed, the thickness was measured again. Shell membrane thickness was the difference between the shell thickness with and without membrane.

Each egg was broken out on a clean flat glass, a digital Vernier calliper was used to

measure the albumen depth, length and width and yolk length and width to the nearest millimetre. After which the yolk was separated from the albumen and weighed to the nearest gram to obtain the yolk weight.

Yolk percentage was calculated using the following formula:

$$\text{Yolk Percentage (\%)} = \frac{\text{Yolk weight (g)}}{\text{Egg weight (g)}} \times 100$$

Weight of egg albumen was obtained by subtracting weights of yolk and shell from the weight of the whole egg. Albumen percentage was calculated using the following formula:

$$\text{Albumen Percent (\%)} = \frac{\text{Albumen weight (g)}}{\text{Egg weight (g)}} \times 100$$

Haugh unit (HU) was calculated by the expression of Haugh (1937);

$$\text{HU} = 100 \log (h + 7.57 - 1.7 W^{0.37})$$

Where:

h = albumen height (mm)

W = Egg weight (g)

Fertility and Hatchability

Birds were inseminated with semen collected by abdominal massage as described by Donoghue and Wishart (2000). Insemination was done twice a week and eggs were collected daily from the hens. Eggs were collected for seven consecutive days from each strain, labelled appropriately and stored at 16°C. They were sorted on the 7th day to remove cracked and abnormal sized ones before being set in an electric incubator. The incubation temperature and relative humidity were 37.5°C and 60%, respectively. Candling was done on the 10th and 18th day of incubation and all clear eggs and dead embryos were removed. This was done for three consecutive months and a total of 300 eggs were set for the experiment.

Eggs were considered fertile if there was development of embryo. Fertility was then calculated as follows:

$$\text{Fertility (\%)} = \frac{\text{Number of fertile eggs}}{\text{Number of eggs set}} \times 100$$

Hatchability referred to the number of eggs that hatched at the end of the incubation period. It was calculated as follows:

$$\text{Hatchability (\%)} = \frac{\text{Number of eggs that hatched}}{\text{Number of fertile eggs set}} \times 100$$

Statistical Analysis

Data were analysed in a Completely Randomized Design using the linear model of Statistix 9.0. Where means differed, Least Significant Difference (LSD) was used to separate them.

Results

The effect of chicken strain on hen-day egg production is shown on Figure 1. The FUNAAB-alpha had the highest ($P < 0.05$) mean (68.95%) followed by ISA brown (58.85%) and Bantam the least (47.50%).

Table 1 shows the effect of strain on egg quality characteristics of chickens. Strain significantly affected egg weight. ISA brown had the highest ($P < 0.05$) egg weight followed by FUNAAB alpha and then the Bantam. Egg width followed same pattern as egg weight. Egg height was lower ($P < 0.05$) for the Bantam, while it was similar for the others. Egg shape index was similar for ISA brown and Bantam while the FUNAAB alpha had a lower ($P < 0.05$) mean.

Albumen weight and height were higher ($P < 0.05$) for ISA brown followed by FUNAAB alpha and Bantam. ISA brown and Bantam had similar albumen length while width was similar for the FUNAAB

alpha and ISA brown. Yolk weight was highest ($P < 0.05$) for the FUNAAB alpha while Bantam had the least weight. However, the Bantam had the highest ($P < 0.05$) yolk percentage.

Egg shells were heavier ($P < 0.05$) for the ISA brown and lighter for Bantam. Shell percentage and thickness were higher ($P < 0.05$) for the Bantam compared to others. Shell membrane thickness was thinnest ($P < 0.05$) for the FUNAAB alpha while the Bantam had the thickest.

Table 2 shows the effect of strain on fertility and hatchability of the chicken eggs. Fertility and hatchability were highest ($P < 0.05$) for the FUNAAB alpha followed by the Bantam and least for Isa Brown.

Discussion

Hen-day egg production in this study was influenced by strain which confirmed the reports of Singh *et al.* (2009) and Khawaja *et al.* (2013) that genotype influenced hen day egg production. The FUNAAB-Alpha compared favourably to the Isa Brown in egg production. The lower production of the Bantam may be because they have not been selected for egg production like the Isa Brown or the FUNAAB-Alpha.

Egg weight is among the most important parameters not only for consumers, but for egg producers as well (Genchev, 2012). In this study, egg weight was affected by the strain of the chicken with the Isa Brown eggs being heavier. This should be expected since the Isa Brown chicken has been selected over many years for high egg weight (ISA, 2009). The observation in the current study confirmed earlier reports of Katuley (1990) and Egahi *et al.* (2013) that different genetic groups of chickens laid eggs of different sizes.

The FUNAAB – Alpha had a better egg shape index compared to the other strains. Eggs are classified based on shape index (SI) as sharp eggs ($SI < 72$), normal eggs ($SI = 72$

– 76) and round eggs ($SI > 76$) (Duman *et al.*, 2016). This shows that it produced normal shaped eggs which fit well to egg trays and reduced transit losses (Rath *et al.*, 2015) while the other groups produced eggs that were slightly round.

The internal egg quality traits of the eggs were higher for the FUNAAB – Alpha and Isa Brown compared to the Bantam except in percent yolk. The results are in agreement with the finding of Khawaja *et al.* (2013) that breed has an influence on internal quality of eggs. The eggs with higher albumen height tend to have better internal egg quality. Albumen height is an important trait and it is possible to improve egg quality through selection for it. In the present experiment, the proportion of yolk of the Bantam was larger than those of the FUNAAB – alpha and Isa Brown. This is contrary to the observation of Ahn *et al.* (1997) that yolk proportion of Fayoumi eggs is smaller than those of their crosses because of its small egg size. This may be as a result of genotype and environmental differences between this work and theirs.

In this study, shell weights of FUNAAB-Alpha, Isa Brown and Bantam were different from each other, which is similar to reports of Singh *et al.* (2009) that different strains of laying hens vary significantly in egg shell quality. Interestingly, the Bantam had a higher proportion of shell with thicker shell and membrane. This may be because it has not been selected for large egg weight. Shell thickness of the Isa brown in this study was within the range 43.55 – 64.51mm reported for Isa brown in Nigeria by Ukwu *et al.* (2017).

Fertility and hatchability are major parameters of reproductive performance which are most sensitive to environmental and genetic influences (Kingori, 2011; Ajayi and Agaviezor, 2016). The results of this study showed that breed difference had significant influence on fertility and

hatchability which agrees with the report of Fikremariam and Tilahun (2016) who noted that fertility and hatchability were highest for Fayoumi breed than Dominant breed in Ethiopia. Similarly, Ajayi and Agaviezor (2016) also showed that difference in breed had significant effect on fertility and the different hatchability parameters of the Nigerian local chickens. Moreki *et al.* (2014) also indicated that hatchability is influenced by genetic factors. Similarly, Nwakpu *et al.* (1999) observed that the black Olympia and Hubbard and Nick strains (layer- type chicken) were 20% and 19% (respectively) higher in egg fertility than the investigated Nigerian local chicken.

Conclusion and Recommendation

The FUNAAB- alpha compared favourably with the ISA brown but was superior to the Bantam in egg production. Fertility and hatchability were best for the FUNAAB alpha they can be recommended for adoption by farmers in Nigeria.

References

- Ahn, D.U., Kim, S.M. and Shu, H. (1997). Effect of egg size and strain and age of hens on the solids contents of chicken eggs. *Poultry Science*, **76**:914–919.
- Ajayi, F. O. and Agaviezor, B. O. (2016). Fertility and hatchability performance of pure and crossbred indigenous chicken strains in the high rainforest zone of Nigeria. *International Journal of Livestock Production*, **7**(12): 141-144. DOI: 10.5897/IJLP2016.0308
- Donoghue, A. M. and Wishart, G. J. (2000). Storage of poultry semen. *Animal Reproduction Science*, **62**: 213 – 232.
- Duman, M., Şekeroğlu, A., Yıldırım, A., Eleroğlu, H. and Camcı, Ö. (2016). Relation between egg shape index and egg quality characteristics. *European Poultry Science*, **80**. DOI: 10.1399/eps.2016.117
- Egahi, J. O., Dim, N. I. and Momoh, O. M. (2013). The effect of plumage modifier genes on egg quality indices of the Nigerian local chicken. *IOSR Journal of Agriculture and Veterinary Science*, **2**(2): 04-06
- Fikremariam, F. and Tilahun, A. (2016). Fertility and Hatchability of Fayoumi and Dominant Breeds of Chicken in Debere Zeit Agricultural Research Centre, Ethiopia. *Academia Journal of Agricultural Research*, **4**(5): 241-246. DOI: 10.15413/ajar.2015.0133
- Genchev, A. (2012). Comparative investigation of the egg production in two Japanese quail breeds – Pharaoh and Manchurian golden. *Trakia Journal of Sciences*, **10** (1): 48-56.
- Haugh, R. R. (1937). The Haugh unit for measuring egg quality. *US Poultry Magazine*, **43**: 552 – 555.
- ISA (2009). From egg to chicken: Hatchery manual. Institut de Sélection Animale [ISA], A Hendrix Genetics Company. Institut de Sélection Animale BV Villa ‘de Körver’, The Netherlands. Retrieved January 18, 2016 from: www.isapoultry.com
- Katuley A M (1990). Studies on the prospects of improving the performance of local chicken populations in Tanzania by cross breeding. Unpublished Thesis for Award of PhD Degree at Sokoine University of Agriculture, Tanzania.
- Khawaja, T., Khan, S. H., Mukhtar, N., Ullah, N. and Parveen, A. (2013). Production performance, egg quality and biochemical parameters of Fayoumi, Rhode Island Red and their reciprocal crossbred chickens, *Journal of Applied Animal Research*, **41**(2): 208-217. DOI: 10.1080/09712119.2012.739969
- Kingori, A. M. (2011). Review of the factors that influence egg fertility and hatchability in poultry. *International Journal of Poultry*

- Science*, 10(6): 483 – 492.
- Moreki, J. C., Mmopelwa, G. M. and Nthoiwa, G. P. (2014). Hatchability traits of normal feathered and naked neck Tswana chickens reared under intensive system. *International Journal of Current Microbiology and Applied Sciences*, 3(5): 395-401
- Nwakpu, P. E., Odo, B. I., Omeje, S. I., Akpa, M. and Edoga, C. C. (1999). Hatching performance of three strains of layer-type chicken and their lines. In: Joseph, J. K., Awosanya, B., Apata, D. F., Belewu, M. A., Atteh, J. O. and Ayorinde, K. L. (Eds.) *Proceedings, 26th Annual NSAP Conference* 21- 25 March, 1999, Ilorin, Nigeria.
- Padhi, M. K. (2016). Importance of indigenous breeds of chicken for rural economy and their improvements for higher performance. *Scientifica*, Article ID 2604685, 9 pages. Doi: 10.1155/2016/2604685
- Rath, P. K., Mishra, P. K., Mallick, B. M. and Behura, N. C. (2015). Evaluation of different egg quality traits and interpretation of their mode of inheritance in White Leghorns. *Veterinary World*, EISSN: 2231-0916. Retrieved August 7, 2016 from: www.veterinaryworld.org/Vol.8/April-2015/3.pdf
- Saleh, B., Mbap, S. T., Kalla, D. J. U., Doma, U. D. and Duwa, H. (2017). Effect of varying levels of dietary energy and protein on reproductive performance of FUNAAB - alpha hens. *Livestock Research for Rural Development*, 29, Article #57. Retrieved March 18, 2017, from <http://www.lrrd.org/lrrd29/3/sale29057.html>
- Singh, R., Cheng, K. M. and Silversides, F. G. (2009). Production performance and egg quality of four strains of laying hens kept in convectional cages and floor pens. *Poultry Science*, 88: 256 – 264.
- Ukwu, H. O., Abari, P. O. and Kuusu, D. J. (2017). Principal component analysis of egg quality characteristics of Isa Brown layer chickens in Nigeria. *World Scientific News*, 70(2): 304-311.

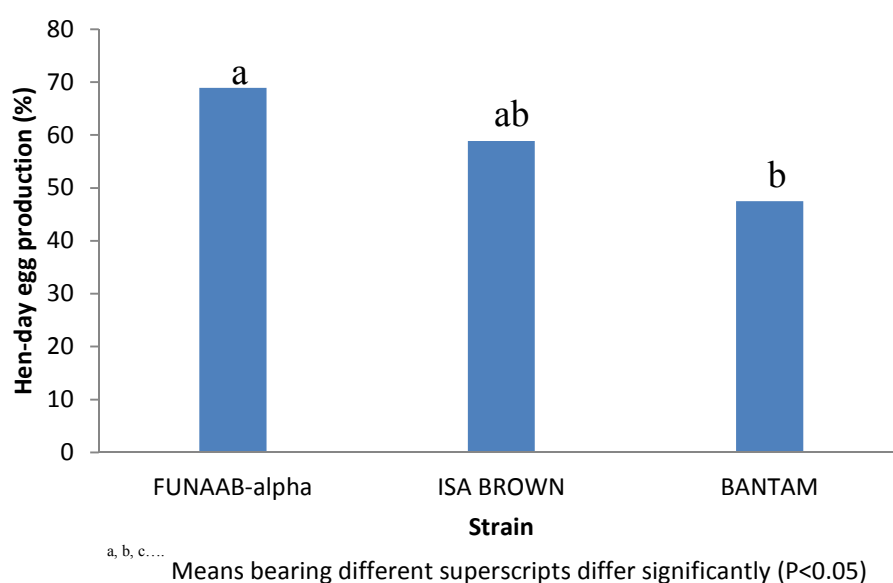


Figure 1: Effect of strain on hen-day egg production of chickens

Table 1: Effect of strain on egg quality of chickens

Parameter	FUNAAB - alpha	ISA brown	Bantam	± SEM
Egg weight (g)	60.66 ^b	65.53 ^a	40.93 ^c	0.67*
Egg Width (mm)	43.50 ^b	45.22 ^a	38.84 ^c	0.25*
Egg Height (mm)	57.15 ^a	56.78 ^a	49.03 ^b	0.39*
Egg Shape Index (%)	76.25 ^b	79.70 ^a	79.28 ^a	0.64*
Internal Quality				
Albumen Height (mm)	7.66 ^b	8.82 ^a	5.38 ^c	0.23*
Albumen Length (mm)	80.69 ^a	76.64 ^b	76.75 ^b	1.21*
Albumen Width (mm)	67.25 ^a	65.71 ^a	58.79 ^b	0.92*
Albumen Weight (g)	36.13 ^b	42.15 ^a	22.53 ^c	0.59*
Albumen Percent (%)	59.53 ^b	64.25 ^a	54.99 ^c	0.49*
Haugh Unit	86.60 ^b	91.97 ^a	79.16 ^c	1.29*
Yolk Weight (g)	17.44 ^a	15.75 ^b	12.32 ^c	0.30*
Yolk Percent (%)	28.77 ^b	24.09 ^c	30.16 ^a	0.41*
Shell quality				
Shell Weight(g)	7.08 ^b	7.63 ^a	6.08 ^c	0.20*
Shell Percent (%)	11.71 ^b	11.66 ^b	14.85 ^a	0.32*
Shell Thickness (mm)	0.17 ^b	0.18 ^b	0.24 ^a	0.03*
Shell Membrane Thickness (mm)	0.03 ^c	0.04 ^b	0.05 ^a	0.004*

a, b, c,... Means within the same row bearing different superscripts differ significantly (P<0.05);

SEM: standard error of mean; NS: not significant (P>0.05); *: Significant (P<0.05).

Table 2: Effect of strain on fertility and hatchability of chicken

Parameter (%)	FUNAAB - alpha	ISA brown	Bantam	±SEM
Fertility	35.00 ^a	19.75 ^b	33.00 ^a	6.59*
Hatchability	53.33 ^a	8.33 ^c	26.53 ^b	7.69***

a, b, c,... Means within the same row bearing different superscripts differ significantly (P<0.05);

SEM: standard error of mean; NS: not significant (P>0.05); *: Significant (P<0.05); **: Significant (P<0.01);

***: Significant (P<0.001).