Journal of Applied Biosciences 47: 3205– 3213

ISSN 1997–5902

Incidence of spur gene and effect on metric parameters in male and female Nigerian local chicken

Egena S.S.A *, Ijaiya A.T, Kolawole R and Ahmed M.A.
Department of Animal Production, School of Agriculture and Agricultural Technology, Federal University of Technology, Minna, Niger State, Nigeria.

*Corresponding author email: essa_may25@yahoo.com
Original Submitted In 7th July 2011. Published online at www.biosciences.elewa.org on November 29, 2011.

ABSTRACT

Objectives: The objective of this study was to investigate the incidence of spur gene and its effects on metric parameters in male and female Nigerian local chicken sampled in Niger state and add onto existing knowledge on the indigenous chickens.
Methodology and results: Seven hundred and fifty adult local chickens brought to the local market for sale were used in the experiment. Parameters measured were body weight, body length, body girth, wing length, shank length and thickness. Results shows that the calculated gene frequency was significantly (P<0.05) higher than the expected Mendelian frequency for dominant alleles. There were significant differences (P<0.05) between the male and females in all the parameters measured. Spurred (sl) male chickens were significantly (P<0.05) better in body length, wing length and shank length than spurred females and spurless males and females. Live body weight correlated (P<0.0001) with the linear body parameters measured.
Conclusion and application of results: It was concluded that the presence of spur gene (sl) in the Nigerian local chickens confers some advantages on the chickens expressing it. The results of this study will be useful to geneticists and animal scientists generally as it provides a basis for selection. Local farmers can now know that the presence of spur in chickens is a pointer that the birds will be heavier than those not having the appendage.
Key words: Spur, metric parameters, Nigerian local chickens.

INTRODUCTION

The poultry industry is one of the most important sectors of the Nigerian economy contributing substantially to the nation's Gross Domestic Product (GDP) (Ambali *et al.,* 2003). In 2005 the population was estimated to be about 190 million (Orajaka, 2005) comprising of 8.0 % exotic breeds and over 90 % indigenous species (Nwanta *et al.,* 2006). Native chickens play an important role as household food supply in rural areas of developing countries (Zaman *et al.,* 2004) and recently have been raised in semi-intensive systems with more efficient output per bird (Saadey *et al.,* 2008). The rural poultry is therefore a fast means of bridging the protein deficiency prevalent in most developing countries (Jibir and Usman, 2003). It is also a means of providing additional income to the generally resource-poor small holder farmers (Gueye, 2004), thereby helping to alleviate poverty.

The genetic resources of poultry in West Africa are mainly represented by domestic local chickens (*Gallus gallus domesticus*), guinea fowl (*Numida* *meleagris*) and ducks (*Cairina spp*) (Youssao *et al.,* 2010). These birds are bred mostly under traditional or extensive management with little or no serious recourse to healthcare. The Nigerian local chicken represents a great genetic resource which, unfortunately, has been left unexploited. The mass importation of exotic birds for commercial farming means that research focusing on local birds has been limited. Also, attempts at crossing the large exotic cockerels with small sized local hens with the intension of producing progenies with increased body weight in West Africa have largely failed (FAO 2004). The failure was attributed to lack of follow-up or adaptability to husbandry techniques. In addition, majority of the resulting females did not show good maternal abilities (incubation, hatching, chicks' follow-up).

There has been recent increase in research on the local chicken, which is necessary if its potential as a source of genetic variability is to be fully tapped. The aim of this work therefore was to investigate the incidence of spur gene and its effect on metric parameters in male and female Nigerian indigenous chicken

. .

Figure 1: Arrow showing spur on a male chicken

Figure 2: Arrow showing spurless male chicken

Figure 3: Arrow showing spurless female chicken

Figure 4: Arrow showing spurs on female chicken

MATERIALS AND METHODS

Study area: The study was carried out in Niger state, located in the Southern guinea savannah area of Nigeria around 30˚ 2' North and 11˚ 3' east. The state has a land area of 80,000 square kilometres with maximum altitude at its highest point of 1475m above sea level. The state experiences distinct dry and wet seasons with annual rainfall varying from 1100mm in the north to 1600mm in the south annually. The dry season lasts for 6 to 7 months (from October to April) in the northern part of the state, and, 4 to 5 months (from November to March) in the southern part. The maximum temperature does not exceed 39˚C and is experienced between March and June, while minimal temperature as low as 21˚C is usually experienced between December and January.

Data collection: Seven hundred and fifty (750) adult local chickens brought to the market for sale, were sampled in the three (3) administrative zones (A, B and C) of Niger state. The birds were randomly sampled at Bida, Lavun and Badeggi (representing zone A), Minna, Paikoro and Gwada (representing Zone B) and at Kontagora, Tegina and Rijau (representing zone C).The birds were classified on the basis of presence or absence of the spur condition.

Parameters measured: Body weight of individual birds was measured using a mechanical hanging balance of 2.5 kg with a precision of 20 g. The following metric measures were recorded using tape rule (cm): body length (BL), body girth (BG), wing length (WL) and shank length (SL). Shank thickness (ST) (mm) was determined using a pair of vernier calliper. The metric measurements were as described by Fayeye *et al.* (2006). The measurements were;

Body length: Distance from the tip of the beak, through the body trunk to the tail.

Body girth: The circumference of the breast region.

Wing length: Length of the wing from the scapula joints to the last digit of the wing.

Shank length: Length of the tarso-metatarsus from the hock joint to the metatarsal pad.

Shank thickness: Diameter of the tarso-metatarsus just below the spur.

The phenotypic frequencies were computed by direct count. The proportion (%) of individuals carrying the appendages was determined as follows:

Phenotypic frequency =

$$\frac{\text{Number of individuals having spur}}{\text{Total number of individuals sampled}} \times 100$$

Chi square analysis was employed to test the observed number of spurred fowls against the expected Mendelian values (25% and 75% respectively for spur incidence and spurlessness) while Hardy-Weinberg principle (Falconer, 1989) was used to estimate gene frequency as given below:

$$q = \sqrt{m} /t$$

Where:

q = frequency of recessive gene (sl).

m = number of indigenous chickens expressing spur trait (genotype sl/sl).

t = total number of local chicken sampled (all genotypes).

Data analysis: The statistical analysis was carried out using the General Linear Model (PROC GLM), PROC CORR and t-test procedures of SAS software (Statistical Analysis System, 2000). Means were separated by the method of Duncan (1955). Significance level was set at P<0.05. A linear model was adjusted to the data of body measurements and live weight. This model included the fixed effects of the genotype and the sex. The model of variance analysis is shown below:

$$Y_{ijk} = \mu + G_i + S_j + GS_{ij} + e_{ijk}$$

Where:

Y_{ij} = single body measurement.

μ = overall mean.

G_i = fixed effect of the genotype ($_i$ = spurred, spurless).

S_j = fixed effect of the sex ($_j$ = male, female).

GS_{ij} =interaction between the $_i^{th}$ genotype and the $_j^{th}$ sex.

e_{ijk} = random error

RESULTS

Gene and phenotypic frequency of spur gene (sl): The distribution and gene frequencies of spur (sl) and spurless (Sl^+/-) genes in Nigerian local chickens in Niger state is shown in Table 1. Spurred (sl) chickens in Niger state were predominant (595; 79.33 %) while spurless (Sl^+/-) birds were fewer (155; 20.67 %). Calculated gene frequencies were 0.89 for spur (sl) and 0.11 for spurlessness (Sl^+/-) alleles. Frequency of occurrence (79.33 %) and gene frequency (0.89) estimated for the recessive spur gene (sl) were significantly (P<0.05) different from the frequency of occurrence (20.67 %) and gene frequency (0.11) estimated for the dominant spurlessness gene ($Sl^+/-$).

Table1: Phenotypic and gene frequency of spur gene (sl) in Nigerian indigenous chicken in Niger state

Phenotype	Genotype	N	Obs.freq.	Exp.freq.	Cal.gene freq.	Exp.gene freq.
Spurred	sl/sl	595	79.33a	25	0.89a	0.25
Spurless	$Sl^+/-$	155	20.67b	75	0.11a	0.75
Total		750				

[ab]Values followed by different superscripts in the same column are significantly different (P<0.05)
N = Number; Obs.freq.=Observed phenotypic frequency; Exp.freq. = Expected phenotypic frequency; Cal.gene freq. = Calculated gene frequency; Exp.gene freq. Expected gene frequency

Effect of sex on metric parameters: Males had significantly (P<0.05) larger sizes compared to the females (Table 2). The difference between the mean live weight of male and female chickens was 160 g in favour of the males. The differences in mean body measurements also in favour of males were: BL (1.51 cm), BG (0.53 cm), WL (0.64 cm), SL (0.79 cm) and ST (0.07 mm). The most important differences were observed in the live weight and SL where sexual dimorphism accounted for 10.19 % of the live weight of the females and 7.57 % of the SL of the females.

Table 2: Effect of sex on metric parameters in Nigerian local chickens in Niger state

Parameter	Sex	N	Mean ± SEM	% Difference	LS
Body weight (Kg)	Male	543	$1.73{\pm}0.02^a$	10.19	*
	Female	207	$1.57{\pm}0.04^b$		
Body length (cm)	Male	543	$39.19{\pm}0.22^a$	4.01	*
	Female	207	$37.68{\pm}0.36^b$		
Body girth (cm)	Male	543	$25.45{\pm}0.11^a$	2.13	*
	Female	207	$24.92{\pm}0.18^b$		
Wing length (cm)	Male	543	$22.40{\pm}0.11^a$	2.94	*
	Female	207	$21.76{\pm}0.18^b$		
Shank length (cm)	Male	543	$11.23{\pm}0.17^a$	7.57	*
	Female	207	$10.44{\pm}0.28^b$		
Shank thickness (mm)	Male	543	$1.12{\pm}0.01^a$	6.67	*
	Female	207	$1.05{\pm}0.02^b$		

[ab]Means followed by different superscripts in the same column are significantly different (P<0.05)
N=Number; LS=Level of significance; SEM=Standard error mean.

Effect of spur gene (sl) on metric parameters of chickens: Spurred (sl) male local chickens were observed to have significantly higher (P<0.05) values than spurred females only in BL (39.32 cm), WL (22.46 cm) and SL (11.34 cm) (Table 3). In terms of BW, BG and ST, males were not significantly different from the females. However, spurred (sl) female chickens had significantly higher (P<0.05) values than spurless ($Sl^+/-$) males and females in all the parameters evaluated except for ST where spurred (sl) females were not significantly different when compared spurless ($Sl^+/-$) males. Generally, spurless ($Sl^+/-$) females performed poorly in all the parameters measured.

Correlation between body weight and metric parameters: All the parameters were significantly (P<0.0001) and positively correlated except for correlation between SL and ST (table 4). The correlation between BW and BL was highest (0.709) followed by that between BL and WL (0.696) and that between BW and WL (0.667). The lowest correlation (0.124) was between SL and ST.

Table 3: Genotype-sex interaction on body weight and body measurements of indigenous chickens in Niger state, Nigeria

Sex	N	Genotype	BW	BL	BG	WL	SL	ST
male	76	Sl^{+}/-	1.49±0.06[b]	38.38±0.47[c]	24.91±0.30[b]	22.05±0.29[d]	10.56±0.13[c]	1.04±0.02[bc]
	467	sl/sl	1.77±0.02[a]	39.32±0.25[a]	25.25±0.12[a]	22.46±0.11[a]	11.34±0.23[a]	1.13±0.01[a]
Female	79	Sl^{+}/-	1.33±0.02[c]	36.24±0.39[d]	23.91±0.27[c]	20.82±0.23[c]	10.13±0.15[d]	0.97±0.02[c]
	128	sl/sl	1.73±0.03[a]	38.56±0.35[b]	25.55±0.18[a]	22.34±0.20[b]	10.64±0.19[b]	1.10±0.02[ab]

[ab]Means followed by different superscripts alongthe same column are significantly different (P<0.05).
N = Number; BW = body weight; BL = body length; BG = body girth; WL = wing length; SL = shank length; ST = shank thickness.

Table 4: Correlation between body weight and metric parameters in indigenous chickens in Niger state, Nigeria

	BW	BL	BG	WL	SL	ST
BW	1					
BL	0.709**	1				
BG	0.488**	0.352**	1			
WL	0.667**	0.696**	0.516**	1		
SL	0.204**	0.213**	0.212**	0.200**	1	
ST	0.499**	0.419**	0.360**	0.406**	0.124ns	1

** Significant (P<0.0001); ns = not significant (P>0.05); BW = body weight; BG = body girth; SL = shank length; BL = body length; WL = wing length; ST = shank thickness.

DISCUSSION

Calculated spur gene frequency in indigenous chickens in Niger state is higher than the expected Mendelian frequency of 25 % and 0.25 gene frequency. The 79.33 % phenotypic frequency observed in this study is much higher than the 54 % spur incidence reported by Mancha *et al.* (2006) in northern region of Jos Plateau and the 37.15 % reported by Oguntunji and Ayorinde (2009) in a population of indigenous chicken in Oyo East, South West Nigeria. This is a pointer that there is a greater preponderance of spur gene in indigenous chickens in Niger state compared to Plateau and Oyo states. This is indicative of a high level of inbreeding in the population which has led to the entrenchment of the trait in the indigenous chicken.

Male chickens irrespective of genotype were significantly (P<0.05) heavier and had better (P<0.05) mean values for metric parameters than females. The same tendency was observed in local chickens in Benin republic (Godonou, 2002; Dossou, 2005; Youssao *et al.,* 2010). Oguntunji and Ayorinde (2009) however observed that males were non-significantly (P>0.05) better than females in South West Nigeria. This might be due to environmental influence and the fact that body weight could easily be prejudiced by the nutritional status, age and management of the birds at the time of weighing. The sexual dimorphism observed in all the parameters is however in consonance with earlier reports in the Nigerian local chicken (Fayeye *et al.,* 2006; Hassan and Abdullahi, 2006; Oguntunji and Ayorinde, 2009). Sexual dimorphism seems to be greater as the birds' attained adulthood. Youssao *et al.* (2010) reported similar occurrence in their study of *Gallus gallus* specie of savannah and forest ecotypes of Benin. This probably accounted for the larger dimorphism observed for shank length and shank thickness compared to body length, body girth and wing length. The average weight of Nigerian indigenous chickens were observed to be heavier than those of Benin republic (Youssao *et al.,* 2010) and those studied by Oguntunji and Ayorinde (2009) in Oyo East, South West Nigeria.

Spurred local chickens irrespective of sex had significantly (P<0.05) higher adult body weight and metric parameters than spurless ones. The observed result contradict the earlier reports of Oguntunji and Ayorinde (2009) who reported no significant (P>0.05) differences in live body weight and metric parameters. Spurred female chickens were also observed to be heavier, and had better body measurements than spurless males and females. This is an indication that the presence of spur gene confers certain advantages on chicken. Oguntunji and Ayorinde (2009) reported that spur gene moderately improves skeletal growth, muscling and meatiness of local chickens. It is possible that the gene also has a positive impact on feed efficiency/feed conversion and weight gain. The preponderance of spur in males could be because it is needed for defence especially when fighting for territorial control.

A great degree of correlation was observed between BW and the other metric parameters evaluated. This means that the traits could be selected for at the same time for possible improvement in the local chickens. Previous studies have reported appreciable degree of correlation between body weight and linear body measurements of animals (Ige *et al.,* 2006; Egena *et al.,* 2010).

CONCLUSION

The results of this study indicate that the presence of spur gene (sl) confers certain advantages in Nigerian local chickens as evidenced by the higher mean body weights and linear body measurements. Male chickens express the spur gene (sl) more frequently than the females, and the females expressing the gene performed better than spurless males and females. Body weight and other linear measurements in the Nigerian local chickens are highly and positively correlated. This means the traits could be selected for improvement simultaneously.

REFERENCE

Ambali AG, Abubakar MB, James TE, 2003. An assessment of poultry health problems in Maiduguri, Borno state, Nigeria. Tropical Veterinarian 21: 138-145.

Dossou F, 2005. Caractérisation phénotypique des types génétiques de populations locales de volailles de l'espèce *Gallus gallus* dans la Commune d'Abomey-Calavi. *Memoire de fin de formation a l'EPAC,* UAC, Abomey-Calavi. Pp: 49.

Duncan DB, 1955. Multiple ranges and multiple F. Tests. Biometric 11:1-42

Egena SSA, Garba H, Silas T, Musa TC, 2010. Effect of sex on linear body measurements of guinea pig (*Cavia porcellus*). Assumption University Journal of Technology 14 (1): 61-65.

Falconer DS, 1989. *Introduction to qualitative genetics*. 3rd Edition Longman scientific and technical Publishers, London, UK. 483pp.

FAO, 2004. Food and Agriculture Organization. Banques de données, FAOSTAT: Agriculture. Consulte le 27 Février 2004 à l'adresse: http://www.apps.fao.org/page/collections?subset=agriculture&language=FR.

Fayeye TR, Ayorinde KL, Ojo V, Adesina OM, 2006. Frequency and influence of some major genes on body weight and body size parameters of Nigerian local chickens. Livestock research for rural development 18 (3). http://www.cipav.org.co/lrrd/lrrd/18/3/faye18037.htm.

Godonou YD, 2002. Le système de production du poulet local des élevages suivis par le Programme d'Appui au Développement de l'Aviculture Villageoise (PADAV) dans la région de Ouate: production, commercialisation et possibilité d'amélioration. Theses Ingo. Agro. FSA. UAC. Benin. Pp: 87.

Guéye EF, 2004. Gender aspect in family poultry management systems in developing countries. http://www.fao.org/ag/againfo/themes/en/infpd/documents/papers/2004/12gender318.pdf. (Accessed 20th September, 2008).

Hassan WA. And Abdullahi I, 2006. Variation in body weight and comb size of the indigenous domestic fowls in North Western Nigeria. Proceedings of the 31st Annual Conference of the Nigerian Society for Animal Production.Calabar, 14th -16th March. Cross River State, Nigeria. Pp: 18-21.

Ige AO, Akinade JA, Ojedapo IO, Oladunjoye IO, Amao SR, Animasahun AO, 2006. Effect of sex on interrelationship between body weight and linear body measurements of commercial broilers in a derived savannah environment in Nigeria. Proceedings of the 11th Annual Conference of the Animal Science Association of Nigeria. 18th-21st September. Ibadan, Nigeria. Pp: 231-233.

Jibir M. and Usman AU, 2003. Duck production in the tropics. AgVet International 4: 10-12.

Mancha YP, Mbap ST, Abdul SD, 2006. Phenotypic characterization of local chickens in the northern region of Jos, Plateau. Tropical Journal of Animal Science 9 (12): 47-55

Nwanta JA, Umoh JU, Abdu PA, Ajogi I, Ali Balogun JK, 2006. Management of losses and Newcastle disease in rural poultry in Kaduna state, Nigeria. Nigerian Journal of Animal Production 33 (2): 274-285.

Oguntunji AO. and Ayorinde KL, 2009. The frequency and influence of the spur gene on six metric traits in the Nigeria local chicken. Nigeria Journal of Animal Production 36 (1): 20-27

Orajaka LJE, 2005. The role of local chicken in poultry production in Nigeria. Nigerian Veterinary Journal 26: 68-72.

Saadey S, Mekky A, Galal HIZ, Zein El-Dein A, 2008. Diallel crossing analysis for body weight and egg production traits of two native Egyptian exotic chicken breeds. International Journal of Poultry Science 7 (1): 64-71 http://scialert.net/pdfs/ijps/2008/64-71.pdf

SAS, 2000. Statistical Analysis Software. Guide for personal computers, Release 8.1 (TSIMO). SAS institute Inc. Cary North Carolina, USA

Youssao IAK, Tobada PC, Koutinhouin BG, Dahouda M, Idrissou ND, Bonou GA, Tougan UP, Ahounou S, Yapi-Gnaore V, Kayang B, Rognon X, Tixier-Boichard M, 2010. Phenotypic characterisation and molecular polymorphism of indigenous poultry populations of the species *Gallus gallus* of savannah and forest ecotypes of Benin. African Journal of Biotechnology 9 (3): 369-381. http://www.academicjournals.org/AJB

Zaman MA, Sorensen P, Howlider MAR, 2004. Egg production performances of a breed and three crossbreeds under scavenging system of management. Livestock Research for Rural Development 12 (1). http://www.lrrd.org/lrrd16/8/zama16060.htm