The frequency and influence of the spur gene on six metric traits in the Nigerian local Chicken

*A.O. Oguntunji and **K.L. Ayorinde

*Department of Animal Science and Fisheries Management, P. M. B. 284, Bowen University, Iwo, Osun State, Nigeria.

**Department Of Animal Production, University of Ilorin, Ilorin, Kwara State, Nigeria.

*abelmendez@yahoo.co.in

Abstract

A study was conducted in two local government areas of Oyo State, Nigeria, on adult, free-ranging indigenous chicken on the incidence and possible influence of the spur gene (sl) on body weight and five other metric traits: body length (BL), wing length (WL), shank length (SL), shank thickness (ST) and breast girth (BG) which are indicative of body size and growth. 386 (37.15%) of the 1039 sampled local fowls were spurred and the gene frequency was estimated to be 0.61. The calculated gene and genotype frequencies were significantly different ($P < 0.05$) from the expected values for a recessive gene where complete dominance is operating while sex analysis revealed highly significant ($P < 0.01$) incidence of the spur gene in males (70.73%). There was no significant ($P > 0.05$) genotype effect on any of the metric traits under consideration. It is demonstrated in this study that the incidence of spur gene (sl) seems to be sex-influenced, higher than expected but had no effect on the six metric traits considered.

Key words: Body measurements, indigenous chicken, sex-influenced, spur gene.

Introduction

Spur is one of the morphological traits observed in Nigerian local chicken. The trait is bilaterally expressed on the shank of both males and females but not in chicks. Kozelka (1933) reported the gene controlling the trait to be recessive to its wild allele for spurlessness and assigned symbols sl and Sl⁺ for incidence and absence of spur gene respectively.

Studies revealed other forms of spur expression such as double spur, a condition in

which extra spur on each shank was found almost equal in size with normal spur (Warren, 1946). Washburn and Smyth (1971) also reported an autosomal dominant condition resulting in bilateral extra spur (auxiliary) in both sexes whereby the auxiliary spur arises just above the normal ones.

Some investigators have reported the incidence and association of some morphological traits in Nigerian local chicken with metric traits such as body weight and body size parameters

(Ikeobi *et al.*, 1997; Fayeye *et al.*, 2006), semen characteristics and semen bacteria flora (Oguike *et al.*, 2000), haematological and serum biological indices (Ladokun *et al.*, 2008), egg production and hatchability (Ikeobi *et al.*, 1997; Nwachukwu *et al.*, 2006). Morphological traits having significant association with economic traits could serve as markers in selection and improvement programmes. Results from studies involving relationship of marker traits with metric traits would be a contribution to breeders by enhancing the predictability of animal selection programmes by reducing the amount of 'noise' inherent in statistical animal breeding through direct selection for genotype (Soller and Bechman, 1983).

Earlier report indicates higher but non-significant adult body weight of multiple spurred fowl over normal (Shoffner *et al.*, 1993). Nevertheless, there is a dearth of empirical report on incidence and association of spur gene with metric traits in Nigerian indigenous chickens. In view of the above, the aim of this study was to determine the incidence and association of the spur trait with body weight and five linear body measurements which are predictors of body size and growth in the Nigerian local chicken.

Materials and Methods

One thousand and thirty nine (1,039) scavenging adult local chickens comprising 491 males and 548 females were sampled in eight randomly selected villages in each of Atiba and Oyo East local government areas of Oyo State, Nigeria. The birds were classified on the basis of incidence or absence of spur condition and sex.

Live weights of individual birds were taken with a top loading scale while linear body measurements (BL, BG, WL and SL) were measured with tape rule (cm) except ST which

was measured with a pair of vernier caliper (mm) according to the method of Fayeye *et al.* (2006) as follows:

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

Body girth: The circumference of the breast region.

Wing length: Length of the wing from the scapula joint 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.

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:

$$q = m / t$$

Where

q = frequency of recessive gene (sl)

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

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

Data collected on body weight and linear body parameters of each phenotype were analyzed using the following fixed effect model:

$$Y_{ijk} = \mu + G_i + S_j + (GS)_{ij} + e_{ijk}$$

Where

Y_{ijk} = Single body measurement

μ = Overall mean

G_i = Main effect of genetic group (i = spurred, spurless)

S_j = Main effect of sex (j = male, female)

$(GS)_{ij}$ = Interaction between genetic group and sex

e_{ijk} = Random error

Results and Discussion

The distribution and gene frequencies of spur and spurless genes are shown in Table 1. Normal (spurless) were predominant (653; 62.85 %) while spurred birds were fewer with 386 (37.15 %). Gene frequencies were 0.61 and 0.39 for spur (sl) and spurlessness (Sl⁺) alleles respectively. It is evident from the data analysed that frequency of occurrence (37.15%) and gene frequency (0.61) estimated for recessive spur gene were higher and significantly ($P<0.01$) different from the expected Mendelian occurrence of 25% and 0.25 gene frequency. The higher than expected incidence of spur trait in this study is consistent with a recent report by Mancha *et al.* (2006) who reported significant higher 54.4% spur incidence in a population of Nigerian local chicken sampled in Jos Plateau. Besides, all sampled native fowls exhibited single spur on their metatarsals, none was found exhibiting duplicate, auxillary or multiple spurs; however, spur length was longer in cocks than in hens (data not included).

MCF (2006) reported that reports of series of experiments conducted in the first quarter of the last century showed that hereditary genes involved for this trait (spur) appear very complex

and they overlap those which seem recessive and others which would appear partially or completely dominant. Higher frequency of spur gene might be adduced to possible pleiotropic effect, linkage or interaction of this gene with one or combination of genes/block of gene enhancing fertility, hatchability, viability/fitness or resistance to fowl diseases, thereby indirectly conferring a better chance of survival or influence higher incidence of the trait in local fowls.

The observed and expected number of spurred and spurless fowls in Table 2 indicate that the incidence of spur gene (sl) was highly significant ($P<0.01$) in male (273, 70.73%) compared to female (113, 29.27%) in the sampled population. The observed number for each sex was statistically different ($P<0.01$) from the expected sex ratio (193:193). The prevalence of spur trait in males in this study agrees with Mancha *et al.* (2006); these authors reported expression of the gene (sl) in all the 675 (100%) local cocks sampled; constituting 86.65% of the sampled spurred indigenous birds (758) compared with 13.35% spurred hens (104). Hutt (1949) reported that there is an inconsistent expression of spur in the female and that spur

Table 1. The incidence and frequency of spur gene (sl) in Nigerian local chicken

Phenotype	Genotype	No. of birds	Obs. freq. %	Exp. freq. %	Cal. gene freq.	Exp. gene freq.
Spurred	sl/sl	386	37.15 ^a	25	0.61 ^a	0.25
Spurless	Sl ⁺ /-	653	62.85 ^b	75	0.39 ^b	0.75
Total		1039				

^{ab}Values with different superscripts in the same column are significantly different ($P<0.01$) Obs.(observed); Exp. (expected); Cal. (calculated); Freq. (frequency)

Spur gene in the Nigerian local chicken

Table 2. Sex distribution in spurred Nigerian local chicken

Sex	Observed No	Percentage %	Expected No
Male	273	70.73 ^a	193
Female	113	29.27 ^b	193
Total	386		386

^{ab}Percent incidence with different superscripts are significantly different ($P < 0.01$)

incidence was not common in female chicken but common in Mediterranean breeds such as White Leghorns. This was attributed to inhibition by female ovarian hormone despite the fact that a hen is carrying the gene. Campbell *et al.* (2003) corroborated this report that in normal laying hen, the female hormone (oestrogen) controls the absence of spurs on the legs. The high incidence (70.73%) of spur gene in male despite high number of females in the sampled population suggests possible sex-influence on its expression. Fairful and Gowe (1986) buttressed this assertion from the results of their diallel study that there might be some association of genetic effects for spur incidence with sex chromosome. Besides, *Somes* (1990) stated that metatarsal leg spur development is normally a characteristics of male birds and that the trait is partially sex-limited, being more evident in males than in females.

It is highly probable that the observed number of sampled spurred female in this study might not be reflecting the actual incidence mediated by heredity. It has been reported that the hen could express this trait without any genetic basis and hens with ovarian anomalies can then comprise a reduction or even a disappearance of any female hormonal secretion and subsequent development of spurs (MCF,

2006) thus lending credence to the review by *Hutt* (1949) that removal of ovary (resulting in cessation of secretion of female ovarian hormones) leads to the incidence of spur in all affected hens. It is apparent from these findings that incidence of spur gene is not only hereditary but also secondary morphological sexual characteristic that is sex-influenced and that sex hormones exert influence on its expression.

In all the metric traits considered, spurred local chicken had higher ($P > 0.05$) mean adult body weight (1.05kg); approximately 13% superior to normal (0.91kg) and also maintained non-significant ($P > 0.05$) higher mean values in all the linear body parameters (BL, BG, SI, ST, and WL) measured (Table 3). Higher ($P > 0.05$) numerical body weight obtained for spurred fowls relative to spurless counterparts in this study is similar to the finding reported by *Shoffner et al.* (1993) that lines of chicken expressing multiple spur were non-significantly heavier than their normals.

The marginal higher mean values recorded for spurred local fowls in linear body measurements considered above their normals are indicative of higher body weight; for previous studies had demonstrated an appreciable correlation between linear body parameters and

Table 3. Mean values ($\pm$ sem) of body measurement of spurred and spurless fowls

Body measurement	Phenotype		¹ % difference
	Spurred (sl/sl)	Spurless (Sl ⁺ /-)	
Body weight (kg)	1.05 $\pm$ 0.09	0.91 $\pm$ 0.81	13.00 NS
Body length (cm)	36.56 $\pm$ 0.67	34.28 $\pm$ 0.83	6.24 NS
Body girth (cm)	21.17 $\pm$ 3.33	20.58 $\pm$ 2.45	2.79 NS
Shank length (cm)	4.78 $\pm$ 2.95	4.71 $\pm$ 3.33	1.47 NS
Shank thickness (mm)	19.84 $\pm$ 1.23	19.14 $\pm$ 2.01	3.53 NS
Wing length (cm)	18.69 $\pm$ 2.15	18.52 $\pm$ 1.53	0.91 NS

¹Percentage superiority of spurred fowls over spurless
NS – Non-significant

Table 4: Genotype-sex interaction on body measurements of spurred and spurless Nigerian local chicken.

Metric Trait	Sex					
	Spurred	Male spurless	¹ % diff.	Spurred	Female Spurless	¹ % diff.
Body weight (kg)	1.13 $\pm$ 0.10	1.00 $\pm$ 2.31	11.55	0.94 $\pm$ 0.05	0.88 $\pm$ 1.33	6.40
Body girth (cm)	21.53 $\pm$ 3.66	20.90 $\pm$ 1.11	3.00	20.08 $\pm$ 3.78	20.26 $\pm$ 3.31	1.00
Shank length (cm)	5.67 $\pm$ 0.68	4.68 $\pm$ 1.99	17.50	3.89 $\pm$ 1.89	4.26 $\pm$ 1.01	8.69
Shank thickness (mm)	20.80 $\pm$ 0.34	19.91 $\pm$ 0.42	4.28	18.75 $\pm$ 0.35	18.35 $\pm$ 0.16	2.13
Wing length (cm)	20.08 $\pm$ 3.22	19.79 $\pm$ 2.53	5.00	17.29 $\pm$ 8.64	17.24 $\pm$ 4.00	2.30

¹Percentage difference between sexes of spurred and spurless fowls

liveweight of animal (Ige *et al.*, 2006; Okon *et al.*, 1997; Adeniji and Ayorinde, 1990). Brown *et al.* (1973) also submitted that body measurements in addition to body weight give a more complete description of an animal than the conventional method of weighing and grading. Genotypic effect on body measurements as influenced by sex is presented in Table 4. In all the measurements taken, there was no significant

($P>0.05$) genotype-sex interaction effect on all the metric traits investigated in this study. However, males expressing spur gene (sl) were numerically ($P>0.05$) superior to their normals while spurred females had non significant ($P>0.05$) higher mean values in BW, ST and WL. The higher ($P>0.05$) mean values in the quantitative traits by spurred local cocks and hens, most especially in mean adult live weight

relative to their normals suggest that spur gene (sl) moderately improves the skeletal growth, muscling and meatiness of local chicken. The superiority of normal female over spurred female fowls in BL, BG, and SL may probably account for low percentage difference (6.40%) in adult body weight compared to 11.55% in their male counterparts.

One possibility for higher mean values in the of fowls expressing spur gene (sl) with respect to the quantitative traits considered might be attributed to the fact that this gene plays a contributory role through multiple (pleiotropic) action or linkage with block of genes associated with certain physiological / metabolic pathways enhancing one or combination of growth rate parameters (feed conversion ratio, weight gain and feed efficiency) thereby indirectly improving growth and body weight of indigenous spurred chicken.

Besides, males irrespective of genotype had non significant ($P>0.05$) higher mean values in bodyweight and other body size parameters considered in this study than their female counterparts (Table 5). The marginal ($P>0.05$)

higher mean values obtained for male above female in all body measurements is in consonance with already established fact that sexual dimorphism exists in Nigerian local chicken in respect of adult body weight (Fayeye *et al.*, 2006; Hassan and Abdullahi, 2006).

Conclusion

It is apparent in this study that spur gene (sl) is expressed in both sexes of Nigerian local chicken. The gene seems to be recessive and its highly significant incidence in male suggests possible sex-influence on its expression. The numerically higher mean adult live weight of spurred (male and female) local chicken indicates that the gene has marginal effect on this trait; therefore it could not be employed as a marker in selection and improvement of meatiness of Nigerian indigenous chicken. Considering higher incidence than expected and non-hereditary factors influencing its incidence, further studies in controlled experiments are needed to elucidate the inheritance and actions of the spur gene in Nigerian local chicken.

Table 5: Sex influence on some metric traits in Nigerian local chicken

Body Measurement	Male	Female	% difference
Body weight (kg)	1.06±2.2	0.90±3.00	15.00
Body length (cm)	36.82±0.50	34.02±1.533	7.60
Body girth (cm)	21.22±0.50	20.15±0.85	5.00
Shank length (cm)	5.18±3.20	4.08±1.56	21.24
Shank thickness (mm)	20.42±2.33 ^a	18.52±0.37 ^b	9.30
Wing length (cm)	19.94±1.41	17.27±1.27	13.40

Mean values in the same row with different superscripts are significantly different ($P<0.05$) ¹Percentage superiority of male over female.

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(Received 10th July, 2008 : Accepted 8th January, 2009).