Expression of Spur Gene in the Nigerian Indigenous Chickens in the Guinea Savannah Region of Nigeria: Phenotypic Effects.

Ukwu, H. O.[1*], Tyo, T. T.[1] and Kuusu, D. J.[2]

[1] *Department of Animal Breeding and Physiology, College of Animal Science, University of Agriculture Makurdi, P.M.B. 2373 Makurdi, Benue State, 234 Nigeria.*

[2] *Federal Department of Animal Husbandry Services, Federal Ministry of Agriculture and Rural Development, P.M.B. 135 Garki Abuja, Nigeria.*

[*] **Corresponding author:** ukwuhenry@gmail.com

Abstract

This study was designed to investigate the expression of spur gene and its effects on body weight and body linear measurements of Nigerian indigenous chickens in Benue state, Nigeria. Four hundred (400) mature indigenous chickens were used for this study. Data were collected on body weight using weighing balance with accuracy of 0.1 Kg; linear body measurements (shank length, thigh length, body girth, toe length) were taken using a measuring tape, while shank thickness was measured using Vernier Calipers. Data were analyzed using Statistical Package for the Social Sciences (SPSS) version 20. Results of this study suggest that the calculated allele frequency of spur gene (0.808) in the indigenous chicken was significantly (P< 0.05) higher than the expected Mendelian frequency of 0.25. Nigerian indigenous chicken cocks recorded significantly higher means (P< 0.05) in terms of body weight and linear body measurements when compared to hens. Results also suggest that spurred cocks were better (P< 0.05) than spurless cocks and spurred hens in terms of body weight, shank length, thigh length, body girth, toe length, and shank thickness. Spurred hens were significantly (P< 0.05) better than spurless hens in terms of shank length, thigh length, and shank thickness. Correlations between body weight and linear body measurements were highly positive and significant (P< 0.01). Results of this study suggest that the presence of spur gene in a chicken population could have pronounced positive effect on body weight and linear body measurements of Nigerian native chickens in the guinea savannah region.

Keywords: Body weight, Correlation, Indigenous chicken, Spur gene, Trait.

Expression du Gène Spur chez les poulets Indigènes Nigérians dans la Région de la Savane Guinéenne du Nigéria : Effets Phénotypiques.

Résumé

Cette étude a été conçue pour étudier l'expression du gène spur et ses effets sur le poids corporel et les mesures linéaires corporelles de poulets indigènes nigérians dans l'État de Benue, au Nigéria. Quatre cents (400) poulets indigènes matures ont été utilisés pour cette étude. Les données ont été recueillies sur le poids corporel à l'aide d'une balance avec une précision de 0,1 kg ; les mesures corporelles linéaires (longueur de la tige, longueur de la cuisse, circonférence du corps, longueur des orteils) ont été prises à l'aide d'un ruban à mesurer, tandis que l'épaisseur de la tige a été mesurée à l'aide de pieds à coulisse. Les données ont été analysées à l'aide du package statistique pour les sciences sociales (SPSS) version 20. Les résultats de cette étude suggèrent que la fréquence allélique calculée du gène spur (0,808) chez le poulet indigène est significativement (P < 0,05) supérieure à la fréquence mendélienne attendue de 0,25. Les coqs de poulet indigènes nigérians ont enregistré des moyennes significativement plus élevées (P

<0,05) en termes de poids corporel et de mesures corporelles linéaires par rapport aux poules. Les résultats suggèrent également que les coqs éperonnés étaient meilleurs (P < 0,05) que les coqs sans spur et les poules éperonnées en termes de poids corporel, longueur de la tige, longueur de la cuisse, circonférence du corps, longueur des orteils et épaisseur de la tige. Les poules éperonnées étaient significativement (P < 0,05) meilleures que les poules sans spur en termes de longueur de tige, de longueur de cuisse et d'épaisseur de tige. Les corrélations entre le poids corporel et les mesures corporelles linéaires étaient hautement positives et significatives (P < 0,01). Les résultats de cette étude suggèrent que la présence du gène spur dans une population de poulets pourrait avoir un effet positif prononcé sur le poids corporel et les mesures corporelles linéaires des poulets indigènes nigérians dans la région de la savane guinéenne.

Mots-clés : Poids corporel, Corrélation, Poulet indigène, Gène Spur, Trait.

Introduction

Nigerian indigenous chickens, popularly called the native chickens, are found in different parts of the country, where they are kept by rural farmers. The indigenous chickens found in Nigerian environment are generally small in body size and have evolved over time. Their exposure to extreme or harsh weather conditions, diseases and parasites partly contribute to their poor performance as evidenced by their small mature body weight and small egg size. The indigenous chicken population in Nigeria needs to be exploited for the presence of heritable variants that could be integrated into breeding programmes aimed at genetic improvement of the native chicken population. The need to improve the productivity of Nigerian indigenous chickens has also been reported by Adebambo, (2005). Nigerian indigenous chickens found in Benue State have been described as Tiv ecotype chickens due to their ecological location (Gwaza, 2012). Native chickens in Benue State, usually kept by rural farmers, can be found on free range in their ecological niche, which is guinea savannah region of the middle belt of Nigeria. Over the years, the native chicken ecotype found in the guinea savannah region of Benue State may have adapted to the local environmental condition.

Spur is a morphological character found on the shank of some chickens. In adult chickens, it is an elongated conical structure consisting of a bony core surrounded by soft spongy tissue and covered on the outside by a cornified layer (Hutt, 2003). The phenotypic and genotypic parameters of the presence of spur and its length in White Leghorn hens has been reported (Fairfull and Gowe, 1986). According to that report, the presence of spur and its length in White Leghorns are characters with relatively high additive genetic effects. Fairfull and Gowe (1986) therefore opined that some of the genes controlling the incidence of spur could be on the sex chromosomes. Dang *et al*. (2018) investigated the phenotypic characteristics and productivity of multiple spur chickens in Vietnam and reported that the presence of multiple spurs (4 – 6 spurs on both shanks) is associated with relatively low growth in comparison with other native chicken breeds in Vietnam. Dang *et al*. (2018) further reported that Vietnam native chickens with multiple spurs had diverse phenotypic characteristics that are similar with those of other native chicken breeds, but had low egg production and high egg hatchability when compared with other Vietnam native chicken breeds. The phenotypic effect of spur on metric characters in Nigerian unimproved native chickens in two ecological niches in Nigeria has been reported by some researchers (Egena *et al*., 2011; Oguntunji and Ayorinde, 2009; Mancha *et al*., 2006) with varied results. First, Oguntunji and Ayorinde (2009) reported that the incidence of spur is sex-influenced, higher than expected in

the population, but had no effect on body weight, body length, body girth, shank length, shank thickness and wing length. Second, Egena *et al*. (2011) reported that the presence of spur in chickens is a pointer that the birds will be heavier than those not having the appendage. There is a need to explore the occurrence of spur and its effect on body weight and linear body measurements of Nigerian indigenous chicken populations found in other ecological locations in Nigeria. This study, therefore, was designed to investigate the expression of spur gene and its effects on body weight and linear body measurements of Nigerian unimproved native chicken ecotype found in guinea savannah region of Benue State, Nigeria.

Materials and Methods

Location of Study

This research was conducted in selected Local Government Areas in Benue State, Nigeria. Benue State lies within the lower river Benue trough in the middle belt region of Nigeria. Its geographic coordinates are longitude 7° 47′ and 10° 0 ′ East; Latitude 6° 25 ′ and 8° 8 ′ North. The area is characterized by a period of dry season from October to March, and a period of rainy season from April to September. Annual rainfall ranges from 973mm to 1324mm.

Data Collection

Four hundred (400) mature male and female indigenous chickens of Nigeria in the guinea savannah region of Benue state were sampled during this study. The birds were managed by rural farmers under free-range system. Data were collected from six (6) Local Government Areas (Makurdi, Adikpo, Naka, Katsina-Ala, Otukpo and Gboko) in Benue State using the simple random sampling method. Sampling of birds was carried out on the basis of sex, and presence or absence of spur on the shank. Data were collected on body weight of individual birds using weighing balance with accuracy of 0.1 Kg. The following body linear measurements (in Cm) were recorded using a measuring tape: shank length (SL), thigh length (TL), body girth (BG), toe length (ToeL). Shank thickness (ST) was measured using Vernier calipers. The metric traits were recorded as described by Fayeye *et al*. (2006) as shown below:

Shank length*:* length of Tarso-metatarsus from the hock joint to the metatarsal pad,

Body girth*:* the circumference of the breast,

Toe length*:* length of the third toe measured from the metatarsal fold to the last phalange of the toe,

Shank thickness*:* diameter of the tarso-metatarsus just below the spur,

Thigh length: length between the hock joint and the pelvic joint (Molenaar *et al*., 2008).

The phenotypic frequencies were computed using the expression below:

$$Phenotypic\ frequency = \frac{number\ of\ individuals\ with\ spur}{total\ number\ of\ birds\ sampled} \times \frac{100}{1}$$

Data Analysis

Chi-square test was used to analyze the observed number of spurred birds against the expected Mendelian ratio of 1:3 (25%:75%) for presence or absence of spur, respectively. The estimates of gene frequencies were calculated based on Hardy-Weinberg Principle (Falconer and Mackay, 1996) as given below:

$$\mathbf{q} = \sqrt{\frac{m}{t}}$$

where:

q= frequency of recessive gene (sl)

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

t= total number of local chickens sampled

Data on body weight and body linear measurements were analyzed using the General Linear Model (GLM), Pearson's Product Moment Correlation and t-test procedures of Statistical Package for the Social Sciences

(SPSS) Version 20. The following linear model was used:

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

Where: Y_{ijk} = single body measurement
μ= overall mean
G_i= fixed effect of genotype (i= spurred, spurless)
S_j= fixed effect of sex (j= male, female)
$(GS)_{ij}$= effect of genotype-sex interaction
ε_{ijk}= random error

Results and Discussion

Percentage Expression and Frequency of spur gene in the Nigerian indigenous chicken ecotype in Benue state

The percentage expression of spur in the Nigerian native chickens in six Local Government Areas of Benue State is shown in Table 1. This study revealed that the proportion of cocks that expressed the spurred condition was high in Makurdi (71%), Gboko (63.33%), and Adikpo (60%). The proportion of cocks with spur was higher than the proportion of cocks without spur in all the study area. There were more spurless hens than spurred hens in Naka (58.33%), Otukpo (46.67%), Gboko (25%) and Makurdi (15%) areas. However, there were more spurred hens than spurless hens in Adikpo (28.33%) and Katsina-Ala (25%) areas. This study therefore revealed that the proportion of spurred native chickens, irrespective of sex, in the study area was 261 (65.25%), while that of spurless native chickens was 139 (34.75%). There were more spurred native chickens than spurless native chickens in the study area.

Table 1: Percentage expression of spur gene in the Nigerian native chickens in six Local Government Areas in Benue state

*LGA	N	Males		Females	
		Spurred (%)	Spurless (%)	Spurred (%)	Spurless (%)
Makurdi	100	71.00	7.00	7.00	15.00
Adikpo	60	60.00	6.67	28.33	5.00
Naka	60	16.67	13.33	11.67	58.33
Katsina-Ala	60	50.00	5.00	25.00	20.00
Otukpo	60	23.33	13.33	16.67	46.67
Gboko	60	63.33	1.67	10.00	25.00
Total	**400**	**49.75**	**7.75**	**15.50**	**27.00**

***n = sample size; LGA = Local Government Area.**

The frequency of spur gene in the Nigerian native chickens in Benue State is shown in Table 2. Calculated gene frequency of spur (sl) was significantly ($P< 0.05$) higher (0.808) than that of spurlessness (0.192) in native chickens in the study area. Calculated allele frequency of spur (sl) observed in this study was higher than the expected Mendelian frequency of 0.25. The phenotypic frequency, 65.25% observed in this study was higher than 54.4% spur incidence reported by Mancha *et al*. (2006) for a population of Nigerian indigenous chickens in Jos, Plateau state, and also greater than 37.15% reported by Oguntunji and Ayorinde (2009) for a population of Nigerian indigenous chickens in two Local Government Areas of Oyo State. However, the observed phenotypic frequency in this study was lower than the value 79.33% reported by Egena *et al*. (2011) for Nigerian indigenous chickens in three administrative zones in Niger state.

Table 2: Phenotypic and gene frequencies of spur (sl) gene in the Nigerian native chickens in Benue state.

Phenotype	Genotype	N	Obs. ratio (%)	Expected ratio	Observed gene freq.	Expected gene freq.
Spurred	sl/sl	261	65.25[a]	1	0.808[a]	0.25
Spurless	Sl^{+}/-	139	34.75[b]	3	0.192[b]	0.75
Total		400	100		1.00	1.00

N= number of observation; Obs. ratio = observed phenotypic ratio; ab = values with different superscript in the same column are significantly different (P< 0.05)

Effect of sex on body weight and linear body measurements

Body weight and linear body measurements of Nigerian native chicken males were significantly (P< 0.05) higher than that of their female counterparts (Table 3) in the study area. Results are similar to the reports of Egena *et al*., 2011, Momoh and Kershima (2008) for Nigerian indigenous chickens, and Dossou (2005), Youssaou *et al*. (2010) for indigenous chickens in Benin republic. However, some researchers (Fayeye *et al*., 2006; Oguntunji and Ayorinde, 2009) reported that Nigerian indigenous chicken males had non-significantly (P> 0.05) higher body weight and body linear measurements than their female counterparts. The observed differences in body weight and body linear measurements by different authors could be attributed to age of birds, nutritional and health status of birds at the time of sampling. In this study, sexual dimorphism accounted for 27.61%, 23.42%, 20.15%, 10.45%, 18.10% and 20.14% differences in body weight, shank length, thigh length, body girth, toe length and shank thickness, respectively. This result suggests that sexual dimorphism has pronounced effect on body weight and body linear measurements of the native chickens since male chickens performed better than their female counterparts in terms of body weight and body linear measurements.

Table 3: Effect of sex on body weight and some linear body measurements of the Nigerian native chickens in Benue state.

Parameters	Mean±SEM		Differences %
	Cocks	Hens	
No. of obs.	228	172	
BW (kg)	1.63±0.03[a]	1.18±0.02[b]	27.61
SL (cm)	10.63±0.08[a]	8.14±0.07[b]	23.42
TL(cm)	15.53±0.11[a]	12.40±0.10[b]	20.15
BG(cm)	31.40±0.19[a]	28.12±0.21[b]	10.45
ToeL(cm)	5.58±0.04[a]	4.57±0.05[b]	18.10
ST (cm)	1.39±0.01[a]	1.11±0.01[b]	20.14

ab= means in the same row with different superscript are significantly different (P< 0.01), SEM= standard error of mean, BW= body weight, SL= shank length, TL= thigh length, BG= body girth, ToeL= toe length, ST= shank thickness, No. of obs= number of observation

Effect of spur gene on body weight and linear body measurements

The effects of spur gene on body weight and linear body measurements are shown in Table 4. Spurred native chickens irrespective of sex had significantly (P< 0.05) higher body weight, shank length, thigh length, body girth, toe length and shank thickness than spurless native chickens in the study area. This observation agrees with the report of Egena *et al*. (2011) but contradicts the

result of Oguntunji and Ayorinde (2009) who reported non-significant (P> 0.05) higher mean values for body weight and linear body parameters of spurred native chickens over spurless native chickens of Nigeria. The higher performance of spurred native chickens over their spurless counterparts observed in this study, irrespective of sex, could suggest that the presence of spur gene in a chicken may have a pronounced positive influence on its body weight and body linear measurements. This is evidenced by higher body weight and body linear measurements of spurred chickens over their spurless counterparts as reported by several researchers (Mancha *et al*., 2006; Oguntunji and Ayorinde, 2009; Egena *et al*., 2011) who carried out similar study on indigenous chickens found in different ecological zones in Nigeria. Thus, the presence of spur on a native chicken could be used as an index to selection for higher body weight for the improvement of the Nigerian native chickens.

Table 4: Effect of spur gene on body weight and body linear measurements of the Nigerian native chickens in Benue state.

Parameters	Mean±SEM		Difference (%)
	Spurred chickens	Spurless chickens	
N	261	139	
BW (kg)	1.60±0.02[a]	1.12±0.02[b]	30.00
SL (cm)	10.20±0.09[a]	8.36±0.11[b]	18.04
TL(cm)	15.06±0.12[a]	12.54±0.14[b]	16.73
BG(cm)	31.18±0.18[a]	27.77±0.24[b]	10.94
Toe L(cm)	5.39±0.05[a]	4.68±0.06[b]	13.17
ST (cm)	1.35±0.01[a]	1.12±0.01[b]	17.04

ab= means in the same row with different superscript are significantly different (P< 0.01), SEM= standard error of mean, BW= body weight, SL= shank length, TL= thigh length, BG= body girth, ToeL= toe length, ST= shank thickness, N= genotype number

Effect of genotype and sex interaction on body weight and body linear measurements of the Nigerian native chickens in guinea savannah area of Benue state

The effects of genotype and sex interaction on body weight and linear body measurements are presented in Table 5. Genotype and sex interaction had significant (P< 0.05) effect on body weight and body linear measurements of the Nigerian native chickens in the guinea savannah region of Benue state. Spurred native chicken cocks were superior (P< 0.05) to spurless cocks and spurred hens in terms of body weight, shank length, thigh length, body girth, toe length and shank thickness. These results are in contrast to the reports of Oguntunji and Ayorinde (2009) who reported that incidence of spur was sex-influenced and had no effect on body weight, body length, body girth, shank length, shank thickness and wing length. In addition, spurred native chicken hens recorded significantly (P< 0.05) higher means for body weight, body girth and shank thickness than their spurless counterparts. There were no significant differences (P> 0.05) in shank length, thigh length and toe length of spurred hens and spurless hens.

Table 5: Effect of Genotype-Sex interaction on body weight and linear body measurements of the Nigerian native chickens in Benue state

Parameters\ Genotypes	Spurred		Spurless	
	Cock	Hen	Cock	Hen
No. of obs.	198	63	30	109
BW	1.70±0.02 [a]	1.28±0.03 [b]	1.14±0.05[c]	1.12±0.03[c]
SL	10.80±0.07 [a]	8.31±0.11 [b]	9.50±0.26[c]	8.05±0.10 [b]
TL	15.77±0.11 [a]	12.82±0.15 [b]	13.93±0.33[c]	12.16±0.13 [b]
BG	31.80±0.20 [a]	29.23±0.29 [b]	28.80±0.52 [b]	27.48±0.27[c]
ToeL	5.63±0.05 [a]	4.63±0.08 [b]	5.20±0.10[c]	4.53±0.06 [b]
ST	1.41±0.01 [a]	1.15±0.02 [bc]	1.21±0.03 [b]	1.10±0.01[c]

[abc]means in the same row with different superscripts are significantly different (P< 0.05), BW= body weight, SL= shank length, TL= thigh length, BG= body girth, ToeL= toe length, ST= shank thickness; SEM= standard error of mean, No. of obs= number of observations

Correlations between body weight and linear body measurements

The correlations between body weight and body linear measurements (shank length, thigh length, body girth, toe length and shank thickness) were highly positive and significant (P< 0.05) (Table 6). This implies that a strong linear relationship exist between body weight and body linear measurements of the native chickens. Thus, selection for high body linear measurements will result to an improvement in body weight of the native chickens. This result corroborates the reports of Momoh and Kershima (2008), Yahaya *et al*. (2012), Alabi *et al*. (2012) and Ukwu *et al*. (2014) that high positive correlation exists between body weight and linear body measurements of chickens.

Table 6: Correlations between body weight and body linear measurements of the Nigerian native chickens in Benue state

Parameters	BW	SL	TL	BG	ToeL	T
BW	1					
SL	0.740**	1				
TL	0.771**	0.903**	1			
BG	0.745**	0.625**	0.653**	1		
Toel	0.680**	0.781**	0.780**	0.576**	1	
ST	0.799**	0.773**	0.796**	0.646**	0.679**	1

****Correlation is significant at the 0.01 level. BW= body weight, SL= shank length, TL= thigh length, BG= body girth, ToeL= toe length, ST= shank thickness**

Conclusion

This study revealed that the proportion of the Nigerian native chicken cocks with spur were higher than the proportion of cocks without spur in all the study area. It could be observed from this study that the Nigerian native chicken cocks with spur had better body weight than native cocks without spur. In addition, the native chicken hens with spur also had better body weight than native hens without spur. Therefore, the presence of spur on the shank of the Nigerian native chicken could be an indication that the chicken will be heavy. There exist highly positive correlations between body weight and linear body

measurements of the Nigerian native chickens. Therefore, the presence of spur in the native chickens could be exploited as a morphological marker in a selection programme for the improvement of body weight of the Nigerian indigenous chickens.

References

Adebambo, O. A. 2005. Indigenous Poultry Breeds genetic improvement from meat and eggs. Proceedings of the 1st International poultry summit, Feb. 20 – 25, Ota, Ogun State, Pp 1 – 8.

Alabi, O. J., Ngambi, J. W., Norris, D. and Egena, S. S. A. 2012. Comparative study of three indigenous chicken breeds of South Africa: body weight and linear body measurements. Agric. J., 7(3): 220 – 225.

Dang, T. N., Han, Q. H. and Nguyen, H. N. (2018). Phenotypic characteristics and productivity of multiple spur chickens. Journal of Animal Husbandry Science & Technics, No. 235, 21 – 26.

Dossou, F. 2005. Caractérisation phénotypique des types génétiques de population locales de volailles de lespèce Gallus gallus dans la commune d'Abomey-Calavi. Memoire de fin de formation a I'EPAC, UAC, Abomey-Calavi., Pp 49.

Egena, S. S. A., Ijaiya, A. T., Kolawole, R. and Ahmed, M. A. 2011. Incidence of Spur gene and effect on metric parameters in male and female Nigerian local chickens. J. Applied Biosciences, 47: 3205 – 3213.

Falconer, D. S. and Mackay, T. F. C. 1996. Introduction to Quanitative Genetics, 4th Edn. Longman Group Ltd.

Fayeye, T. R., Ayrinde, K. L, Ojo,V. and Adesina, O. M. 2006. Frequency and influence of some major genes on body weight and body size parameters of Nigerian local chickens. Livestock Research for Rural Dev., 18(3).

Gwaza, D. S. 2012. Genetic study of the Fulani and the Tiv local chicken ecotypes in the Southern Guinea Savannah of Nigeria. Ph.D. thesis submitted to the Department of Animal Breeding and Physiology, University of Agriculture Makurdi, Benue state.

Hutt, F. B. 2003. Genetics of the Fowl: The Classic Guide to Chicken Breeding and Chicken Genetics. Pub: Norton Creek Press.

Mancha, Y. P., Mbap, S. T., Abdul, S. D. 2006. Phenotypic characterization of local chickens in the Northern region of Jos, Plateau. Tropical J. Animal Sci., 9(12): 47 – 55.

Molenaar, R. Reijrinke, I. A. M., Meijerhof, R. and Van Den Brand, H. 2008. Relationship between hatchling length and weight of later production performance of broilers. World's Poultry Sci. J., 64(4): 599 – 603.

Momoh, O. M. and Kershima, D. E. 2008. Linear body measurements as predictors of body weight in Nigerian local chickens. Asset Series A., 8(2): 206 – 212.

Oguntunji, A. O. and Ayorinde, K. L. 2009. The frequency and influence of the spur gene on six metric traits in the Nigerian local chickens. Nig. J. Anim. Prod., 36(1): 20 – 27.

Ukwu, H. O., Okoro, V. M. O. and Nosike, R. J. 2014. Statistical Modelling of Body Weight and Linear Body Measurements in Nigerian Indigenous Chickens. IOSR Journal of Agric. and Vet. Sci., 1(5): 27 – 30.

Yahaya, H. K., Ibrahim, H. and Abdusalam, S. 2012. Correlation between body weight and body conformation of two broiler strains under the same dietary treatment. Int. J. Anim. and Vet. Adv., 4(3): 181 – 183.

Youssao, I. A. k., Tobada, P. C., Koutinhouin, B. G., Dahouda, M., Idrissou, N. D., Bonou, G. A., Tougan, U. P., Ahounou, S. Yapi-Gnaore,V. Kayang, B. Rognon, X., Tixier-Boichard, M. 2010. Phenotypic Characterization and molecular polymorphism of indigenous poultry

populations of the species *Gallus gallus* of Savannah and forest ecotypes of Benin. African J. Biotech., 9(3): 369 – 381.

Date received: 1st July, 2022
Date accepted: 20th December, 2022.