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Qualitative Traits Variation in Indigenous Chickens of Bekwarra, Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Author SID designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors EOO and DMO managed the analyses of the study. Author EBTBO managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

A study was conducted to investigate the distribution and gene frequency of some qualitative traits of indigenous chickens of Bekwarra, Southern, Nigeria. One thousand and sixty adult scavenging chickens were sampled from 208 rural households. Data obtained were subjected to chi- square test and gene frequencies were calculated using both the Hardy – Weinberg equilibrium and the Mendelian principle of inheritance. The most predominant skin colour, eye colour, comb type, feather distribution, foot feathering and plumage colour were white (75.85%), black (44.72%), single (88.49%), fully feathered (93.21%), smooth feet (73.59%) and black (39.43%), respectively. There were highly significant ($P<0.001$) differences between and within sexes for comb type, feather distribution, foot feathering and plumage colour. The dominant genes for rose comb, pea comb, naked neck and feathered feet segregated at low frequencies (0.083; 0.094; 0.035; and 0.142). The dominant alleles segregated at lower frequency probably due to social preference, natural selection, adaptation and interaction of genes. The indigenous chickens constitute a store of useful genetic materials that are well adapted to their environment and should be improved for better productivity.

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1. INTRODUCTION

The indigenous chickens constitute 80% of the 120 million poultry found in Nigeria [1]. They are hardy, possess the ability to scavenge for feed, brood and hatch their eggs, and they have high natural immunity against endemic poultry diseases.

Production of indigenous chicken is popular in the rural areas as high cost of formulated feed, health management, lack of electricity and poor brooding techniques limits industrial poultry production where exotic strains are used. They are used for religious, nutritional and recreational purposes and can be harnessed for rural poverty reduction. They are kept to supplement meals, honour guests as gifts, supply manure to crops and serve as a means of checking time [2].

The use of qualitative genes in poultry is gaining wide application and recognition [3]. These genes have been documented to be relevant in the adaptation and productivity of the chicken in its local environment, influencing both their meat and egg-laying traits [4].

Several researchers have worked on the special adaptive traits of Nigerian indigenous chicken like small body size, multicoloured plumage, the presence of major genes affecting feather structure and feather distribution [5,3,1] among others. It is important to note that efforts to characterize and improve the Nigerian indigenous chicken require the understanding of the roles of genes influencing the specific characteristics of the breed, their relative frequencies and their possible utilization.

Rarely have any attempt ever been made to study the indigenous chicken populations in remote areas of Bekwarra, Nigeria. It is strongly believed that in remote areas/villages, genetic originality may still be found. The aim of this study, therefore, was to investigate the distribution and gene frequency of some qualitative traits of the indigenous chicken population of Bekwarra Nigeria.

2. MATERIALS AND METHODS

2.1 Study Area

The study was carried out in Bekwarra Local Government Area of Cross River State, Nigeria. Cross River State lies within latitude 5º45'N and 8º30'E of the equator. Bekwarra lies within latitude 6º41'38"N and 8º58'03"E of the equator. It covers an area of 306 square kilometres with a total human population of 105,822 [6]. It is a rainforest zone characterized by a minimum temperature of 10-22.3ºC in December which could rise to a maximum of 18.5-35.8ºC in February. The altitude of the study area ranges from 400-3,000 metres above sea level. Rainfall is between 1500-1,849.3millimetres in an area with lower altitude and 1556-1960millimetres in the high land areas. It has a low intensity of light due to the thick forest with a relative humidity ranging between 61% in February, 92% in August and a yearly average of 95% [7]. The study area is made up of 10 administrative council wards which were effectively covered in the study.

2.2 Experimental Birds and Their Management

A total of 1,060 adult indigenous chickens made up of 444 males and 616 females were randomly sampled from 208 households. The chickens were managed by rural farmers in remote villages according to the extensive system where they freely roam about during the day, scavenging for food processing wastes, insects, earthworms and leafy vegetables. At dusk they return to the homestead where minimum shelter made up of bricks, wood and old corrugated roofing sheets are provided.

2.3 Data Collection

Six qualitative traits were individually recorded for all birds sampled in the population: skin colour were categorized into yellow and white. Eye colour (black, brown, dark-red, orange and pink), comb type (single, rose and pea), feather distribution (fully covered and naked neck), foot covering (smooth and feather feet) and plumage colour (black, white, brown, red, ash and multicoloured) were also observed and recorded accordingly. Data obtained from the various locations which made up the study area were pooled before being subjected to statistical analysis.

2.4 Statistical Analyses

The qualitative traits were expressed in percentages and categorized according to sex.

Chi-Square (x^2) values using the formula

$$X^2 = \frac{\sum(\text{observed} - \text{expected})^2}{\text{expected}}$$

were computed to determine if any two traits were inherited independently or if there was some form of relationship (that is test for independence) as described by [3]. Where both agreed, the frequencies of genes controlling the traits were calculated. The calculations of gene frequencies were based on a combination of both the Hardy-Weinberg equilibrium and Mendelian Principle of inheritance [8].

The frequency, '*q*', of the recessive alleles (w, na^+ fsh, r) and the frequency '*P*' of the dominant alleles (W, Na, Fsh, R, P) were computed using the formulae:

$$q = \frac{\sqrt{m}}{t} \quad \text{and} \quad p = 1 - q$$

Where,

Q = frequency of the recessive gene
m = observed number of chicken expressing the recessive trait
t = total number of chicken sampled
p = frequency of the dominant alleles

3. RESULTS

Table 1 presents the distribution of qualitative traits in the Nigerian indigenous chicken. White (75.85%) and yellow (24.15%) were the two possible skin colours observed. Eye colour varied from black (44.72%), brown (27.74%), dark red (13.40%), orange (9.05%), to pink (5.09%). The predominant comb type was single (88.49%), followed by Rose (7.17%) and then pea comb (4.34%). The fully feathered chickens were most frequent (93.21%) compared to the naked neck (6.79%) in feather distribution. Smooth feet (73.59%) chickens were more common than the feathered feet (26.41%) in the population sampled. Six different plumage colours were profiled in the population. Black (39.43%) were the most predominant plumage colour feathered by white (23.02%), Brown (15.47%), Ash (11.13%), while multicoloured (1.51%) was the least common.

The distribution of qualitative traits by sex is displayed in Table 2. Chi-square test showed no significant ($P>0.05$) differences between and within sexes in skin colour and eye colour. However, it was significant ($P<0.001$) between and within sexes for comb type, feather distribution, foot feathering and plumage colour. Females had significantly ($P<0.001$) higher percentages of comb type (Single: 48.50%,

Table 1. Summary of distribution of qualitative traits in the Nigerian indigenous chicken

Trait	Characteristic	Frequency	Percentage
Skin colour	White	804	75.85
	Yellow	256	24.15
Eye colour	Black	474	44.72
	Brown	294	27.74
	Dark-red	142	13.40
	Orange	96	9.05
	Pink	54	5.09
Comb type	Single	938	88.49
	Rose	76	7.17
	Pea	46	4.34
Feather distribution	Fully feathered	988	93.21
	Naked neck	72	6.79
Foot feathering	Smooth feet	780	73.59
	Feathered feet	280	26.41
Plumage colour	Black	418	39.43
	White	244	23.02
	Brown	164	15.47
	Ash	118	11.13
	Red	100	9.43
	Multicolour	16	1.51

Rose: 6.00%, Pea: 3.61%) than the male (Single: 40.00%, Rose: 1.16%, Pea: 0.73%) chickens. The hens had higher (P<0.001) numbers of fully feathered (41.89%) and naked neck (58.11%) than the cocks (37.14% fully feathered and 56.00% naked neck). Also, 20.30% of the hens had feathered feet compared to 6.15% of the cocks. Smooth feet occurred at a percentage ratio of 37.81% hens to 35.74% cocks. The predominant plumage colour was black with hens expressing significantly (P<0.001) higher number (23.24%) than the cocks (16.20%).

The gene frequencies of some qualitative traits of the Nigerian indigenous chicken are shown in Table 3. Test of observable ratios for skin colour, comb type, feather distribution and feet feathering fitted well into their expected values, hence their gene and genotypic frequencies were calculated. The white skin genotype had a frequency of 0.758 while the yellow genotype had a frequency of 0.242. The dominant allele (W) had a frequency of 0.509 while its recessive counterpart (w) expressed a frequency of 0.491. For comb type, with the assumption of Mendel, the two genes at the R-r and P-p loci had allele frequencies of r= 0.917, p=0.906, R= 0.083 and P= 0.094. The double recessive genotype (rrpp) were more common (with the frequency of 0.885) than the dominant genotypes. Feather distribution revealed the full cover genotypes had a frequency of 0.932 while the naked neck genotype gave a frequency of 0.068. Their corresponding allele frequencies were 0.965 and 0.035, respectively. The *Fsh* gene which influenced foot feathering gave an estimated frequency of 0.142 while the recessive allele, *fsh,* that expressed smooth feet had a frequency of 0.858. The genotypic frequencies were 0.264 and 0.736, respectively.

4. DISCUSSION

The higher proportion of white-skinned colour chicken reported in this study agrees with the findings of [9] and [3]. [4] opined that body pigmentation in birds is affected by social preference, natural selection, adaptation and nutrition. The variability in eye colour is consistent with data in the literature [10]. Differences in eye colour depend on the carotenoid pigments and blood supply to the structures within the eye [11]. Three types of comb (Single, Rose and Pea), with single being the most commonly observed agrees with the findings of [3] and [1]. It, however, contradicted the work of [12] and [13] who reported the presence of walnut and multiple comb types in their study. Combs are important avenues for heat loss in birds and they are important in

Table 2. Distribution of qualitative traits in Nigerian indigenous chicken by sex

Trait	Characteristics	Number of chicken by sex				X^2 test
		Male		Female		
		Expected	Observed	Expected	observed	
Skin colour	White	337	327	467	477	
	Yellow	107	117	147	139	2.12^{ns}
Comb type	Single	393	424	545	514	
	Rose	32	12	44	64	36.51^{***}
	Pea	19	8	27	38	
Feathering distribution	Fully feathered	414	394	574	594	
	Naked neck	30	50	42	22	24.51^{***}
Foot feathering	Smooth feet	327	379	453	401	
	Feathered feet	117	65	163	215	53.94^{***}
Eye colour	Black	199	199	276	275	
	Brown	123	123	171	171	
	Dark-red	60	59	83	83	0.02^{ns}
	Orange	40	40	56	56	
	Pink	23	23	31	31	
Plumage colour	Black	175	172	243	246	
	White	102	127	142	117	
	Brown	69	66	95	98	30.28^{***}
	Red	49	45	69	73	
	Ash	42	23	58	77	
	Multicolour	7	11	9	5	

Table 3. Gene frequencies of some qualitative traits in the Nigerian indigenous chicken

Traits	Characteristics	Alleles	Gene frequency	Genotypic frequency
Skin colour	Yellow	w	0.491	0.242
	White	W	0.509	0.758
Comb type	Single	r	0.917	0.885(rrpp)
		p	0.906	
	Rose	R	0.083	0.072(RR,Rr^+)
	Pea	P	0.094	0.043(PP,Pp^+)
Feather distribution	Full cover	na	0.965	0.932
	Naked neck	Na	0.035	0.068
Foot feathering				
	Smooth feet	fsh	0.858	0.736
	Feathered feet	Fsh	0.142	0.264

ensuring the survival and production of the breed. Feather distribution favoured the fully covered bird (93.21%) more than the naked neck (6.79%). This result agrees with the work of [14,3] and [15]. This implies negative selection against the naked neck genotype by the farmers. The naked neck chicken are mostly used in rituals and sacrifices and considered ugly and irritating; fit to be raised only by old people and for occultic purposes [16]. However, the naked neck chickens have great potential in genetic improvement of heat tolerant chickens in the tropics.

In harmony with the observation in this study, [4] and [3] reported the higher occurrence of smooth feet and fewer incidences of feet feathering in the Nigerian indigenous chicken. The highly variable plumage colouration observed in this study corresponds with the findings of [3,13] and [1]. [17] attributed this to the lack of selection of breeding programme directed towards the choice of plumage colour. [4] suggested that social presence, natural selection and adaptation could have led to variations in plumage colour. The significant ($P<0.001$) differences between and within sexes for comb type, feather distribution, foot feathering and plumage colour following chi-square test reported agrees with the findings of [3].

The higher occurrence of white skin determinant gene (W) in this study did not differ significantly from the frequency of the gene controlling yellow skin (w). [9] and [3] made a similar observation on local chickens in Bauchi and Plateau States, respectively. Farmers in the study area seemed to have a special preference for white skin coloured chicken. The gene frequencies estimated for comb type in this study is consistent with the findings of [4] and [3]. Gene frequencies for feather distribution reported agreeing with the findings of [3] and [10]. The very low frequency of naked neck allele (Na) in this study despite the advantage it gives for heat stress adaption points to the fact that it is at the risk of extinction. The gene frequencies of fsh= 0.858 for smooth feet and Fsh= 0.035 for feathered feet differed from fsh= 0.948 and Fsh= 0.052 reported by Mancha (2004). The dominant alleles (R, P, Na, and Fsh) were observed to segregate at a lower frequency. The recessive alleles (r, p, na, fsh) had higher transmission ability and were more frequently transmitted to the next generation than their corresponding dominant alleles. This might be as a result of the combined effect of social preference, natural selection, adaptation and interaction of genes.

5. CONCLUSION

The indigenous chicken in the study area was mostly black or white in plumage colour with black eyes and single combs. The farmers seemed to discriminate against Rose comb, Pea comb, naked neck and feathered feet chicken. The dominant alleles segregated at a lower frequency probably due to social preference, natural selection, adaptation and interaction of genes. The indigenous chickens constitute a store of useful genetic materials that are well adapted to their environment and should be improved for better productivity.

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Daikwo, IS, Okpe, AA and JO Ocheja. Phenotypic characterization of local chicken in Dekina. International Journal of Poultry Science. 2011;10(6):444-447.
2. Nwagu B. Incidence and influence of naked neck and frizzle genes on body size of local chickens. M.Sc Thesis, University of Ilorin. 2002;105.
3. Mancha YP. Characterization of local chickens in northern part of the Jos Plateau. Ph.D Thesis, Animal Production Programme, Abubakar Tafawa Balewa University, Bauchi. 2004;250.
4. Ikeobi CON, Ozoje MO, Adebambo OA, Adenowo JA. Frequency of feet feathering and comb type genes in the Nigerian local chicken. Partanika Journal of Tropical Agricultural Science. 2001;24(2):147-150.
5. Orheruata MA, Okpeku M, Imumorin IG. Phenotypic and body measurement characteristics in native and some exotic chickens in Edo State. Proceedings of the 29th annual conference of the Nigerian society for Animal Production. 2004;29:17-21.
6. Wikipedia. Wikipedia the Free Encyclopedia; 2008. Available:http://en.wikipedia.org/wiki/bekwarra
7. CRSMA. Cross river state ministry of agriculture. Annual Agricultural Bulletin. 2002;35(12).
8. Falconer DS, Mackay TFC. Introduction to Quantitative Genetics. 4th Edition. Longman, London. 1996;464.
9. Saidu IA. Characterization of local chickens in Bauchi. PGD dissertation, Animal Production Programme, Abubakar Tafawa Balewa University Bauchi. 2002; 84.
10. Dahloum L, Moula N, Halbouche M, Mignon-Grasteau S. Phenotypic characterization of the indigenous chickens (*Gallus gallus*) in the northwest of Algeria. Archives of Animal Breeding. 2016;59:79-90.
11. Eskindir A, Kefelegn K, Tadelle D, Banerjee AK. Phenotypic characterization of indigenous chicken population in Ethiopia. International Journal of Interdisciplinary and Multidisciplinary Studies. 2013;1:24-32.
12. Badubi SS, Rakereng M, Marumo M. Morphological characteristics and feed resources available for indigenous chickens in Botswana. Livestock Research for Rural Development. 2006;18(1). Available:http://www.cipav.org.co/
13. Egahi JO, Dim NI, Momoh OM, Gwaza DS. Variation in qualitative traits in the Nigerian Local Chicken. International Journal of Poultry Science. 2010;9(10):978-979.
14. Sonaiya, EB. Producing local livestock—improving rural livelihoods. Proceedings of the 28th Annual conference of the Nigerian Society for Animal Production. 2003;458-465.
15. Ige AO, Salako AE, Yakubu A, Adeyemi SA. Qualitative traits characterization of Yoruba and Fulani ecotype indigenous chickens in derived Savanna Zone of Nigeria. International Journal of Poultry Science. 2012;11(10):616-620.
16. Sonaiya EB, Olori VE. Village poultry production in Southwestern Nigeria. In: Sonaiya EB. ed. Rural poultry in Africa: Proceedings of International workshop held in Ile-Ife, Nigeria.1990;243-247.
17. Nwosu CC, Gowon FA, Obioha FC, Akpan IA, Onuora GI. A biometrical study of the conformation of the native chicken. Nigerian Journal of Animal Production. 1985;12:141-146.

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