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Nigerian Indigenous Chicken: A Valuable Genetic Resource for Meat and Egg Production

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Abstract: This review work aims at determining the potential usefulness of the Nigerian indigenous ecotype chickens and the effect of the major genes of frizzling and naked neck for poultry production in the tropical humid climate. Classification by ecological zones does not consider the effect of the major genes hence the heavy and light chickens or the Fulani and Yoruba ecotype chickens respectively. Heritability estimates of body weight of 0.43 and 0.30 for heavy ecotype chicken at 8 and 20 weeks, respectively is an indication that the heavy chicken ecotype may possess dual potential to be selected as meat type or egg-type bird because 8 weeks and 20 weeks of age are broiler and layer ages, respectively. The frizzling and naked neck genes conferred better feed conversion, growth rate, feed efficiency and dressing percentage than the normal feathered chicken. The feather structure and feather distribution genes are well adaptive to the harsh tropical environment; survive on low energy feed, highly resistant to diseases and superior to their exotic counterparts. Crossbreeding with the exotic breeds improved body weight greatly at 12 weeks of age. Limited reports are available on the molecular characterization of Nigerian indigenous chickens, it is necessary to determine genetic distance between or within indigenous naked neck, frizzled and normal feathered chicken populations for future breeding plans. Thus, this present review provides genetic and performance information on naked neck, frizzled and normal feathered chickens which may be useful for breed improvement and development for future generation.

Key words: Major genes, Nigeria, molecular characterization, heritability

INTRODUCTION

Indigenous chickens are widely distributed in the rural areas of tropical and sub-tropical countries where they are kept by the majority of the rural poor. Indigenous chickens in Africa are in general hardy, adaptive to rural environments, survive on little or no inputs and adjust to fluctuations in feed availability. Chickens largely dominate flock composition and make up about 98% (Gueye, 2003) of the total poultry numbers (chickens, ducks and turkeys) kept in Africa.

Indigenous chicken constitutes 80% of the 120 million poultry type raised in the rural areas in Nigeria (RIM, 1992). They are self reliant and hardy birds with the capacity to withstand harsh weather condition and adaptation to adverse environment. They are known to possess qualities such as the ability to hatch on their own, brood and scavenge for major parts of their food and possess appreciated immunity from endemic diseases. Their products are preferred by the majority of Nigerian because of the pigmentation, taste, leanness and

suitability for special dishes (Horst, 1989). Their outputs (egg and meat) are readily available to villagers and people in urban semi urban areas thus serves as a good source of protein in their diet, in the same vein, they serve as good source of income.

The indigenous poultry species represent valuable resources for livestock development because their extensive genetic diversity allows for rearing of poultry under varied environmental conditions, providing a range of products and functions. Thus, great genetic resources embedded in the indigenous poultry await full exploitation that will provide basis for genetic improvement and diversification to produce breeds that are adapted to local conditions for the benefit of farmers in developing countries (Horst, 1988; Sonaiya *et al*., 1999).

Though poultry breeding in Nigeria started in 1985 at the National Animal Production Research Institute, Zaria (Adebambo, 1992), reports have it that research on the local chicken had started earlier with comprehensive information about the local fowl. The local chicken of Nigeria is small in size and grows slowly. There have been reports on the characterisation of the local chicken in Nigeria and its potential for egg and meat production (Nwosu, 1979; Adebambo, 2005).

In Nigeria, indigenous chickens were characterized along genetic lines of feather and plumage colour (such as normal or frizzled feathered), body structure (such as naked neck, dwarf types and colour variants (such as black, white, brown, mottled etc.). The frequency distribution of the normal feathered chicken was about 91.8% while that of frizzled and naked neck were 5.2 and 3.0% respectively in Bayelsa State of Nigeria (Ajayi and Agaviezor, 2009). Classification has also been on the basis of location. There are various ecotypes of the local chicken in the different agro ecological zones in Nigeria as reported by different authors. Most of the classification by the different agro ecological zones considered mainly the normal feathered indigenous chicken because they are the most prominent whereas the naked neck and frizzled feathered are rare and almost becoming endangered and the gene pool they represent may be lost if not characterized and conserved. For instance, Olori (1992) noted two ecotypes characterized as forest and savannah or Yoruba and Fulani ecotypes, respectively Nwosu (1979) identified three main strains in ecotype named Nsukka, Owerri and Awgu types at the South Eastern states of Nigeria (Hill and Modebe, 1961) and Oluyemi *et al*. (1982) also reported variation in many traits of the indigenous chicken from the Southern region of Nigeria which they found to be different from those of other parts of the country. It was agreed by all these researcher that the Nigerian chicken is a light breed, often with single comb and that black and brown plumage, laced with various colours such as mottling are common (Adebambo, 2005). Recent works revealed that the different ecotypes can be grouped into two major categories on the basis of body size and body weight as heavy ecotype and light ecotype (Momoh *et al*., 2007). The heavy ecotype (also referred to as Fulani ecotype) is found in the dry Savannahs (Guinea and Sahel Savannah), Montane regions and cattle Kraals of the North and weigh about 0.9-2.5 kg at maturity. The light ecotype are those chicken types from the Swamp, Rainforest and Derived Savannah agro-ecological zones whose mature body weight ranges between 0.68-1.5 kg.

This review aim at describing the characteristics of the Nigerian ecotype chickens, the effect of the major genes and possibilities for genetic improvement.

Genetic Background of Nigerian Indigenous Chicken

Certain major genes have been found to be relevant to the indigenous breeds in their tropical production environment which is characterized by stress factor (Horst, 1989;

Mathur and Horst, 1990). The feather distribution gene, naked gene (Na) and the feather structure gene, frizzle (F) are among these major genes. Major genes are economically interesting in modern breeding systems as they act as sex marker genes and disease resistant factors (e.g., avian leucosis). These genes cause a reduction in tropical heat stress by improving the breed's ability for convection, resulting in improved feed conversion and better performance. Horst (1989) further stated that the Na and F gene confer superiority in some production characters in the tropics. Horst (1988) and Mathur and Horst (1990) showed that individuals with F and Na genes both singly and in combination were superior to those individuals with normal feathering for egg number, egg mass/weight and forty-week body weight in tropical environments According to Ibe (1993), naked neck and the frizzed genes are associated with earlier sexual maturity in a tropical environment.

Molecular Basis of Nigerian Indigenous Chickens

Nigeria is endowed with varied ecological zones and possesses diverse animal genetic resources of the local breeds. These local breeds contain genes and alleles pertinent to their adaptation to a particular environments and local breeding goals (Romanov *et al*., 1996). Indigenous chickens in Nigeria are becoming seriously endangered owing to the high rate of genetic erosion resulting from diseases and predation. Attempt must be made so that these adaptive features of the local stocks will not be eroded before they are characterized and conserved. Little has been done on the molecular characterization of the indigenous chicken in Nigeria. Adebambo *et al*. (2009) found no significant differences in genetic distance of indigenous chicken from three populations (Southwest, Northwest and Northeast ecological zones) of Nigeria. They concluded that these chicken populations exhibited genetic homogeneity resulting from intermixes of germplasm in Nigeria as the country allows free flow of human and animal traffic. Molecular markers have played a leading role in characterization of diversity which provides relatively rapid and cheap assays in the absence of quality phenotypic measures (Toro *et al*., 2006). As a result the classification of genetic resources based on geographical location needs to be supported by molecular data to provide unbiased estimates of genetic diversity (Pimm and Lawton, 1998) for the purpose of genetic resource conservation and utilization. Characterization includes a clear definition of the genetic attributes of an animal species or breed, which has a unique identity and the environment to which the species or breed populations are adapted (FAO, 1984). The genetic distinctiveness of an animal forms the basis for distinguishing it among different animal genetic resources and for assessing the available diversity (FAO, 1984).

Productive and Reproductive Performance of the Local Chicken

Growth Performance

Although, the Nigerian indigenous chickens possess small body size and grows slowly, it has been concluded that they reach point of inflection earlier than the exotic (Nwosu *et al*., 1980). Body size of an individual is also determined by its rate of growth (Ibe, 1993). Olawunmi *et al*. (2008) found that the Fulani ecotype chicken was bigger in size than the Yoruba ecotype chicken 1.76±0.4 and 0.79±0.21 kg for Fulani and Yoruba ecotypes respectively. Indigenous male chicken was also bigger in size than their female counterparts 1.5±0.06 kg versus 1.29±0.04 kg, respectively (Ajayi and Agaviezor, 2009). Major genes have been reported to show pronounced effect on the performance of indigenous chicken in the tropics (Ibe, 1992). It has also been reported that the frizzled feathered and naked neck genes conferred better feed conversion on these genotypes when compared to their normal-feathered counterpart (Horst, 1997; Gunn, 2008). Table 1 shows the growth rate

Table 1: Growth rate of pure indigenous, exotic and their crossbred chickens

		Age in weeks (weight, g)					
Genetic resource	Day old	1	4	8	12	20	Source
Ind A	27.45				484.72		Nwosu *et al.*
Ind B	26.83				504.69		(1980)
Ind C	29.66				557		
Exotic	42.28				728.18		
Ind		33.13±0.9	85.18±6.1	286.93±19.4	545.08±36.9		Adebambo
Ex× Ind		42.98±1.1	132.0±7.1	456.2±22.7	804.0±43.4		(2005)
Ind× Ex		37.72±0.9	119.8±6.0	409.0±19.1	742.5±36.9		
Fulani ecotypes	27.00±4	37.00±7	116.00±27	306.00±45			Fayeye *et al.*
	28.00±4	39.00±7	114.000±23	312.00±66			(2005)
Naked neck	36.17±0.75		142.90±8.46	348.61±4.21			Adedeji *et al.*
Frizzle	35.10±0.75		169.03±8.42	366.46±4.11			(2004)
Normal	35.30±0.75		150.24±8.30	351.31±4.45			
White Leghorn	30.18±0.90		152.35±12.89	351.22±6.65			
Normal			135.1±6.00	314.0±12.56	511.3±13.33		Ibe (1993)
Naked-neck			118.3±14.96	290.8±31.34	496.7±33.25		
Frizzle			112.0±13.71	282.0±28.72	499.0±30.48		
Normal	29.45±0.29	53.89±1.11	168.45±3.79	330.51±8.63	520.13±11.54	986.12±21.32	Gunn (2008)
Frizzled	30.67±0.28	49.28±0.93	156.84±3.50	311.10±7.31	488.54±10.26	995.02±19.45	
Naked neck	30.22±0.29	52.10±1.36	158.52± 4.67	341.87±10.93	572.56±17.32	1040.72±22.19	

at various ages for the indigenous pure bred chicken of various ecotypes in Nigeria and its crossbred counterpart with exotic strains. It has been established that differences existed between these ecotypes from morphological point of view (Olawunmi *et al.*, 2008). Crossbreeding indigenous chicken with exotic also improved body weight greatly at 12 weeks (Adebambo, 2005).

Egg Production

Growth rate and egg production under conventional system of rearing in the villages are very low. This is generally due to the insufficient feed supply and problem of diseases and social behavior (Ibe, 1998). Egg production when raised extensively is about 40 eggs year^{-1} (Ikeobi *et al.*, 1996) whereas under improved conditions, egg yields of local birds may be doubled (Nwosu, 1979). The age at sexual maturity ranged between 133-169 days under scavenging condition whereas in cage system, it increases to about 189 days (Gunn, 2008). This report contradicts the findings of Islam and Nishibori (2009) for indigenous chicken of Bangladesh. Adedokun and Sonaiya (2001) also reported mean age at first egg of 157±3.7, 160±3.8 and 165±3.7, respectively for hens from Derived savannah, Guinea savannah and Rain forest zone of Nigeria (Table 2). Ibe (1992), also noted that frizzled and naked neck individuals in the tropical environment attaining earlier maturity than normal-feathering birds. The difference in age of pullet in attainment of sexual maturity was attributed to system of management (Tadelle *et al.*, 2003) and productive trait (Gunn, 2008). Although, egg weight was higher for the heavy ecotype than the light ecotype chicken (Fayeye *et al.*, 2006; Momoh *et al.*, 2007), the latter lays more egg than the former. Adedokun and Sonaiya (2001) in their investigation reported that birds that attained early sexual maturity end egg laying production earlier than those late sexual maturity ones. More feed was also utilized in producing a dozen eggs by the indigenous chicken than the crossbred chicken (Table 2).

Fertility and Hatchability of Eggs

Fertile eggs from indigenous chickens in Nigeria are comparable in fertility and hatchability with indigenous chickens from other regions of the world under local conditions. Fertility and hatchability were 76 and 48% respectively for Fulani ecotype chicken which was

Table 2: Egg production performance of Nigerian indigenous chicken ecotypes, exotic and their crossbreds

Genetic resource	Rearing system	Age at 1st egg (days)	Body weight at 1st egg (kg bird^{-1})	Egg weight (g bird^{-1})	Egg mass Egg (kg)	Feed/doz. (g bird^{-1})	Reference
Fulani ecotype	Deep litter						Fayeye *et al.* (2005)
Local×white leghorn	Cage	135.0±0.422	1.07±0.007	40.73±4.07		1.83	Agaviezor *et al.*
Local×Giriraja	Cage	165.20±0.668	1.47±0.011	41.14		2.02	(2004)
Local	Cage	136.36±0.45	0.94±0.007	37.15		2.14	
Ind A	Scavenging	135		39.45			Nwosu *et al.* (1980)
Ind B	Scavenging	139					
Ind C	Scavenging	136					
Exotic	Cage	145					
Ind	Scavenging	169.5±28		34.5±0.7			Akinokun (1990)
Heavy ecotype	Cage			40.34±0.24	5740.85±21.42		Momoh *et al.* (2007)
Light ecotype	Cage			37.32±0.23	5008.21±17.86		
White leghorn (WL)	Cage	137.84	1.25	31.78		2.01	Adebambo (2005)
Giri	Cage	161.41	2.171	36.83		2.86	
Black Nera	Cage	178.88	1.356	47.2		2.56	
WL×Local	Cage	135.6	1.079	41.14		2.23	
Giri×Local	Cage	162.2	1.471	37.15		2.14	
Local, nana	Cage	133.36	0.94	39.45		2.54	
Normal	Cage	168.68	1.134.76	42.24			Gunn (2008)
Frizzled	Cage	189.02	1.129.33	40.76			
Naked neck	cage	189.68	1.047.91	37.36			

Table 3: Fertility and hatchability of eggs

Traits	Heavy/Fulani ecotypes	Light ecotypes	Normal feathered	Naked neck	Frizzled feathered	Reference
Fertility (%)	76					Fayeye *et al.* (2005)
Live germ at 17/18th day	75					
Hatchability (%)	48					
Fertility (%)			55	52	58	Peters *et al.* (2004)
Hatchability (%)			72	54	84	
Fertility (%)			92.3	78.4	80.5	Ajayi *et al.* (2008)
Hatchability (%)			45	93.1	81.8	

within the range of 83.0-92.7 and 52.4-87.0% reported for indigenous full feathered Bangladesh chickens (Islam and Nishibori, 2009). Although, the fertility of the normal feathered (nana ff), naked neck (NaNa) and the frizzled feathered chickens were just a little above average (Table 3), they all have high hatchability between 72-93.1% except the normal feathered birds with about 45% hatchability (Ajayi *et al.*, 2008).

Meat Quality and Consumer's Preference for the Indigenous Chicken

Scanty reports abound in literature on the meat quality characteristics of the Nigerian indigenous chickens. Major genes have significant effect on carcass and organ weight at 20 weeks of age. Naked neck had higher breast percent than both frizzled and normal feathered birds (Gunn, 2008) but the frizzled and naked neck excelled in weight of other cut parts than the normal feathered chicken. Recent studies on incorporation of naked neck into broiler birds showed the superiority of the same over the normal feathered chicken in terms of growth rate, feed efficiency, dressing percentage and other important broiler traits (Singh *et al.*, 1996; Mathur and Horst, 1990; Ibe, 1993; Yunis and Cahaner, 1999; Ikeobi *et al.*, 1996).

Indigenous chicken meat and egg are preferred by majority of the rural dwellers mainly because of their toughness, pigmentation, taste, leanness and suitability for special dishes (Horst, 1991; Islam, 2000). Meat and eggs from indigenous chicken are also of moderate prices compared to products from commercial birds (Horst, 1989; Gueye, 1998).

Table 4: Heritability of body weight in chicken

Trait	Heavy ecotype	Main crossbred	Reciprocal crossbred
Body weight			
0	0.17±0.19	0.08±0.10	0.19±0.22
4	0.18±0.19	0.09±0.16	0.20±0.21
8	0.43±0.26	0.02±0.16	0.31±0.28
12	0.29±0.21	0.22±0.15	0.36±0.31
16	0.16±0.18	0.25±0.17	0.26±0.25
20	0.30±0.23	0.16±0.13	0.20±0.22

Estimate of Heritability of Growth Traits in Indigenous Chicken

For a given trait, heritability is the amount of the superiority of the parents above their contemporaries, which on the average is passed on to the offspring. In order to establish breeding programme it is necessary to count with heritability estimates of traits of economic importance and genetic association between them. This is because the degree of heritability allows one to estimate the amount of improvement by selection and genetic association that can dictate method of selection. There is little report in literature of estimate of heritability of body weight of Nigerian local fowls at various ages. Oluyemi and Oyenuga (1974) reported 12th week body weight heritability of 0.32 (h^2_S), 0.29 (h^2_d) and 0.31 (h^2_{s+d}). Nwosu *et al.* (1984) obtained estimates of heritability for 4 and 8 weeks as 0.36, 0.38 and 0.37, 0.32, 0.36 and 0.34 for sire, dam and combined components, respectively estimates of heritability are necessary to predict response to direct or indirect selection.

Using three breeding groups, pure light and heavy ecotype chickens and a crossbred between heavy and light ecotype chickens, Ndofor *et al.* (2006) reported that heritability estimate between 4-20 weeks for light chicken was 0.40±0.44, while 0.37±0.09 and 0.29±0.57 were recorded for heavy and main cross chickens respectively. They concluded that appreciable improvement in the trait could be achieved if the pure parents are individually selected at the age of 12 or 16 weeks. Momoh and Nwosu (2008) also reported heritability estimates of body weight of 0.43 and 0.30 for heavy ecotype chicken at 8 and 20 weeks respectively (Table 4). There is an indication that the heavy chicken ecotype may possess dual potential to be selected as meat type or egg-type bird because 8 weeks and 20 weeks of age are broiler and layer ages, respectively. The moderate to high heritabilities indicate that response to selection at the 8th or 20th week could be rapid (Momoh and Nwosu, 2008). The Nigerian indigenous chickens have the capability of being developed into meat-type and egg-type birds.

Indigenous Chickens and Future Breed Development

The indigenous breeds represent a huge reservoir of chicken genome. Their continued use in a low input small scale village production systems serve as a cheap in-situ conservation technique that needs to be encouraged and supported (Olori, 2009). The frizzling and the naked genes in particular have been described as adaptability genes acting as sex marker and disease resistant factor (Islam and Nishibori, 2009).

Indigenous chickens need to be maintained for the purpose of conserving the wide gene pool that they represent into the future. In this form, they are of the highest value especially in this era of genomics research and enhanced potential for the development of new improved breeds for the future. This will be achieved largely through the increased application of molecular genetics in poultry (Fulton, 2008). There is a wide gap between indigenous chickens and exotic breeds raise udder harsh environmental conditions. Crossbreeding indigenous chicken with exotic breed will go a long way in improving the performance of the indigenous without necessarily losing its adaptive features as their

desirable genes are conserved (e.g., for disease resistance). This will enhance better productivity of these indigenous stocks and also help in planning sustainable breeding programme for future.

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