A COMPARATIVE MORPHOLOGICAL CHARACTERIZATION OF THREE LOCAL AND THREE EXOTIC CHICKEN TYPES IN NIGERIA.

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Abstract

Three adullt local chicken types in Nigeria (wild type, Ibile; naked neck, Abolorun and frizzled feather, Asaa; and three exotic types; Bovans near, Isa brown and Cobb) were characterized using twenty morphological traits. The descriptive analysis: group means and the standard deviations values of the 20 traits studied showed significant differences for all 20 morphological traits analysed using SPSS 15.0 version..The correlation matrixes, dendrogram and Principal Components Analysis (PCA) revealed the exotic types distant from the local types. However, it was observed that the closest neighbour with the local types, 26% coefficient level, was with the naked neck. The Asaa and the Ibile local chicken types show closer level of relatedness (89%) while Abolurun and the exotics indicated 34% similarity. At 0.90 coefficient level Wattle size, comb length, beak length and spur number show some degree of interdependence so also the tail length, shank length, number of toes and wing length clustering together. However, the back length and the height indicate closer interaction between and form a distance relationship with other eight traits. These are indications that the three local chicken types may not fall into same classification and that some morphological traits may influence one another.

Keywords: *Nigeria, Morphological, Characterization, Local chickens, Relatedness*

INTRODUCTION

Over 60% of the world's total poultry population are from the rural poultry population in most African nations (FAO, 2000). This fact reveals that genetic diversity of most livestock is found in the developing countries, thus, great reservoir of important genes e.g. the disease resistance genes that enable them to adapt to the tropical conditions and traditional husbandry, and stressful environment (Bumstead *et al*, 1993; Hu *et al.*, 1997 and Ogunkanmi *et al.*, 2008).

Phenotypic and genotypic variations have been reported to be very high in poultry, local and commercial types alike (Mollah *et al.*, 2009). A number of factors may be responsible for the variations. These factors include natural and artificial selection, mutation, migration, genetic drift, random and non-random mating. In most developing world indigenous chicken populations are often developed as a result of uncontrolled cross breeding programmes between various "lines", "ecotypes" or types of local and exotic breeds (Mogesse, 2007). Distinct indigenous chicken "breeds", "lines", "ecotypes" or types have been reported and named in Cameroon, Egypt, Ethiopia, Kenya, Morocco, Nigeria, Sudan, Tanzania and Zimbabwe. Each local area has various names for the different "breeds", "lines", "ecotype" or types of local chicken. These names which are phenotypic descriptions of the birds which include-frizzled feathered, featherless, naked neck, barred feathered, feathered shanks, bearded, dwarfism, comb type and short tail among others (Gueye, 1998; Msoffe *et al.,* 2001 and Mogesse, 2007).

Different studies at different times and places has shown that different indigenous chicken "types" differ in their expressions of various genes such as gene for meat production, egg production, colours, comb type, disease resistance capability (Matur et *al.*, 2010 and Msoffe *et al.*, 2004), temperature tolerance, feed efficiency, growth rate, carcass composition and feather type among other morphological and genomic traits (Dennis *et al.*, 2006; Goto *et al.*, 2009; Mollah *et al.*, 2009 and Singh *et al.*, 2001) the geographical locations playing significant role as well. These facts provide evidences that considerable differences may exist among these local chicken types earlier referred to as "source of great genetic reservoir".

Biosystematics revealed that the local chicken-*Gallus gallus* descended from the wild red jungle fowl of India and Southeast Asia (Mogesse, 2007). According to Mogesse, (2007) the history of the evolution of domestic fowl can be classified into three stages namely evolution of *Gallus gallus*, emergence of domesticated chicken from its ancestors, which according to recent archaeological evidence commenced in China in 6000 BC (West and Zhou, 1989) and thirdly the introduction of new breeds, varieties, strains and lines in great numbers. Characterizations of the population structure of species are useful in different contexts. Clear understanding of genetic, in combination with morphological relatedness of within-species population structure has been widely applied for classifying subspecies, for defining intraspecific conservation units, for understanding events in the history of a species, for identifying ongoing speciation events, and for testing hypotheses about evolutionary processes (Noah *et al.*, 2001). It is thus, necessaries that investigation is carried out to ascertain the possible usefulness of these factors with the view of employing them towards proper characterization of the local chickens and conservation of poultry animal genetics especially in Africa.

In this study we investigated the degree of relatedness and non-relatedness among three local chicken types and interaction between and among some traits measured, towards establishing a clearer characterization of the Nigeria local chickens.

Materials and Methods

A total of 110 chickens made up of 80 local chickens: 30 frizzle feather (Asaa), 30 naked neck (Abolurun) and 20 wild type (Ibile) sampled from the south-east, south-west, south and northern and 30 exotic individual: 10 Bovans nera (BN), 10 Isa brown (IB) and 10 Cobb (CB)were used for this study. The indigenous chicken types chosen were based on their unique morphological traits, ability to adapt in the different environmental and stress conditions, survival rates and economic importance (Mogesse, 2007). The phenotypic characters studied were classified into qualitative and quantitative traits: 10 quantitative traits namely back length, height, beak length, comb length, number of toes, tail length, spurs number, shank length, wattle size and wing length; 10 qualitative traits: comb type, shank colour, eye colour, tail colour, feather distribution, plumage colour, skin colour, feet feather, feather morphology and beak colour. All traits were selected based on FAO standard descriptors (FAO, 1986).

The morphological traits were measured and the derived data were analysed using the SPSS 15.0 evaluation version software package to determine the descriptive analyses mean, standard deviation, correlation matrix and generate a hierarchical cluster analysis (dendrogram) and scatter plot (principal component analysis (PCA)). The qualitative values were converted to metric values (1 and 0); 1 representing presence and 0 absence of the trait.

RESULTS

Descriptive analyses (Table I) show the group mean values and standard deviations of the four chicken types for each quantitative trait investigated. The correlation matrixes for the different chicken types are shown in Table II. The matrixes show that not less than 54% of the traits measured have less than 0.1 correlations (*Asa* 74%, *Abolurun* 41%, *Ibile* 53%, exotics 46%).

The scatter plot (principal component analysis) in figure 1, generated from their group mean values (quantitative traits), showed a dispersed scattered plot of the four chicken types. The exotic type was found to be more distant from the local types.

The dendrogram using Average Linkage (Between Groups) fig 2 showed that the exotic type is so distant from the local types; however, it was observed that the closest neighbour with the local types, 26% coefficient level, was with the *Abolorun* local chicken type in cluster N. The *Asaa* and the *Ibile* local chicken type clustered together (cluster M) at a very close level of relatedness (89%) away from the second cluster of the exotic and *Abolorun* types. Furthermore, the *Asaa* and the exotic types also showed a more distant relatedness.

Fig 3 was generated to determine the relationship/ influences that may exist among the 10 studied traits (quantitative) of the 4 chicken types due to the possible interdependence observed and reported among the traits (Yakubu *et al.*, 2009). The dendrogram revealed 2 main clusters (H and C) at 0.84 simlarity. At 0.90 coefficient level cluster H was further separated into 2 clusters, A and B, 4 traits in each: wattle size, comb length, beak length and spur number (cluster A) and number of toes, tail length, shank length and wing length in the second cluster (B). The third cluster (C) was formed by the back length and the height. Cluster C consist of height and back length formed a more distant relation with the other eight traits. A clearer figure was observed in fig 4 the principal component analysis (scattered plot) of the 10 traits.

The relatedness among the 4 chicken types using the qualitative measurements is shown in fig 5. The commercial type was further separated into the 3 commercial breeds because of the differences in morphological appearances. The figure revealed Phenotype distinctions among these chicken types and among the breeds: the scattered plot showed the *Ibile* (wild) almost at the centre with other flanking at different distances. The *Asaa* and the *Abolurun* types appeared to be closer neighbours to the *Ibile* type while the commercial breeds are distantly located at different points. Furthermore, while the local types share some degree of relatedness towards the base (origin) of the chart the commercial breeds also show some degree of relatedness with all three breeds located towards the upper region of the chart. These patterns of relatedness among the types and breeds observed tend to correspond with what was revealed in Figures 1 and 2.

Table 1: (Descriptive analyses) Group mean values and standard deviation (st.d) of 10 quantitative measurements

Traits	*Ibile*		*Asaa*		*Abolurun*		Exotic	
	Mean	St.d	Mean	St.d	Mean	St.d	mean	St.d
BACK LENGTH	18.70	2.01	16.39	1.21	17.76	2.179	21.77	2.18
HEIGHT	24.23	3.35	22.74	3.25	30.36	6.55	29.85	6.55
BEAK LENGTH	2.43	0.48	2.50	0.18	2.39	0.45	4.04	0 .45
COMB LENGTH	3.83	0.74	0.77	0.64	1.53	0.50	3.31	0.50
NO OF TOES	8.00	0.00	8.00	0.00	8.00	0.00	8.00	0.00
TAIL LENGTH	10.19	2.61	7.50	2.00	12.49	5.77	9.44	5.77
SPUR NUMBER	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SHANK LENGTH	7.59	2.57	5.48	0.55	5.53	0.78	12.39	0.78
WATTLE SIZE	1.20	0.51	0.89	0.76	2.05	0.92	3.16	0.92
WING LENGTH	16.53	2.26	12.71	3.10	9.67	2.52	11.70	2.52

Table 2

Descriptive Statistics:

Correlation Matrix for the 10 quantitative measurements for the 4 chicken types

IBILE	(cm)	BACK LENGTH	HEIGHT	BEAK LENGTH	COMB LENGTH	NO OF TOES	TAIL LENGTH	SPUR NUMBER	SHANK LENGTH	WATTLE SIZE	WING LENGTH
Correlation	BACK LENGTH	1.000	0.488	0.467	-0.139	.	0.622	.	0.392	-0.140	0.440
	HEIGHT	0.488	1.000	0.236	0.264	.	0.412	.	0.744	-0.114	-0.112
	BEAK LENGTH	0.467	0.236	1.000	0.159	.	0.613	.	0.101	-0.205	0.302
	COMB LENGTH	-0.139	0.264	0.159	1.000	.	0.210	.	0.360	0.454	0.162
	NO OF TOES	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000
	TAIL LENGTH	0.622	0.412	0.613	0.210	.	1.000	.	0.504	-0.324	0.375
	SPUR NUMBER	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000
	SHANK LENGTH	0.392	0.744	0.101	0.360	.	0.504	.	1.000	-0.245	-0.252
	WATTLE SIZE	-0.140	-0.114	-0.205	0.454	.	-0.324	.	-0.245	1.000	0.1490
	WING LENGTH	0.440	-0.112	0.302	0.162	.	0.375	.	-0.252	.1490	1.000

ASAA	(cm)	BACK LENGTH	HEIGHT	BEAK LENGTH	COMB LENGTH	NO OF TOES	TAIL LENGTH	SPUR NUMBER	SHANK LENGTH	WATTLE SIZE	WING LENGTH
Correlation	BACK LENGTH	1.000	0.558	-0.350	0.308	.	-0.219	.	0.123	0.123	0.054
	HEIGHT	0.558	1.000	-0.492	0.709	.	-0.152	.	-0.084	0.613	0.082
	BEAK LENGTH	-0.350	-0.492	1.000	-0.490	.	-0.003	.	0.074	-0.574	-0.021
	COMB LENGTH	0.308	0.709	-0.490	1.000	.	0.046	.	-0.032	0.762	0.271
	NO OF TOES	.	.	.	.	1.000	.	.	.	.	.
	TAIL LENGTH	-0.219	-0.152	-0.003	0.046	.	1.000	.	0.029	-0.093	0.094
	SPUR NUMBER	.	.	.	.	.	.	1.000	.	.	.
	SHANK LENGTH	0.123	-0.084	0.074	-0.032	.	0.029	.	1.000	-0.260	0.001
	WATTLESIZE	0.123	0.613	-0.574	0.762	.	-0.093	.	-0.260	1.000	-0.126
	WING LENGTH	0.054	0.082	-0.021	0.271	.	0.094	.	0.001	-0.126	1.000

ABOLORUN	(cm)	BACK LENGTH	HEIGHT	BEAK LENGTH	COMB LENGTH	NO OF TOES	TAIL LENGTH	SPUR NUMBER	SHANK LENGTH	WATTLE SIZE	WING LENGTH
Correlation	BACK LENGTH	1.000	0.392	0.222	0.160	.	0.367	0.352	0.532	-0.238	0.175
	HEIGHT	0.392	1.000	0.254	0.619	.	0.765	0.504	0.298	-0.751	-0.374
	BEAK LENGTH	0.222	0.254	1.000	0.096	.	0.605	0.163	0.546	0.178	0.441
	COMB LENGTH	0.160	0.619	0.096	1.000	.	0.686	0.292	0.277	-0.572	-0.138
	NO OF TOES	.	.	.	.	1.000	.	.	.	.	.
	TAIL LENGTH	0.367	0.765	0.605	0.686	.	1.000	0.419	0.422	-0.581	-0.056
	SPUR NUMBER	0.352	0.504	0.163	0.292	.	0.419	1.000	0.209	-0.187	0.031
	SHANK LENGTH	0.532	0.298	0.546	0.277	.	0.422	0.209	1.000	-0.009	0.535
	WATTLE SIZE	-0.238	-0.751	0.178	-0.572	.	-0.581	-0.187	-0.009	1.000	0.542
	WING LENGTH	0.175	-0.374	0.441	-0.138	.	-0.056	0.031	0.535	0.542	1.000

EXOTIC	(cm)	BACK LENGTH	HEIGHT	BEAK LENGTH	COMB LENGTH	NO OF TOES	TAIL LENGTH	SPUR NUMBER	SHANK LENGTH	WATTLE SIZE	WING LENGTH
Correlation	BACK LENGTH	1.000	0.612	0.008	0.024	.	0.348	.	0.461	0.428	0.316
	HEIGHT	0.612	1.000	-0.031	0.191	.	0.421	.	0.648	0.313	0.149
	BEAK LENGTH	0.008	-0.031	1.000	0.156	.	0.274	.	0.211	0.318	0.070
	COMB LENGTH	0.024	0.191	0.156	1.000	.	0.163	.	0.177	-0.026	-0.061
	NO OF TOES	.	.	.	.	1.000	.	.	.	.	.
	TAIL LENGTH	0.348	0.421	0.274	0.163	.	1.000	.	0.486	0.403	0.322
	SPUR NUMBER	.	.	.	.	.	.	1.000	.	.	.
	SHANK LENGTH	0.461	0.648	0.211	0.177	.	0.486	.	1.000	0.469	0.380
	WATTLE SIZE	0.428	0.313	0.318	-0.026	.	0.403	.	0.469	1.000	0.599
	WING LENGTH	0.316	0.149	0.070	-0.061	.	0.322	.	0.380	0.599	1.000

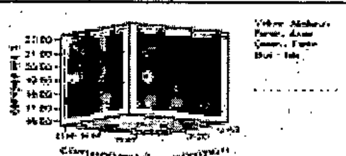

Fig 1: Scatter plot of the four chicken types using the mean values (quantitative measurements) showing degrees of relatedness

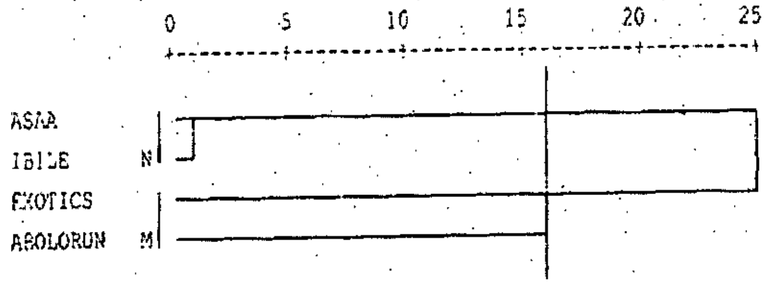

Fig 2: Dendrogram for 4 chicken types showing the degrees of relatedness among the four types

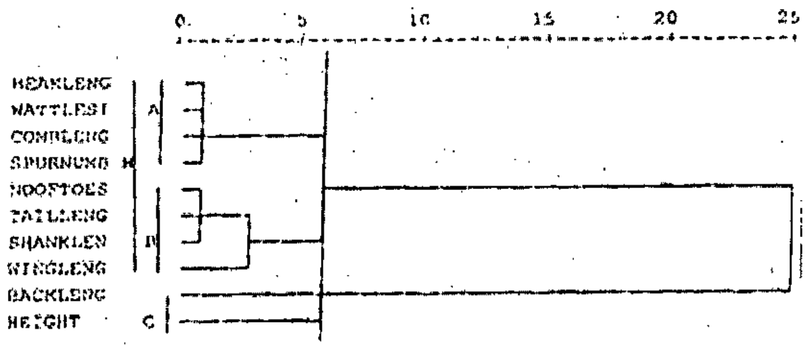

Fig 3: Dendrogram showing degrees of relatedness among the 10 traits (quantitative)

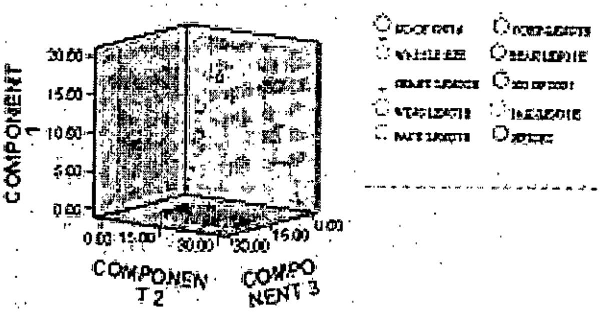

Fig 4: the degrees of relatedness among the 10 traits (quantitative)

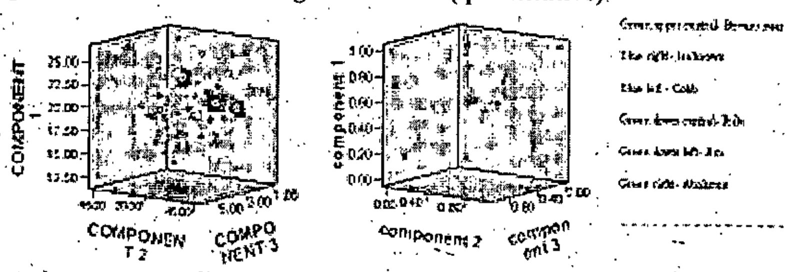

Fig 5: a. Relatedness among all the individuals; b. the relatedness among the 4 chicken types and the commercial type further separated into the 3 commercial breeds.

DISCUSSION AND CONCLUSION

For proper identification of these local chickens it is therefore necessary that proper characterisation is done as it has been established among the commercial or exotic breeds. This information will help to ascertain the category: "line", "breed", "variety" or type, a particular local chicken belongs.

Variations were observed in the plumage colours, shank colours and tail colours (qualitative traits). Major colours observed include white, black, brown, gray, red and mixture of colours, however, considerable number of the chickens show heterogeneity. The presence of such large variations in colours, especially plumage colours, may be the result of factors such as geographical isolation, natural and artificial selections, uncontrolled cross breeding among others. This is in agreement with previous reports from Ethiopia, Tanzania and Senegal (Mogesse, 2007 and Msoffe *et al.*, 2001). The correlation matrixes show that not less than 54% of the traits measured have less than 0.1 correlations, an indication that some traits may be interdependent.

Dispersed locations of the four chicken types were observed. The exotic type was found to be more distant from the local types, although, the local types did not cluster together, an indication that certain degree of non-relatedness may exist. This may be due to the considerable genetic differences that exist between them; however, it was observed that the closest neighbour with the local types, 26% similarity level, was with the *Abolorun* local chicken type suggesting that the naked neck may be more closely related to the exotics. The *Asaa* and the *Ibile* local chicken types show a closer relationship at a very close level of relatedness (89%) away from the exotic and *Abolorun* types suggesting some considerable genetic similarity. Furthermore, the *Asaa* and the exotic types also showed a more distant relatedness, over 90% non-relatedness. The similarities or relatedness and non-relatedness are, of course, due to the variations observed in the measured traits which are in agreement with previous reports from the other African countries listed in this report.

In this study 4 traits: wattle size, comb length, beak length and spur number were found to show some degree of interdependence. Interdependence among morphological traits was also reported by Ogah (2009). Interdependence was also observed among number of toes, tail length, shank length and wing length while a closer relationship was seen between the back length and the height. This suggests stronger interaction between height and back length than with the other eight traits. Thus, this may be a possible suggestion that some degree of influences or relationships may exist between or among these traits. This agrees with the report of Moggese, (2007) and Msoffe *et al.*, (2001). It is recommended that no conclusion be drawn; therefore, it is very necessary that genetic studies are carried out on this aspect of the study to verify and ascertain this finding.

Variations were also observed to exist in the qualitative traits measured. This report is in agreement with previous reports from Senegal, Ethiopia, Zimbabwe, Botswana and

Tanzania (Badubi *et al.*, 2006; Mcainsh *et al.*, 2004; Moggese, 2007 and Msoffe *et al.*, 2001). The commercial type was further separated into the 3 commercial breeds because of the differences in their morphological appearances. The figure revealed phenotype distinctions among these chicken types and among the breeds: the scattered plot showed the *Ibile* (wild) type positioned almost at the centre with others flanking at different distances which may be suggesting that the other types might have originated from it. The *Asaa* and the *Abolurun* types appeared to be the closest neighbours to the *Ibile* type while the commercial breeds are distantly located at different points. Furthermore, while the local types share some degree of relatedness towards the base (origin) of the chart, possibly due to some genetic similarities, the commercial breeds also show some degree of relatedness with all three breeds located towards the upper region of the chart. This is in line with the expected result. These patterns of relatedness among the types and breeds observed tend to correspond with what was revealed in the Figures (1-4) generated from the quantitative measurements. Variations in head shape has also been reported in other countries (Badubi *et al.*, 2006; Bhuiyan *et al.*, 2005; Moggese, 2007 and Mcainsh *et al.*, 2004), although in this report head shape was not investigated; the findings are in agreement. Moggese (2007) reported that genetic differences exist among local chickens (Ethiopia) stating that, "the population tested as a group there is a relatively high genetic variation as indicated by the high heterozygosity values". Our results show indications that the three local chicken types may not fall into same classification and that some morphological traits may influence one another. Therefore, further studies are needed to catalogue and investigate for the genetic and overall characterization of local chicken populations.

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