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Morphological and morphometric characterization of local duck population in South-east ecological zone of Nigeria

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Target Audience: *Duck farmers, livestock breeders, researchers.*

Abstract

The study was conducted to characterize morphologic and morphometric variations among local duck populations found in the south-east ecological zone of Nigeria. A total of one hundred and forty-six (146) adult local ducks of both sexes were randomly selected from Imo and Abia States and used for the study. Nine morphological traits which include eye colour, plumage colour, bean colour, body carriage, bill colour, bill shape, shank colour, caruncle colour, crested were studied. Also eight morphometric traits such as body weight, body length, body circumference, thigh circumference, bill length, neck length, foot length, total foot length and wing length were studied. Data on morphological traits were subjected to descriptive analysis, such as frequencies, percentages, and averages, while data on morphometric traits were subjected to analysis of variance (ANOVA) in a completely randomized design. Results showed seven (7) phenotypes among local ducks. Predominant plumage colour was black/white (54.79%), shank colour was slate gray (70.55%) predominant eyes colour was brown (76.03%). The majority of local ducks (97.26%) had a pink/white colour, while 97.95% of the ducks had horizontal body carriage. Caruncle colour, bill shape, bean color, and crested showed no variation among duck populations. Drakes were superior ($p<0.05$) to hens for body weight and other morphometric traits measured. Positive and highly significant correlations ($p<0.01;0.05$) were observed among measured morphometric traits. The results obtained in this study could be used for the improvement and conservation of these local ducks in the south-east ecological zone of Nigeria.

Key words*: Characterization; Diversity; Ducks; Phenotype; Variation*

Description of the Problem

The protein consumption from animal origin in Nigeria is significantly lower than in other countries of the world. To meet up with the growing demand for animal protein, efforts should be directed to rearing animals that are prolific and have short generation intervals and one of such animals is the duck. The duck is a locally adapted poultry specie in Nigeria and has an outstanding potential for meat and egg production and also the ability to feed well on feed materials that are unretrivable by other livestock. Despite the potentials of the duck, it has been highly neglected and greatly prejudiced as it is surrounded by myths and taboos which has hindered greatly its acceptance thereby affecting its improvement and conservation and the waning number of

ducks in recent years corroborates reports of the total neglect of this poultry specie by farmers (1) (2). These ducks, are predominantly found in rural areas where they are reared by small-holder farmers (3) (4) even though they are a vital part of local poultry sector in Nigeria.

The Nigerian ducks also suffer research and improvement neglect as shown by limited publications on their productivity, genetic diversity and phenotypic characterization which is fundamental to its conservation, and efficient utilization. Specifically, the phenotypic and genetic variations inherent among duck populations of southeastern Nigeria required for the development of proper breeding plans and programmes for the zone and Nigeria as a whole has however not been correctly clarified, thus many gaps exist in the identification and conservation of genes controlling advantageous traits in these ducks (5).

Morphological characterization in ducks is vital because directional selection on morphological traits, which commonly occurs in natural populations (6), rarely operates on only one character at a time. Knowledge about body size and skeletal proportions of native stock is important as it can show, to some extent, the genetic differences existing among populations (5) and can equally serve as the foundation upon which DNA analysis can be built. Morphometric characters are continuous traits describing aspects of body shape (7) (8), and at such their variations between populations could provide the basis for understanding flock structure, and may be more applicable for studying short-term, environmentally induced variations. Thus, it could be applicable to duck management. According to (9), morphological description is an important component of breed characterization that could be used to physically identify, describe and recognize a breed, and also to classify livestock breeds into broad categories, hence this study was carried out to determine the phenotypic variations among local duck populations of south-east Nigeria using morphological and morphometric traits.

Materials and Methods

The study was conducted to determine the phenotypic variations among local duck populations in Imo and Abia States of Nigeria. The area is located in a lowland area of the agro-ecological zone of Nigeria's rainforest at latitude $5^{0}45^{1}$N and longitude $8^{0}30^{1}$E. The average annual rainfall varies from 1980 to 2700mm while average minimum and maximum annual temperature varies from 19° C to 24° C and from 30° C to 35° C respectively, with an annual relative humidity of up to 90% during the rainy season (10). From the two States, two agricultural zones in each state and three local government areas in each agricultural zone were selected on purpose and used for the study. Due to the non-popularity of duck farmers in the region, the snowball sampling method was adopted: identification of ducks farmers were done through a request make to known ducks farmers to give information about other duck farmers they know in the area as described by (21). Thus, a total sample of 146 randomly selected adult local ducks of both sexes were used for the study. A simple structured questionnaire was designed and used to collect data on morphometric traits such as eye colour, plumage colour, bean colour, body carriage, bill colour, bill shape, shank colour, caruncle colour, crested (12)

In addition, nine morphometric traits such as body weight, body length, body circumference, thigh circumference, bill length, neck length, foot length, total foot length and wing length, were also determined as described by (13) (14) (15) (1).

Morphological characteristics were analyzed using descriptive statistics such as

frequencies, percentages and averages (16). Morphometric characters were subjected to analysis of variance (ANOVA) according to a completely randomized plan using the statistical model

$Y_{ij} = \mu + T_i + e_{ij}$

Where Y_{ij} = overall observation

μ = population mean

T_i = treatment effect of individual ducks

e_{ij} = Error term (normally, independently and identically distributed with zero mean and constant variance)

Means were separated using Duncan's Multiple Range Test of the same statistical software (32). The Pearson coefficients of correlation among the various body parameters were also estimated using (32).

Results and Discussion

Phenotypic variations among ducks

Figure 1 shows the variations in the plumage colour of local ducks in the study area. The predominant plumage colour was black with white patches (54.79%), followed by completely black (17.81%), completely white (10.96%), completely brown (8.22%), white with black patches (3.42%), brown with black patches (3.42%), brown with white patches (1.37%). The results of this study showed diverse plumage colours, indicating the presence of genetic variability among the duck population. This result is consistent with the findings of (17) in eastern Nigeria that reported seven phenotypes among native ducks. Similarly, black and multicoloured (marbled) as the predominant plumage color among local ducks was equally reported in the west (18), in the north-central (19), in the northwest (20), and in North eastern (21) parts of Nigeria. Plumage colour is a very important trait as it affects the selling price of these ducks. The small population of white ducks (white, black or brown) with feathers recorded in the study area may be due to the fact that these plain coloured ducks are associated with religious rituals and uses. These also attract higher prices, so they are quickly sold off instead of breeding them. Consumers prefer molted or multicolored ducks, as they are rarely used for rituals or for religious purposes but rather used for breeding hence the reason for their large number in the study area (18). In a similar study with local chicken, (22) reported that the presence of large variations in plumage colors may be the result of geographic isolation as well as periods of natural and artificial breeding. The significant variation in plumage color observed in the duck population in this study may be a trait of adaptability and survival (23).

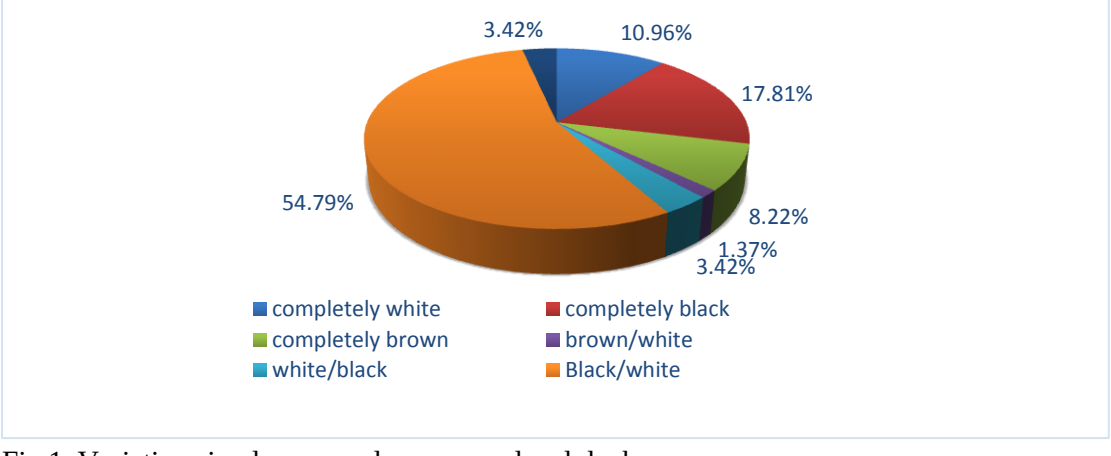

Fig 1. Variations in plumage colour among local ducks

Results on morphological traits of local ducks are shown in Table 1. The Muscovy duck was the predominant duck breed found in the study area while predominant shank colour among ducks was slate grey (70.55%), black colour (26.71%) and yellow colour (2.74%). Brown eye colour was predominant among local ducks (76.03%). Majority of the ducks (97.26%) had pink/white bill colour. Horizontal body carriage was observed for all ducks, caruncle colour for all ducks was red (100%), bill shape was uniform for all ducks (100%), bean colour was white (100%) while no duck was crested (100%).

Table 1: Morphological traits of local ducks

Traits	Characteristics	Imo (N=72) Freq. (%)	Abia (N=74) Freq. (%)	Overall Freq. (%)
Breed	Muscovy	72(100.00)	74(100.00)	146 (100.00)
	Others	0(0.00)	0(0.00)	0(0.00)
Bean Colour	Black	0(0.00)	0(0.00)	0(0.00)
	White	72(100.00)	74(100.00)	146 (100.00)
	Dark brown	0(0.00)	0(0.00)	0(0.00)
Body Carriage	Horizontal	72(100.00)	71(95.95)	143(97.95)
	Slightly upright	0(0.00)	3(4.05)	3(2.05)
Bill Colour	Pink /white	72(100.00)	70(94.59)	142(97.26)
	Black	0(0.00)	0(0.00)	0(0.00)
	Yellow	0(0.00)	4(5.41)	4(2.74)
Bill Shape	Uniform	72(100.00)	74(100.00)	146(100.00)
	Saddle	0(0.00)	0(0.00)	0(0.00)
	Hooked	0(0.00)	0(0.00)	0(0.00)
	Short	0(0.00)	0(0.00)	0(0.00)
Shank Colour	Yellow	1(1.39)	3(4.05)	4(2.74)
	Black	21(29.17)	18(24.32)	39(26.71)
	Slate grey	50(69.44)	53(71.62)	103(70.55)
Eye Colour	Yellow	0(0.00)	0(0.00)	0(0.00)
	Black/dark	20(2.78)	15(20.27)	35(23.97)
	Brown	52(72.22)	59(79.73)	111(76.03)
Caruncle colour	Red	72(100.00)	74(100.00)	146(100.00)
	Black	0(0.00)	0(0.00)	0(0.00)
Crested	Yes	0(0.00)	0(0.00)	0(0.00)
	No	72(100.00)	74(100.00)	146(100.00)

The predominant shank colour observed in this study is in line with findings by (19), who reported predominant shank colour as black-yellow pigmentation, followed by black and yellow in Northern Nigeria. In another study, four shank colours of yellow, black, slate and ash was reported among ducks of Western Nigeria of which the yellow pigmentation was predominant (18). This result equally collaborates the findings of (2) that reported yellow shank colour as the predominant shank colour among ducks in Cambodia. The variations in shank colour reported in this study could be due to indiscriminate matings among local ducks when selection for controlled breeding purposes is not practiced by duck farmers. Figure 2 show the various plumage colours among ducks in the study area. The predominant brown eye colour reported for this study agrees with the findings of (2) and (17) that reported brown eye colour as the most dominating eye colour among

indigenous ducks of Cambodia district and Imo state Nigeria respectively. Black bill colour was not recorded in the study area.

The results on bill colour among local ducks is in line with the findings of (20) that majority of ducks in North-west Nigeria had black-white bill, but disagrees with (19) that reported black-yellow as the predominant bill colour among North-central Nigeria ducks. Similarly, black was reported as the predominant bill colour among ducks in Southwest Nigeria and Cambodia (18) (2).

However, no variations observed in traits such as caruncle colour, bill shape, bean colour and crested. Although caruncle colour was red, caruncle colours in males were brighter and more prominent than in females were it was smaller and dull in colour. This result is in agreement with the findings of (2) and (18) that reported red colour as the predominant caruncle colour among Nigerian ducks. This results are equally at variance with (2) that reported black as the predominant bean colour among Cambodian ducks while (18) reported absence of red, brown and white bean colours in rainforest Muscovy ducks of Nigeria.

Fig: 2 Variation among ducks of southeast ecological zone, Nigeria

Sexual dimorphism among local ducks

Table 2 shows results on sexual dimorphism among local ducks in the study area. The local ducks exhibited a high degree of sexual dimorphism for each growth trait measured. The drakes were superior ($p<0.05$) to the ducks for body weight and all the body characteristics studied. The average body weight for mature males and females were 1734.46g and 1438.28g respectively. Sexual dimorphism in body weight and other linear body measurements in favour of males recorded in this study is consistent with the reports of previous studies on Muscovy ducks (24) (13) (14) (3), Musk duck (25) and other water birds such as Great Comorants (*Phalacrocorax carbo*) (26) and Carlifornia Gulls (*Larus carlifonicus*) (27). The differences observed in weight and body measurements could be due to the more efficient feed conversion of the drakes (28). While studying sexual size dimorphism of the musk duck, (25) found that body mass ratios (male: female) for Musk ducks are among the highest reported for birds (more than 3:1). This result agrees with (29) who discovered that in most sexually dimorphic species, males appear bigger in size and more conspicuous compared to their female counterparts.

Table 2: Descriptive statistics showing sexual dimorphism among local ducks

Parameters	Mean±SE	
	Male	Female
Body weight(g)	1734.46 ± 136.38^a	1438.28± 26.68^b
Shank length(cm)	5.78 ± 0.18^a	5.44 ± 0.05^b
Wing length(cm)	25.82 ± 0.49^a	24.68 ± 0.19^b
Bill length(cm)	5.12 ± 0.19^a	4.67 ± 0.05^b
Body length(cm)	45.04 ± 0.78^a	42.69 ± 0.23^b
Body circumference(cm)	33.85 ± 0.97^a	32.01 ± 0.25^b
Thigh length(cm)	11.35 ± 0.36^a	10.73 ± 0.18^b
Neck length(cm)	14.14 ± 0.31^a	13.57 ± 0.12^b
Total foot length(cm)	24.03 ± 0.52^a	22.73 ± 0.11^b

a, b – Means with different superscripts are significantly different ($p<0.05$)

The values for body weights reported in this study is lower the values reported by (3) and this could be due to differences in geographical location of ducks. Female ducks in this study equally displayed a narrower body which is appropriate for egg production and brooding while the males showed longer body length and higher mean values for body circumference which is indicative of meatiness as reported by (14).

Sexual dimorphism observed in the study of (29) (30) was attributed to the usual between-sex differential hormonal effects on growth which is responsible for greater muscle development in males than in females. The proximate cause of sexual dimorphism is the factor that produces intersexual differences in growth rate, such as differences in growth hormone concentrations or trade-offs in allocating energy between growth and reproduction (31). Another possible explanation for the appearance of extreme sex-related differences in the biometrics of ducks is the strong female selection for high quality males or competition among males for limited access to females which leads to fixation of larger body size and other secondary sexual characters in males (25). Generally, a higher phenotypic variation of traits indicates a higher genetic variation which guarantees a sufficient selection response (14).The variations between male and female ducks recorded in this study

further suggests that there should be different selection and genetic improvement programs for male and female ducks.

Correlation of morphometric traits among ducks

Correlation coefficients of body weight and linear body measurements of the local ducks are presented in Table 3. Positive and highly significant ($p< 0.01$) correlations were observed among all growth traits measured which ranged from 0.132 to 0.914. The highest correlation value (0.914) was for body circumference and body weight and the least correlation value (0.132) was thigh length and body length. Body length and thigh length however did not show any significant correlation while shank length and thigh length showed a negative correlation. Body circumference has been reported in different studies to be highly correlated to body weight hence, a good indicator of body weight.

The high and positive correlation reported in this work agrees with the reports of other authors (21) (32) (14), for zoometric body measurements of Muscovy ducks in which high, positive and highly significant correlations were observed between body weights and all body measurements. High and positive correlations have also been reported between zoometrical measurements and body weights in African Muscovy ducks in general (13).

The strong and positive correlation coefficients reported between traits in this study suggest that duck populations will respond positively for selection of traits of economic importance (32). This result simply indicates that selecting for body weight in a breeding programme will positively improve all other growth traits of local ducks in the study area. Again high positive relationship between traits indicates that they are under the same gene action and can be predicted from one another singly or in combination (33). This implies that these easily measured body parts can be used as basis for assessment and selection of body weight in ducks. Furthermore, the association existing between body measurements could present useful information on the performance and productivity of these ducks.

Table 3: Correlation matrix of body weight and linear body measurements of local ducks in Imo and Abia States

Parameters	Body weight (g)	Shank length (cm)	Wing length (cm)	Bill length (cm)	Body length (cm)	Body circumference(cm)	Thigh length (cm)	Neck length (cm)	Total foot Length (cm)
Body weight(g)	1								
Shank length(cm)	0.646**	1							
Wing length(cm)	0.373**	0.198*	1						
Bill length(cm)	0.742**	0.451**	0.266**	1					
Body length(cm)	0.738**	0.611**	0.366**	0.785**	1				
Body circumference(cm)	0.914**	0.637**	0.284**	0.764**	0.750**	1			
Thigh length(cm)	0.220**	-0.067	0.508**	0.231**	0.132	0.174*	1		
Neck length(cm)	0.531**	0.296**	0.440**	0.392**	0.387**	0.443**	0.410**	1	
Total foot length(cm)	0.707**	0.499**	0.484**	0.698**	0.655**	0.713**	0.301**	0.409**	1

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Conclusion and Applications

1. Morphologic and morphometric variations exist among local ducks in the study area.
2. Higher phenotypic variation among traits indicates a higher genetic variation which promises sufficient selection response that will respond positively for selection of traits of economic importance.
3. The results obtained in this study could be used for the improvement and conservation of these local ducks in the south east ecological zone of Nigeria.

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