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Phenotypic Characteristics of Pigeons (Columbia livia var domestica) found in Rain Forest Zone of Nigeria

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Abstract— Morphological characterization is an essential tool in assessing the genetic properties of any animal species. Although, it has been largely explored in many poultry species but little had been done in pigeon. Data on metric and non metric traits were collected on two hundred and eight (208) pigeons: 44 squabs, 45 weaners and 119 adults for the purpose of this study. The metric traits measured were body weight, body length and chest width while the non metric traits were the colour of the eyes, plumage patterns (on the head, wings and tail) and the colouration of the body extremities. Five types of pigeons: Types A, B, C, D and E were encountered in the study. Type C recorded the highest frequency of occurrence (29.81 %) while type E recorded the lowest frequency of occurrence (12.02 %). The body weights (g) among the groups though statistically similar {p>0.05) were 282.91g, 284.83g, 286.60g, 281.37g and 279.45g, respectively, for types A, B, C, D and E. Body length and chest width of squab and adult pigeons and the effect of age group on them were similar (p>0.05). Sex showed significant (p<0.05) effect on body weight and body dimensions of the birds with the male showing higher values. The length and width measurements of the weaner were significantly (p<0.05) lower to those of the squabs and adults. Pearson's correlation coefficients (r) of body weight with body length (r=0.33) and chest width (r =0.31) were positively correlated (p<0.05). Like in most tropical breeds of animals, indigenous pigeons had a small body size. The lack of statistical differences in the body weight of the various strains of pigeon suggested a high level of homozygosity in the pigeon genetic resource.

Index Terms— **Genetic properties, Homozygosity, Metric traits, Non metric traits, Pigeon.**

I. INTRODUCTION

Pigeons, though associated with myths (information gathered from owners/sellers interviewed orally), is the second most numerous poultry species kept in Nigeria [1]. In Nigeria, pigeons are generally raised for consumption within the compound and only a very small number of them reach the trade market where they are either sold for meat or as breeding stock [2]. Pigeon, apart from being extensively used for scientific research notably in genetics, parasitology, physiology and psychology [3], its meat has a gamy bird taste. The squab is highly nutritious with greater dressing percentage; larger proportion of soluble proteins and a smaller proportion of connective tissue compare to most meats. The meat is therefore good for invalids and people with digestive disorders.

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Pigeons are excellent parents as both adult male and female produce a nutritious 'pigeon milk'. The milk is produced by sloughing of layers of cells lining the crop, the rapid growth of these cells being controlled by the endocrine system [4], that is fed by regurgitation to the young. This milk is remarkably similar to mammalian milk being rich in protein and fats.

Despite these attributes, pigeon had been largely neglected as a potential genetic resource in all fields of agricultural researches. The reason for this could be attributed to the poor performance of the bird in term of meat and egg production. As a lead up to the improvement of the species, different phenotypic traits of the birds need to be identified and characterized accordingly.

Phenotypic traits are the external features of living organisms which could be metric or non metric. Non metric traits are measured subjectively i.e. by visual appraisal while metric traits involve objective measurements of height, length and width. Phenotypic characterization is useful in obtaining a better understanding of the composition and developmental patterns of the breed and such understanding can aid in guiding a breeding programme. It is also used to divide animals into species since it can reveal great diversity across species.

[5] reported that live weight is the best parameter for making management, health, production and marketing decisions. [6] reported that variation in body weight within a flock can be attributed to genetic variation and environmental factors that impinge on individuals. [7] concluded that body dimensions of farm animals play a profound role in determining the health status of the animal in question and have also been used in assessing growth rate, weight, feed utilization and carcass characteristics of farm animals. Also, [8] reported that body weight and dimensions are useful tools in determining the value of animals in terms of income and potential as breeding stock.

Effects of age on body weight and body dimensions of birds have been widely studied and documented in guinea fowl [9], [10], [11], [12]. Sexual dimorphisms on account of body weight in guinea fowls have also been documented [13], [10].

It is therefore the object of this study to phenotypically identify different strains of the bird using a few metric and non metric traits and to document quantitative variability obtained from these traits.

II. MATERIALS AND METHODS

A. *Source of Data*

The data for this study was collected from 208 pigeons at the Central Market in Ado-Ekiti, Nigeria. The market was chosen because of the high populations of pigeons brought there for sale from neighbouring villages particularly on market days.

B. *Management of Experimental Animals*

From oral interview gathered from owners who brought them for sale, the birds were managed under the traditional semi-intensive system of animal husbandry. Cubicles were provided for the birds at passages in the houses of the owners for the use of the birds at convenience. In the morning, the birds were served broken maize or guinea corn before they were allowed to roam freely to find their own food such as insects, leaves, bulbs, seeds, worms etc around the owners' house. It is a production system that can be afforded by the rural poor because of its low input and it constitutes a part of the rural economy. No routine health management was administered on the birds.

C. *Collection of Data*

Data were collected on metric and non-metric traits of the birds. The metric traits measured included: body weight, body length and chest width while the non metric traits included: colour of the eyes, plumage patterns (on the head, wings and tail) and the colouration of the body extremities (bill and claw).

Body weight of individual bird was taken using a sensitive digital weighing scale with sensitivity of 0.01 g as the total weight of the live pigeon; the body length was taken as the distance between the posterior end of the pygostyle and the anterior of the nasal openings and chest width measured as the distance between the anterior and posterior points of keel.

The measurements were effected using a measuring tape calibrated in centimetres. All variables were measured by the same trained operator to eliminate error due to personal differences. The measurements were taken in the mornings, before the animals were fed and allowed to leave the shelter to scavenge. Apparently this was done to avoid undesirable variations because of changes in live weight and internal organs' volumes as a result of feeding.

D. *Statistical Analysis*

The least square method of unequal subclass frequencies as outlined by [14] was applied to the body weight and body measurements using the following statistical model:

$$Y_{ijkl} = \mu + S_i + X_j + A_k + e_{ijkl}$$

Where:

Y_{ijkl} = estimated value for body weight or body linear measurement; μ = population mean that would exist if all classes had equal numbers; S_i = fixed effect of strain; X_j = fixed effect of sex; A_k = fixed effect of age group; e_{ijkl} = residual error

Correlation and regression analyses were carried out using [15] statistical package.

III. RESULTS AND DISCUSSION

A. *Metric Characteristics*

Table 1 showed the least square means of body weight, body length and chest width together with the frequency of occurrence of the pigeon types obtained in this work. Succinctly, five types of pigeons tagged Types A, B, C, D and E were encountered in the random sample of 208 pigeons in ten visits to Ado Ekiti central market between June and September 2009. In a similar study by [2], eleven types were reported. Type C recorded the highest frequency of occurrence (29.81%) while Type E recorded the lowest frequency (12.02%). Female pigeons brought for sale was 44.71% of the total while the male accounted for the remaining 55.29%. The reason why more male than female were brought to market for sale could be due to the fact that more female are needed in the breeding territory for proliferation. Again, it could be due to an unconscious attempt by owners to maintain sex ratio for breeding purpose or negative selection of male for sale because of their preferred body weight [16], [17]. Adult pigeon brought for sale represented 56% while the squab and weaner represented 21% and 23%, respectively. This situation suggested that those brought to market for sale were not necessarily for consumption but probably for mythical and other salient purposes because it is widely believed that more squab and weaner are consumed than the adult pigeon [3].

The body weights of all the types reported in this study were similar ($p>0.05$) with a range of 7.15 g. The average body weight of the pigeon types was 283.32±1.43 g which was similar to the value of between 268 g and 294 g reported by [2]. However, the value recorded in this study was lower than the range of 340 - 680 g reported by [3]. This disparity might be due to differences in the management practices employed in raising the birds. Sex exerted statistical significant ($p<0.05$) effect on body weight of the birds with the male showing higher value. The sexual dimorphism observed in this study explained the differences between male and female sex-hormones with the male hormone demonstrating growth promoting effect which tends to confer greater ability for muscle development in male than in female. Body weight of the pigeons varied significantly ($P<0.05$) among the age groups. The results showed that squab were the heaviest followed by adult pigeon. The reason for this could be due to the parental care the squab received, especially the 'pigeon milk', which was reported to double the squab's weight within two to three weeks after hatch [18]. The lower weight of the adult pigeon compared to the squab could be ascribed to the reduction of the body weight as a result of reproductive pressure because reproductive activities are energy sapping. Therefore, a good proportion of the energy meant for growth will be directed towards body maintenance and reproductive activities rather than for weight development. This relatively low body weight of the weaner is a pointer to the natural tendency for the weaner to gain more weight with age.

The least square means for body-length and chest width of squab and adult pigeons were statistically ($p>0.05$) similar with ranges of 0.76 and 0.50 cm, respectively. These values differ from the range of 0.96 and 0.59 reported by [2] for body length and chest width in local pigeons. The body length which depicts bone growth and the chest girth which describes the muscularity of the birds were statistically (p>0.05) similar in all the types. This suggests that all the types are homozygous but differ only in plumage colouration. Body-length and chest width varied significantly (p<0.05) between the two sexes with the male showing higher value in both cases. It is important to note that these two parameters followed the same trend with the live weight and therefore the same reasons adduced for live weights in both male and female go for the body measurements. The effect of age group on the body length and chest width measurement were similar (p>0.05) between the squab and the adult birds. However, the length and width measurements of the weaner were significantly (p<0.05) lower to those of the squabs and adults. These lower body measurements of weaners are pointing to the natural tendency for developing skeletally and muscularly with age.

Characteristics of most tropical breeds of animals, indigenous pigeons in this study, have a small body build and linear measurements which elucidate their malleability to their harsh environmental conditions. This conceivably means that their unrelenting survival in the tropics was made possible by perpetual reductions in body weight and zoometrical measurements over a long period of time. This is because small body stature and linear measurements are fundamental factors in reducing the maintenance feed requirements and increase feed efficiency which is essential for survival in the scavenging system due to dearth and insecurity surrounding feed supply. This is consistent with the report of [19] that linked environment with the phenotypic characteristics of individual chickens in the tropics.

The Pearson's correlation coefficients between body weight and body measurements are presented in Table 2. The three measured body characteristics were positive and significantly correlated (P<0.001). The highest correlation coefficient recorded was between body length and chest width (r=0.50), followed by body weight and body length (r=0.33) and body weight and chest width (r=0.31). These findings are in agreement with the reports of [17and [2]. The positive and significant relationships among these body parameters suggest that the parts were under the influence of the same gene.

B. Non-metric Traits

Table 3 showed the plumage pattern on head, wing and tail of the studied populations. In Type A, a combination of white and black colourations was observed on the head, wing and tail of the birds. Type B has a combination of gray and red, Type C has blue and black combinations; Type D has a combination of black, gray, red and blue while Type E has a combination of Gray, Green, Purple and Blue on the selected body parts. From the present result, it is difficult to identify the various strains based solely on the plumage colouration because of the high degree of variability observed. Further screening of the strains through phenotypic assortative mating, that is, mating like to like, would probably assist in revealing the true plumage patterns in the strains.

It is relevant to add at this point that, melanin is the pigment which provides the colour that are seen and since in the case of white, melanin is not put into the feather; white can therefore not be regarded as a feather colour [20].

During embryonic development, melanin pigment synthesis could be disrupted such that the melanin is never produced or it is produced but did not get placed into the feather of the bird. Consequently, the feather grows normally, but without melanin available to colour it. The white colour seen is a result of light rays hitting the feather and being bounced back to eyes. Since none of the various light rays are absorbed by the melanin, all of them are bounced back as white [20].

Succinctly, depending on melanin's shape and concentration, the three primary colours (red, green and blue) and their combinations are manifested [20].

C. Coloration of Body Extremities

Table 4 showed the frequency of colouration patterns on the bill and claws in different types of the studied pigeon. Two colours- pink and black were identified at the body extremities made up of the bill and claw. Type A has a frequency of 83.33% and 72.92% of pink and 16.67% and 27.08% of black at the bill and claw regions respectively. Type B recorded a frequency of 64.10% and 58.97% of pink and 35.90% and 41.03% of black at the same areas respectively. Type C has a frequency of 41.93 % and 38.71 % of pink and 58.06% and 61.29% of black at the bill and claw areas, respectively. The frequency of Type D were 64.71% and 70.59% of pink and 35.29% and 29.41% of black at the bill and claw regions respectively while Type E recorded frequencies of 24.00% and 52.00% of pink and 76.00% and 48.00% of black at the bill and claw regions, respectively. Pigmentation had been reported to depend on melanin concentration in the dermis and epidermis of skins which is nutritionally driven [21], [22]. Consequently, it could be deduced that the food resource for the birds investigated were not likely to make the birds acceptable to consumers according to [23] who favoured yellow shank as favourable attributes for consumers' preference. Also, [24] reported that yellow and black colours are common colours in skin and extremities of poultry contrary to the finding in this study that favours pink and black.

D. Sex Effect on Colouration of Bill and Claw

Table 5 showed the frequency of black and pink colouration patterns on the bill and claw in male and female pigeons. Type A has frequencies of 43.75 and 45.83% pink bill and 8.33 and 2.08% black bill for male and female, respectively. The frequencies of the claw in Type A as obtained in this study were 52.08 and 27.08% pink and 8.33 and 12.50% black for male and female, respectively. In Type B, the frequency of occurrence of bill colouration in male and female pigeons were respectively 43.59 and 25.64% pink and 12.82 and 17.95% black while the corresponding claw frequencies were 30.77 and 30.77 % pink and 25.64 and 12.82% black. Type C frequencies of the colouration in male and female pigeons respectively were 32.36 and 11.29% pink bill, 30.65 and 25.91% black bill, 16.13 and 15.13% pink claw and 49.32 and 27.42% black claw. The record for Type D revealed 38.24%, 20.59%, 32.35% and 26.47% for pink bill, black bill, pink claw and black claw in male pigeons and corresponding values of 20.59%, 20.59% 26.47% and 14.71% for female pigeons. Lastly in Type E the frequencies were 12%, 16%, 48%, 24%, 40%, 20%, 24% and 16% for pink bill in male, pink bill in female, black bill in male, black bill in female, pink claw in male, pink claw in female, black claw in male and black claw in female, respectively. Except in Type A and E with very similar pink bill in both male and female, the pink bill was predominant in male. On the other hand, the black bill was predominant in Type E of male, the same in Type D of male and female while it has the least frequency in Type A of female. The pink claw was predominant in Types A and E of male, the same in Types B and C of male and female and similar between the males and females in Type D. Black claw predominated in Type C of males.

IV. CONCLUSION

The mean values obtained for the body weight and body linear measurements of the pigeon varied significantly according to sex and age. The lack of significant difference in body weight of the pigeon of various strains suggests a high level of homozygosity in the pigeon genetic resources. Plumage pattern and colouration of body extremities showed slight but sometimes distinct peculiarities.

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Table 1: The Least Square Means (LSM) for body weight (g) and body dimensions (cm) of pigeon

		Body weight (g)		Body length (cm)		Chest width (cm)		
Types	No	LSM	SE	LSM	SE	LSM	SE	Frequency (%)
A	48	282.91	3.32	17.60	0.20	17.32	0.21	23.08
B	39	284.83	3.72	17.22	0.21	17.23	0.20	18.75
C	62	286.60	2.93	17.22	0.14	17.12	0.15	29.81
D	34	281.37	4.04	16.84	0.23	16.84	0.21	16.35
E	25	279.45	4.63	17.15	0.26	16.82	0.22	12.02
Sex								
Male	115	290.41^{a}	1.91	16.63^{a}	0.11	16.72^{a}	0.10	55.29
Female	93	269.53^{b}	1.74	15.72^{b}	0.10	15.80^{b}	0.10	44.71
Age								
Squab	44	301.14^{a}	2.60	17.12^{a}	0.10	17.33^{a}	0.10	21
Weaner	45	252.40^{c}	2.51	16.61^{b}	0.10	16.72^{b}	0.10	23
Adult	119	283.31^{b}	1.62	17.43^{a}	0.10	17.24^{a}	0.10	56

^{abc} means with different superscripts in the same column in types, sex and age are significantly (P>0.05) different.

Table 2: Correlation coefficient between body weights, body length and chest width of the pigeons

Characteristics	Body weight	Body length	Chest width
Body weight	1	0.33***	0.31***
Body length		1	0.50***
Chest width			1

*** = P<0.001

Table 3: Plumage patterns on selected parts of the body of the pigeons

Types	**Head**	**Wing**	**Tail**
A	White/Black	White/Black	White/Black
B	Gray/Red	White/Red/Gray	White/Red/Gray
C	Black/ Blue	Black	Black/Blue
D	Gray/Red	Black/Gray	Black/Blue
E	Gray/Green	Green/Gray	Purple/Blue

Table 4: Frequency of coloration of extremities (bill and claw) in different types of the pigeons

Parameter	No	Bill		Claw	
		Pink	Black	Pink	Black
Type A	48	40	8	35	13
Type B	39	25	14	23	16
Type C	62	26	36	24	38
Type D	34	22	12	24	10
Type E	25	6	19	13	12

Table 5: Frequency of coloration of bill and claw in different types of male and female pigeons.

		Pink Bill		Black Bill		Pink claw		Black claw	
	No	Male	Female	Male	Female	Male	Female	Male	Female
Type A	48	21	22	4	1	25	13	4	6
Type B	39	17	10	5	7	12	12	10	5
Type C	62	20	7	19	16	10	10	25	17
Type D	34	13	7	7	7	11	9	9	5
Type E	25	3	4	12	6	10	5	6	4