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SHARED VARIABILITY OF BODY SHAPE CHARACTERS IN ADULT MUSCOVY DUCK

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Abstract: In this study body weight and six body measurements namely body length, breast circumference, thigh length, shank length , total leg length and wing length of 150 twenty weeks old male and female Nigeria indigenous muscovy duck, reared under semi intensive system, were subjected to factor analysis. The objectives of the study were to evaluate the main sources of shared variability among body shape characters, to deduce the factors that describe these characteristics and to quantify sex differences in morphometric size and shape in adult muscovy duck. Variation occur in descriptive statistics between male and female traits in favour of the male in almost all traits except shank length. Magnitude of correlation also differ between sexes. Common factor variability in the measured traits in both sexes were accounted for by two factors and are about similar. Body conformation and shape appears to be controlled by common and unique factors. Communalities ranged from 0.671 for shank length to 0.987 for body length.

Key words: muscovy duck, body measurement, communality, shared variability and
factor analysis

Introduction

Biometrical variation into size and shape component in domesticated animal has been an area of growing interest to animal breeders. These concepts are fundamental to the analysis of variation in the animals. Morphological measurement have been found useful in contrasting size and shape of animal *(Mckraken et al., 2000; Latshaw and Bishop 2001)* and to estimate body weight. However, correlation between body dimensions may be different if the dimensions are treated as bivariates rather than multivariates. This is because of the interrelatedness or lack of orthogonality (collinearity) of the explanatory variables. Since body measurements are interrelated both genetically and phenotypically

Blasco et al. (1984), the analysis of these traits should be consider interdependence among these traits *(Shahin and Hassan, 2000)*.

Sexual dimorphism in muscovy duck have been expressed by several authors *(Baeza 2001; Yakubu, 2009; Ogah et al., 2009)*. An attempt have also been carry out in assessing size and shape in muscovy duck using principal component analysis *(Ogah et al., 2009)*, not considering the common and unique factors involved.

The current work was to evaluate main sources of shared variability in male and female adult muscovy duck and to deduce factors that describe body conformation in the duck.

Materials and Methods

One hundred and fifty muscovy ducklings made up of 63 males and 87 females were hatched by 60 dams and 10 sires at the duck unit, Livestock Complex, Teaching and Research Farm of the College of Agriculture Lafia , Nasarawa State, Nigeria. The ducklings used for this study were selected randomly at 3 weeks of age and managed under semi intensive system to 20 weeks of age. The birds were fed on grower marsh formulated at 20% CP and 12058kj/kg and water was supplied *ad libitum*.

The body weight in grams and dimension in centimetre were recorded for each ducklings at 3, 5, 10, 15 and 20 weeks of age. The linear body dimensions considered were body length (BL) length between the base of the neck and that of caudal end, Shank length (SL) distance from the shank joint to the extremity of the digitus pedis, breast circumference (BCC) measured under the wing through the anterior border of the breast bone crest and the central thoracic vertebrae, thigh length (TL) from the end of the drumstick to the body flank , total leg length (TLL), measured as the total length of the leg from the thigh to the extremity of the digitus pedis, wing length (WL) taken from the shoulder joint to the extremity of the terminal phalanx. To ensure accuracy each measurement was taken twice and the mean was use in subsequent analysis. The same person took all measurement and weighing throughout thus eliminating errors due to person differences as suggested by *(Shahin and Hassan, 2000)*.

Statistical analysis;

Mean, standard errors, and coefficient of variation of body weight and linear body measurements were calculated . General linear model (GLM) was used to analyse sex effect. Pearson coefficient of correlation (r) among body weight and various morphometric traits were estimated . For each sex the data was subjected to a factor analysis procedure of SAS (1999)(PROC FACTOR). The main sources of shared variation among the interdependence of body measurements (P) was expressed in terms of fewer mutually uncorrelated common factor F1, F2, Fq

(where q< p) than the original measurement *(Darton, 1980)*.The first factor contained the greatest portion of the original variation while the variables that shows higher power for causing this variation load in factor one. It was designated as a general size factor. The second factor normal have those traits that showed close variability not shown in first factor. Subsequent factors were mutually orthogonal to those preceding and to one another and contained less variation.

The model used is as follow as outline by *Shahin and Hassan (2000)*

$X= \Lambda F+U$

Where X= ap x 1 is a vector observational variables

Λ= ap x q a matrix of factor loading (factor-variate correlations, the degree of correlation of the variables with factor (the pattern matrix); F=aq x 1a

Vector of factors (non observable) and U = ap x 1 a vector of the specific unique factor.

The total variance of a variable was equal to unity and can be written as the form of common variance " Communalities" and unique variance"Uniqueness". The communality represent the portion of the variable variance accounted for by all common factor and the Uniqueness represent the portion of the variable variance not ascribable to its correlation with other variable *(Shahin and Hassan, 2000)*.

Results and Discussion

Original non –independent variables: The mean ±standard error and coefficient of variation of body weight and other morphometric traits of the Nigeria adult muscovy duck based on sex are presented in Table 1. Sex – influence ($P<0.05$) difference were observed in all traits except shank length , with superior values recorded for the drakes. These apparent sex associated differences have been reported earlier in previous studies on muscovy duck *(Baeza et al., 2001; Teguia et al., 2008; Yakubu, 2009)*. The dimorphism might be attributed to the usual between sex associated hormonal effect on growth as reported by *(Deeb and Cahaner 2001)*. *Baeza et al. (1999)* submitted that the degree of divergence between sexes however differ, where there was selection for increase body weight the drakes will mutually twice the size of the female. The average live weight and body measurement obtained in the present study are slightly lower than what *Hu et al.(1999, 2006)* obtained but similar to what *Mopate et al.(1999)* reported on African muscovy duck. The differences obtained here might be due to the non selection and continuous inbreeding in the Nigerian muscovy duck.

Tabe 1. Descriptive statistics of body weight(g) and body measurements(cm) of adult muscovy duck based on sex

Variable	Mean ± SE	Coef.Var	Minimum	Maximum
Male				
BW	2691.6±30.7	3.78	2456.4	2887.0
BL	47.61± 0.17	1.23	46.21	48.14
BCC	39.32±0.18	1.51	38.35	40.20
TL	8.88± 0.03	0.97	8.69	9.01
SL	6.59 ± 0.05	2.49	6.40	6.90
TLL	20.52±0.23	3.68	18.11	22.05
WL	36.99±0.16	1.42	36.67	38.27
Female				
BW	1504.6± 9.60	2.02	1491.2	1590.2
BL	38.61± 0.15	1.18	38.34	39.65
BCC	31.89± 0.29	2.85	31.23	33.98
TL	6.84± 0.12	5.65	6.55	7.76
SL	6.59±0.11	5.03	6.20	7.10
TLL	16.86±0.07	1.31	16.76	17.46
WL	32.94±0.23	2.19	32.40	34.63

BW= body weight , BL= body length ,BCC= breast circumference, TL= thigh length , SL= shank length , TLL= total leg length , and WL= wing length .

Table 2. Correlation matrix between body weight and body measurements of adult muscovy duck male (above diagonal) female(below diagonal)

	BW	BL	BCC	TL	SL	TLL	WL
BW		0.858	0.874	0.899	0.643	0.977	0.868
BL	0.783		0.955	0.918	0.741	0.943	0.868
BCC	0.502	0.278		0.968	0.785	0.927	0.843
TL	0.927	0.687	0.616		0.789	0.922	0.884
SL	0.699	0.338	0.728	0.746		0.671	0.685
TLL	0.901	0.546	0.560	0.833	0.691		0.915
WL	0.765	0.413	0.675	0.704	0.949	0.758	

Pairwise correlation between body weight and biometric traits :Phenotypic correlation of the body weight and body measurements of the muscovy duck of both sexes are presented in Table 2. In the drakes significant($p<0.05$) ($P<0.001$) association existed among body weight and the biometric traits. The coefficient of

correlation ranges between 0.64 to 0.97 while the corresponding in female duck the coefficient ranged from 0.28 to 0.95. the estimate of the correlation coeffiecient in the present study are comparable to previous report *(Teguia et al., 2008; Ogah et al., 2009; Yakubu, 2009)*. The strong relationship observed between body weight and body measurements may be useful as selection criterion, thereby providing a basis for the genetic manipulation and improvement of the muscovy duck. The magnitude of the correlation among variable differ between male and female an indication of variability and relationship between measurements due to sex effect supporting the dimorphism earlier outline *(Baeza, 2001)*.

Table 3. Explained variation associated with rotated factor analysis along with communalities for each variable for male and female adult muscovy duck

Traits	Male				Female			
	common. fac. 1	2	communality	unique fac.	common fac. 1	2	Communal.	unique fac.
Body weight	0.942	0.299	0.976	0.024	0.942	0.248	0.948	0.052
Body length	0.668	0.651	0.870	0.130	-0.042	0992	0.987	0.013
Breast circm.	0.727	-0.464	0.743	0.257	0.965	0.002	0.932	0.932
Thigh length	0.931	0.170	0.895	0.105	0.977	-0.032	0.956	0.068
Shank length	0.873	-0.399	0.922	0.078	0.808	-0.132	0.671	0.044
Total leg length	0.898	0.090	0.815	0.185	0.969	0.140	0.959	0.041
Wing length	0.892	-0.304	0.888	0.112	0.031	-0.203	0.909	0.091
% of total var.	72.7	14.5			74.8	16.1		

Varimax rotated independent factors. Table 3 present the result of the factor analysis in male and female muscovy duck. Two common factors were obtained , contributing between 87.2% to 90.9% of the variability of the seven original variable. The first factor (F1) (general size) was characterized by high positive loading (factor –variate correlation) on all traits considered in the male with total percentage variance of 72.7% while in the female all traits had high positive loading to the (F1) except for body length with total percentage variance of 74.8%. The values obtained for the first factors were higher than what was earlier reported when principal component analysis was applied on eleven morphometric traits in muscovy duck (51.42 and 36.76) for male and female respectively *Ogah et al. (2009)*. *Yakubu et al. (2009)* also uses principal component analysis in examining the covariance of some linear traits in three Nigerian local

chicken genotypes found out that the first principal component general size accounted for 73.9%, 80.95 and 74.6% for normal feather, frizzled and necked neck chicken respectively. The differences in the factor extraction has to do with the way the weight is distributed over the body and genetic adaptation to physiological needs *(Goss ,1981)*.

Table 3 listed the communalities for the various traits, the variances of each trait was partitioned into common portion communality shared with some or all of the other variables and a uniqueness portion, unique to that particular trait and not shared with other variables. 74% to 99% of the variation in the conformation traits was brought about by common factors in both sexes, were as 1 to 16% of their variation were contributed by unique factor specific for each trait. In male the communalities for the conformation traits ranged between 0 .74 for breast circumference to 0.98 for body weight. While in female it ranges between 0.67 to 0.99 for shank length and body length respectively. This is similar to what *Shahin and Hassan (2000)* obtained for Egyptian breeds of rabbit.

In male of the body dimensions , breast circumference had the lowest communality with greatest uniqueness about 74.1% of the variation in breast circumference was brought about by common factor, where as 26% of the variation was contributed by a unique factor specific for this trait. In female shank length had the lowest communality 67% and variation brought about by common factor, while body length had the highest communality about 99%. From the result , communalities for skeletal dimension in male (shank length , thigh length , wing length and body length) were higher than the flesh dimension breast circumference. Similarly in female higher communalities were recorded on skeletal dimension .This finding is similar to what *Shahin et al.(1993)* reported, working with Egyptian buffalo bull, found that the communalities for skeletal dimensions(height at wither and hips were much higher than flesh dimension).The relative high estimates of common variance in both male and female traits is an indication that improving any one of the traits could result in the simultaneous improvement in the remaining traits.

Conclusion

The study have assessed the sources of shared variability of body shape in muscovy duck. It outlined significant morphological differentiation between sexes in favour of the male and similarly showed variability in trait association within sex.

The factor analysis method employed have also sufficiently explored the interdependence in the original seven morphometric traits by analyzing them simultaneously rather than individually and it is useful in consolidating and

describing the correlation and covariance among these interdependence traits in terms of the two interpretable common factor(size and shape) in both sexes.

Varijabilnost osobina telesne razvijenosti odraslih mošusnih pataka

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Rezime

U ovom istraživanju su analizirani telesna masa i šest osobina telesne razvijenosti – dužina tela, obim grudi, dužina bataka, dužina piska, ukupna dužina noge i krila, na uzorku od 150 nigerijskih autohtonih mošusnih pataka, ženskog i muškog pola, u uzrastu od dvadeset nedelja, koje su gajene u polu-intenzivnim uslovima/sistemu. Ciljevi ispitivanja su bili da se ocene osnovni izvori podeljene varijabilnosti između osobina telsne razvijenosti, da se odrede faktori koji opisuju ove karakteristike i kvanitifikuju razlike između polova u morfometrijskoj veličini i obliku tela odraslih mošusnih pataka. Varijacije u deskriptivnoj statistici su zabeležene između ženki i mužjaka kod skoro svih osobina osim dužine piska. Jačina korelacije se takođe razlikovala između polova. Konformacija tela je pod uticajem zajedničkog i jedinstvenih faktora, u opsegu od 0.671 za dužinu piska do 0.987 dužinu tela.

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