



## Phenotypic Correlation of Body Weight and Linear Body Measurements in Muscovy (*Cairinia Moschata*) and Mallard (*Anas Platyrhynchos*) Ducks

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### Abstract

Data on body weight and linear body measurements (LBMs) namely body height (BH), body length (BL), breast circumference (BC), thigh length (TL), bill length (BiL), wing length (WL) and shank length (SL) were taken from 120 ducks (i. e. 60 Muscovy and 60 Mallard ducks) at 4 and 8 weeks of age were analysed to obtain the phenotypic correlation between LBMs and body weight. The value of the pearson's linear correlation coefficient to determine the level of relationship between the body weight and linear body measurement. This ranged from 0.488 (SL) – 0.996 (BH) and (0.729 (SL) – 0.996 (BiL) in Muscovy and Mallard duck at week 4 respectively. While, at week 8, the value of the pearson's linear correlation coefficient ranges from 0.126 (BiL) – 0.960 (BL) and 0.735(BC) – 0.978 (BH) respectively. This positive and mostly significantly phenotypic relationship between the body weight and linear body measurements indicates that an improvement in one trait could leads to an improvement in the other. Correlation coefficients indicate the strength of a linear relation between traits and thus provide useful information about the traits involved for the purpose of breeding and improvement plan. This shows that favourable relationships exist among traits that have higher correlation coefficients, it further explains that such traits could be collectively included in the selection index to achieve positive phenotypic progress.

**Keywords:** Mallards; Muscovy; Linear body measurements; Correlations.

### 1. Introduction

There are two breeds of ducks commonly found in Nigeria together with their crosses. These include the Muscovy or Barbary and the Mallard Ducks [1]. They differ considerably in size, plumage colour and other characteristics [2] and are maintained traditionally with uncontrolled mating system causing genetic dilution of the local stocks [3]. Ducks represent the second largest poultry population in Africa after chicken. The local ducks in Nigeria constitutes about ten percent of the local poultry population [4]. Ducks production could help to alleviate the problems of animal protein shortage especially in the rural areas.

Growth in animals is a function of time, nutrition, on individual breed, husbandry system; health management practices among other varieties and animals of different ages have different live weight which provides reliable and informative measure for selection [5]. Body weight of an animal is a phenotypic expression of its genetic makeup under the prevailing environmental or rearing condition. Body weight plays important role in the determination of market price in farm animal [6].

Body weight of animals is the significance for the linear body measurement of the animals has been emphasized especially in its use for predicting live weight and relationship with the body morphometric traits [7, 8]. Variation in body weight within a flock can be attributed to genetic variation and environmental factors that impinge on individuals [9]. Linear body measurements are useful in live weight determination [10]. The relationships existing among linear body traits provide useful information on performance, productivity and carcass characteristics [11]. Breeders need to establish the relationship that exists between Body weight and Linear Body Measurements and to organize the breeding programmed so as to achieve an option combination of body weight and good conformation for maximum economic returns. It is important to have knowledge of the variation of morphometric traits in ducks genetic resources as such measurements have been discovered to be very useful in comparing body size and by implication, shape of animals. The study was conducted to identify the level of phenotypic correlation that exists between the body weight and linear body measurement of two different breeds of ducks at 4 and 8 weeks

## 2. Materials and Methods

Linear body measurements (LBMs) and body weight records were taken using measuring tapes and weighing scales from 120 ducklings (i.e. 60 of Muscovy and 60 Mallard) were purchased from a reputable hatchery in Nigeria and brooded for 4 weeks on deep litter. The ducks were randomly divided into 3 replicate per breed (i.e 20 ducks per replicate). The experiment was carried out at the poultry unit of the Department of Animal Science, University of Port Harcourt Demonstration Farm (Livestock Section) Choba Campus, Rivers State, Nigeria.

The experimental animals were penned on a deep litter and were also provided with fresh drinking water and wallowing trough for their water-related activities like preening, bathing, e.t.c. to exhibit their wild nature. They were also fed *ad libitum* with commercial feed throughout the experimental period. Necessary vaccines and medication were provided also for the experiment animals. Experimental Procedure and Data collection

Data on growth rate was obtained at 4<sup>th</sup> and 8<sup>th</sup> weeks from the two breeds of ducks and the following parameters were necessary and determined using measuring tape and electronic weighing scale. Body Weight (BW): Body weight is the entire weigh of the body. Body Height (BH): was measured from the tip of the webbed to the proximity of the head. Body Length (BL): was measured from the point from the joint of the neck to the joint of the caudal end (tail). Breast Circumference (BC): was measured under the wing from the beginning of the chest, to the end. Thigh Length (TL): was measured from the length from the joint of the lap to the point where the feet attaches. Bill Length (BIL): was measured from the length between the tip of the bill and the rear end of the beak. Wing Length (WL): taken from the shoulder joint to the extremity of the terminal phalanx. Shank Length (SL): was measured from the distance from the shank joint to the extremity of the digitus pedis.

To ensure accuracy each measurement was taken twice and the mean was use in subsequent analysis. The same person took all measurements and weighing throughout, thus eliminating errors due to person differences as suggested by [Shahin and Hassan \[12\]](#).

### 2.1. Statistical Analysis

Analysis of variance (ANOVA), using the General Linear Model Procedure of Statistical Procedure for the Social Science [13] was employed in the analysis. The simple Linear Correlation Procedure of SPSS [13] was used to establish the strength of linear relationship and association between the different LBMs together with the body weight using the model;

$$\Gamma = \frac{\sum X_i Y_i}{\sqrt{\sum X^2 \sum Y^2}}$$

Where  $\Gamma$  = Pearson's product moment correlation coefficient.

$X_1$  = the first random variation of the ith LBM or body weight

$Y_i$  = the second random variable of the ith LBM or body weight.

This was achieved using the correlation procedure

## 3. Results

**Table-1.** Phenotypic Correlation between Body weight and Linear Body Measurement of Muscovy at week 4

Traits	BW	BH	BL	BC	TL	BIL	WL	SL
BW	1							
BH	0.996*	1						
BL	0.749	0.805	1					
BC	0.681	0.737	0.994*	1				
TL	0.894	0.353	0.758	0.823	1			
BIL	0.876	0.830	0.782	0.844	0.999*	1		
WL	0.713	0.769	0.998*	0.999*	0.793	0.944*	1	
SL	0.488	0.409	0.993*	1.000**	0.828	0.849	0.998*	1

\*. Correlation is significant at  $p < 0.05$  level.

\*\* Correlation is highly significant at  $p < 0.01$  level.

Body Weight (BW), Body Length (BL), Body Height (BH), Body Circumference (BC), Tail Length (TL) Bill Length (BiL) Wing Length (WL), Shank Length (SL).

**Table 1** showed the phenotypic correlation between body weight and linear body measurement of muscovy at week 4. The results showed that the body weight and linear body measurements was significantly ( $p < 0.05$ ) and positively correlated with body height (0.996), non-significantly but positively correlated with body length (0.749), breast circumference (0.681), thigh length (0.894), bill length (0.876), wing length (0.713) and shank length (0.488). Breast circumference was highly significantly ( $p < 0.01$ ) and positively correlated with shank length (1.000).

**Table-2.** Phenotypic Correlation between Body weight and Linear Body Measurement of Mallard at week 4

Traits	BW	BH	BL	BC	TL	BIL	WL	SL
BW	1							
BH	0.939*	1						
BL	0.925*	0.999*	1					

BC	0.874	0.903*	0.877	1				
TL	0.990*	0.978*	0.969*	0.963*	1			
BIL	0.996*	0.965*	0.953	0.927	0.998*	1		
WL	0.759	0.675	0.701	0.788	0.660	0.701	1	
SL	0.729	0.920*	0.935*	0.646	0.817	0.784	0.106	1

\*. Correlation is significant at  $p < 0.05$  level.

Body Weight (BW), Body Length (BL), Body Height (BH), Body Circumference (BC) Tail Length (TL) Bill Length (BiL) Wing Length (WL), Shank Length (SL).

Phenotypic correlation between body weight and linear body measurements of Mallard at week 4 is presented in Table 2. The result showed that very high and positive phenotypic correlation exists between body weight and linear measurements of Mallard at week 4. Body weight was significantly ( $P < 0.05$ ) and positively correlated with the body height (0.909), body length (0.925), thigh length (0.990), and bill length (0.996), it was also observed that body weight was positively correlated with breast circumference (0.874), wing length (0.759) and shank length (0.729) but not significant ( $P > 0.05$ ). Body height was significantly and positively correlated with body length (0.999), body circumference (0.903), thigh length (0.978), bill length (0.965) and shank length (0.920) but non significantly but positively correlated with wing length (0.675). Also breast circumference was significantly and positively correlated with thigh length (0.963) and bill length (0.927) but non-significantly and but positively correlated with wing length (0.788) and shank length (0.646).

**Table-3.** Phenotypic Correlation between Body weight and Linear Body Measurement of Muscovy at week 8

Traits	BW	BH	BL	BC	TL	BIL	WL	SL
BW	1							
BH	0.721	1						
BL	0.960*	0.626	1					
BC	0.694	0.767	0.579	1				
TL	0.790	0.994*	0.461	0.698	1			
BIL	0.790	0.952*	0.824*	0.625	0.980*	1		
WL	0.678	0.998*	0.610	0.811	0.984*	0.929*	1	
SL	0.957*	0.908	0.903*	0.873	0.977	0.894	0.864	1

\*. Correlation is at the significant at  $p < 0.05$  level.

Body Weight (BW), Body Length (BL), Body Height (BH), Body Circumference (BC) Tail Length (TL) Bill Length (BiL) Wing Length (WL), Shank Length (SL)

Table 3 shows the phenotypic correlation between the body weight and linear body measurements of Muscovy at week 8. The result revealed that body weight of Muscovy at week 8 was positively and significantly ( $p < 0.05$ ) correlated with body length (0.960) and shank length (0.957). It was also observed that body weight was positively correlated but non-significant ( $P > 0.05$ ) with breast circumference (0.694), thigh length (0.790), bill length (0.126) and wing length (0.678).

The highest positive and significant and correlation exist between body height and wing length (0.998) while the least exist between body weight and bill length (0.126).

**Table-4.** Phenotypic Correlation between Body weight and Linear Body Measurement of Mallard at week 8

Traits	BW	BH	BL	BC	TL	BIL	WL	SL
BW	1							
BH	0.978*	1						
BL	0.735	0.870	1					
BC	0.977*	1.000*	0.873	1				
TL	0.787	0.6530	0.732	0.649	1			
BIL	0.990*	0.998*	0.827	0.997*	0.696	1		
WL	0.866	0.742	0.807	0.738	0.879	0.785	1	
SL	0.837	0.972	0.987	0.975*	0.975*	0.929*	0.703	1

\*. Correlation is significant at  $p < 0.05$  level

\*\*. Correlation is highly significant at  $p < 0.01$  level

Body Weight (BW), Body Length (BL), Body Height (BH), Body Circumference (BC) Tail Length (TL) Bill Length (BiL) Wing Length (WL), Shank Length (SL).

Table 4 shows the phenotypic correlation between body weight and other linear body parameters showed that body weight of Mallard was positively and significantly ( $p < 0.05$ ) correlated with body height (0.978), breast circumference (0.977) and bill length (0.990) but body weight was revealed no significantly and positively correlated with body length (0.735), thigh length (0.787), wing length (0.866) and shank length (0.837). Also phenotypic correlations among other body parameters measured indicated that body height was positively and highly significantly ( $p < 0.01$ ) correlated with breast circumference (1.000).

## 4. Discussion

The positive associations in this study suggest that an increase in one variable is associated with an increase in the correlated variable. This is in line with the report of Adeogun and Adeoye [14], who recorded a positively high phenotypic correlation estimates in Japanese quail.

This positive and mostly significantly phenotypic relationship between the body weight and linear body measurements indicates that an improvement in one trait could leads to an improvement in the other if they do demonstrate positive phenotypic association [15]. Similarly, the body weight had positive associations with linear body measurements in this study.

Correlation coefficients indicate the strength of a linear relation between traits and thus provide useful information about the traits involved for the purpose of breeding and improvement plan. The coefficient of correlation from this study varied from strong to low, positive and significant at most of the ages considered. The value obtained for coefficients of correlation at week 4 agreed with literature values reported by Okon, *et al.* [16]. Where moderation to high and positive ranges of phenotypic correlations between body weight and body measurements were observed at this age in their study. This shows that favourable relationships exist among traits that have higher correlation coefficients, it further explains that such traits could be collectively included in the selection index to achieve positive phenotypic progress [17].

The growth pattern result from this study showed that it was also in agreement with the conclusion of [18] that body weight of birds can be easily be predicted from any given value of seven body measurements (body length, body height, breast circumference, thigh length, bill length wing length and shank length). The high association between breast circumference and body weight indicating large muscles, bones and viscera in circumference of Muscovy ducks. Similar observation was reported by Szabone [19] and Raji, *et al.* [20] in geese and Muscovy ducks. This indicated that body weight could likely leads to improvement in body height and thigh length of Mallard at 4 weeks. This agreed with Oyegunle [21], that the significant and high positive correlations obtained for body weight and height (0.89 to 0.92).

These suggest that body height could be used as candidate trait in the improvement of body weight of Mallard at week 8.

These Muscovy and Mallard can be improved by exploiting the principle of phenotypic plasticity [22] to obtain strains [23] to complement other breeds of duck. Muscovy can also be used to upgrade some other indigenous ducks for better performance in a systematic breeding program.

The positive and significant phenotypic correlation coefficients between the two breeds are concomitantly to body weight. This is an indication that these easily measured parts can be used as criteria for estimation of body weight, and hence, can be useful in selection for improvement of traits of economic importance.

## 5. Conclusion

The result of this study indicates that in Muscovy and Mallard breeds of ducks, there is a positive correlation coefficient between the body weight and linear body measurements at week 4 and 8. This shows that unlike some breeds of poultry which exhibits different growth pattern in relation to the linear body measurements. These breeds of ducks have their unique growth pattern as exhibited in this study. This will help duck breeders to select and improve this breed of duck better.

## References

- [1] Suliman, A., Yapi-Gnaore, V., Kayang, B., Rognon, X., and Tixier-Boichard, M., 2010. "Phenotypic characterization and molecular polymorphism of indigenous poultry populations of the species." *J. Anim. Breed and Genet*, vol. 106, pp. 461-469.
- [2] Adesope, O. M. and Nodu, M. B., 2002. *A note on acceptance of duck as table-meat among inhabitants of selected communities in the Niger Delta zone*. Nigeria: Livestock Research for Rural Development. p. 14.
- [3] Muzani, A., Brahmantiyo, B., Sumatri, C., and Tapyadi, A., 2005. "Pendugaanjarak genetic padaitik cihateup, cirebon dan mojosari." *Media Peternakan*, vol. 28, pp. 109-116.
- [4] Oluyemi, J. A. and Ologbobo, A. D., 1997. "The significance and the management of the local ducks in Nigeria." In *Sustainability of the Nigerian livestock industry in 2000 AD*. Egbunike, G. N. and Iyayi, E. D. pp. 96-103.
- [5] Thiruvankander, A. K., 2005. "Determination of best-fitted regression model for the estimation of body weight in Kanni Adu kids under farmer's management systems." *Livestock Research for Rural Development*, vol. 17, p. 85.
- [6] Momoh, O. M. and Kershima, D. E., 2008. "Linear body measurements as predictors of body weight in Nigerian local chickens." *Asset Series A*, vol. 8, pp. 206-212.
- [7] Adewunmi, O. O., Chineke, C. A., A., A. J., and Oladipupo, O. A., 2006. "Effect of genotype and sex on linear body measurement in sheep." In *Proceedings of 11th Ann conf. of Anim. Sci. Asso. Of Nig. (ASAN) 18th Sept. Moor plantation Ibadam, Nigeria*. pp. 207- 209.
- [8] Tegbe, T. B. S. and Olurunju, S. A. S., 1988. "The prediction of live weight of crossbred pigs form three body measurements." *Nigerian Journal of Animal Production*, vol. 15, pp. 9-13.
- [9] Ayorinde, K. L. and Oke, U. K., 1995. "The influence of juvenile body weight and two feeding regimes during the growing phase on growth performance and early lay characteristics of pullets." *Nigerian Journal of Animal Production*, vol. 22, pp. 101-107.

- [10] Gul, S., Gorgulu, O., Keshin, M., Bicer, O., and Sar, A., 2005. "Some prediction equation of live weight from body measurement of show goats." *Nigerian Journal of Animal and Veterinary*, vol. 5, pp. 532-534.
- [11] Kabir, M., Yakubu, H., and Akpa, G. N., 2010. "Repeatability estimates for body linear measurements in broiler chickens." *Nigerian Journal of Animal Science*, vol. 12, pp. 7-14.
- [12] Shahin, K. A. and Hassan, N. S., 2000. "Sources of shared variability among body shape characters at marketing age in New Zealand White and Egyptian rabbit breeds." *Ann. Zootec.*, vol. 29, pp. 435-445.
- [13] SPSS, 2010. *Statistical package for social sciences*. SPSS Inc., 444 Michigan Avenue, Chicago, IL60611.
- [14] Adeogun, I. O. and Adeoye, A. A., 2004. "Heritability and phenotypic correlations of growth performance traits in Japanese Quails." *Livestock Research for Rural Development*, vol. 16, pp. 13–17.
- [15] Oyatade, T. K., 2011. "Morphometric differentiation and assessment of function of the Fulani and Yoruba ecotype indigenous chickens of Nigeria." *Int. Journal of Morphology*, vol. 26, pp. 975-980.
- [16] Okon, B., Ogar, I. B., and Mgbere, O. O., 1996. "Interrelationship of live body measurement of chicken in a humid tropical environment." *Nigerian Journal of Animal. Production*, vol. 24, pp. 7-12.
- [17] Ojo, O. A., 2010. *Genetic analysis of the measurements of hubbard breeders chicken in shika, Nigeria*. An M.SC Thesis Submitted to the Postgraduate school Ahmadu Bello University, Zaira.
- [18] Adeniji, F. O. and Ayorinde, K. L., 1990. "Prediction of body weight of broilers at different ages from linear body measurements." *Nigerian Journal of Animal Production*, vol. 17, pp. 42-47.
- [19] Szabone, W. E., 1987. "Changing of body measurements and correlation of these with body weight from 0 – 16 weeks of age in geese." *Allanthenyezeteses Takarmanyogas*, vol. 46, pp. 409–414.
- [20] Raji, A. O., Igwebuike, J. U., and Usman, M. T., 2009. "Zoometrical body measurements and their relation with live weight in matured local Muscovy ducks in Borno State, Nigeria." *Journal of Agricultural and Biological Science*, vol. 4, pp. 58-62.
- [21] Oyegunle, O. O., 2013. "Genetic, phenotypic and environmental correlation estimates among physical body traits of three turkey genotypes." *International Journal of Agricultural and Forestry Science*, vol. 10, pp. 484-491.
- [22] Auld, J. R., Agraval, A. A., and Relyea, R. A., 2010. "Re-evaluating the coats and limits of adaptive phenotypic plasticity." *Proceedings of the Royal Society B*, vol. 277, pp. 503–511.
- [23] Kokosynski, D. and Bernacki, Z., 2010. "Comparison of some traits in ducks from two conservative flocks." *Arch. Fuer Tierz. Dumerst*, vol. 53, pp. 484–493.