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ZOOMETRICAL BODY MEASUREMENTS AND THEIR RELATION WITH LIVE WEIGHT IN MATURED LOCAL MUSCOVY DUCKS IN BORNO STATE NIGERIA

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ABSTRACT

Zoometrical body measurements and their relationship with body weight of matured Muscovy ducks were determined. The effect of sex and plumage was significant ($P < 0.05$) for all body measurements. Drakes showed significantly higher body weight (2.71kg) than ducks (1.46kg) while black colored ducks had significantly higher weights than the other color types. High, positive and highly significant ($P < 0.01$) correlations were observed between body weights and all body measurements. Though chest girth ($r = 0.85$) and body length ($r = 0.87$) had the highest correlation with body weight, the most reliable prediction from regression analysis was between body weight and body length + chest girth + chest width ($R^2 = 0.856$, SE = 0.290). These parameters may be used to evaluate the body weight of ducks, in addition to being used as selection criteria.

Keywords: ducks, muscovy, body measurements, body weight, regression equations.

INTRODUCTION

Poultry keeping is of great significance to Nigerian households since more than 68% of farmers raise fowls, ducks and pigeons semi intensively (Asafa and Ayodele, 1997). Though the poultry industry has experienced tremendous growth in recent years, the growth has been with chickens (mainly exotic). Apart from the local chickens little or no attention has been given to other promising species like ducks. Though lately, the need to reduce the supply and demand gap of animal protein among rural and urban poor has led to some attention being given to these promising species. Ducks are hardy and resistant to many common poultry diseases (Smith, 1990). They lay many and large eggs and have rapid growth rate and high dressed weight of drakes (Duru *et al.*, 2006). Muscovy make up about 74% of the ducks in Nigeria, its meat has less fat and is considered to be healthier (Adesope and Nodu, 2002). Ferdus (1999) reported that increased duck rearing would be a great supplement to total poultry production since they will not interfere with chicken rearing due to different rearing and scavenging venues. Moreover, duck rearing would increase employment opportunities as well as provide a source of income to the rural women, landless and marginal farmers. Although, precise measurements of the productivity and biometry of the rural poultry is often complicated by the effects of indiscriminate cross breeding which has taken place between them and the exotic strains (Oluyemi, 1989). Chineke *et al.* (2002) reported that the relationship existing among body characteristics provide useful information on performance, productivity and carcass characteristics of animals and that these quantitative measures of size and shape are necessary for estimating genetic parameters in animal breeding programmes. This study is aimed at determining the relationship between body weight and body characteristics (zoometric) of matured Muscovy ducks reared extensively in Borno state of Nigeria.

MATERIALS AND METHODS

Study area

The data for this study was collected from the Maiduguri central poultry market, Maiduguri, Borno State. The ducks were brought from town and villages in Borno state. This site was chosen because ducks were brought for sale on a regular basis.

Climate and location

Maiduguri is located at longitude 13°05' East and 11°50' North and 354 metres above sea level. It falls within the Sahel region of West Africa, which is characterized by a short duration of rainfall. Annual rainfall ranges from 500-600mm, while the ambient temperature varies from 25°C-28°C in December- January and reaches up to 40°C and above by the month of April and May (Ugherughe and Ekedolum, 1986). The mean relative humidity ranges from 30-35% with a minimum in February- April when it drops to as low as 10% and maximum of about 90% in August (Ugherughe and Ekedolum, 1986).

Management of Ducks

Most of the ducks were extensively managed. They roam freely during the day and scavenge for food in refuse dumps and pastures and in some cases their meals are supplemented with kitchen wastes. In the evening, the ducks return home and are housed in shelters provided for protection against predators and harsh weather conditions. However, some birds have no shelter and therefore spend their nights on fences, treetops or roof tops.

Data collection

Using a 5 kg weighing scale and a measuring tape calibrated in centimeters (cm), measurements on body weights and body measurements were individually collected from ducks during 13 visits to the Maiduguri

Monday market. These visits were at random with interval of two weeks between so as to prevent repeated measurement of sets of ducks. Body length: it was measured between the first cervical vertebra and the pygostyle. Chest girth: circumference of the body at the tip of the pectus (hind breast). Chest width: it was measured as the distance between the right and left glenoid cavity. Femur length: this is the length from the knee joint to the hock.

Femur Circumference: circumference of the drumstick at the coxa region. Metatarsus length: length between the genu and the regiotarsalis. Metatarsus circumference: circumference of the middle of the metatarsus. Bill length: length between the tip of the beak and the base. Wing length: it was established as the linear measurement from the caput humeri to the end of the third carpal digit. Sex and plumage color were determined by visual examination.

Data analysis

The collected data were analyzed using the general linear model of SPSS 11.0 with sex and plumage color as fixed factors. Significant means were separated by the Duncan's multiple range tests. Correlation between measurements was determined by the Pearson's Correlation Coefficient. Separate models (Linear and Multiple) for body measurements singly and combined were enumerated. The regression model adopted was as follows:

$$Y = a + b_1 X_1 + b_2 X_2 + b_3 X_3$$

Where Y = body weight (kg)
X_1 to X_3 = body measurements
a = Intercept
b (1-3) = regression coefficients of Y on X (i = 1, 2, 3).

RESULTS AND DISCUSSIONS

Effect of sex

Means and standard error of the effect of sex on body weight and body measurements of Muscovy ducks are presented in Table-1. The Muscovy duck exhibited a high degree of sexual dimorphism. The drakes were superior ($P< 0.01$) to the ducks for body weight and all the body characteristics studied. The average body weight for males and females were 2.71kg and 1.46kg respectively. The body characteristics measured for drakes and ducks respectively were body length; 59.25cm vs 45.5cm, chest girth; 40.57cm vs 37.43cm, wing length; 31.01cm vs 23.99cm, chest width 14.96cm vs 13.00cm and bill length 5.98cm vs 4.91cm. Sexual dimorphism in favour ($P<0.05$) of drakes have been reported for body weight and body measurements (Etuk *et al.,* 2006; Kleczek *et al.,* 2006 and Taguia *et al.,* 2007). Etuk *et al.* (2006) reported body weights of 2507g and 1733.83g for drakes and ducks respectively. These values are close to those reported in this study. In addition, Tai and Rouvier (1998) observed that drakes were 50% heavier than ducks. The difference in weight and body measurements could be due to the more efficient feed conversion of the drakes as reported by Bochno *et al.* (1994).

Effect of plumage

The effect of plumage color on body weight and body measurements of ducks are presented in Table-2. Four plumage colors were recorded in the local Muscovy duck population during the period of the study. These were multicolor (36.9%), white (30.6%), black (6.4%) and black and white (26.1%). The mean body weight for the four plumage colors viz; multicolor, Black, white, and black and white were 2.64kg, 2.05kg, 2.12kg and 1.92kg respectively. The highest body weight among the four is 2.64 ± 0.05 for multicolor, followed by white, black and the least was black and white. In all the parameters measured, multicolor had significantly ($P<0.05$) higher measurements than black, white and black and white plumage color. Fisinin and Zlochevskaya, (1980) reported two populations of Muscovy ducks, the white and the black. Thus, the multicolored types could be the result of breeding between these populations and khaki Campbell or other ducks introduced into the country. The multicolored feather and the wide variation in plumage color observed in the duck population could be adaptability and a survival feature as reported by Odubote, (1994) in local chickens in Nigeria.

Correlation between body weight and body measurements

Correlation coefficients of body weight and zoometrical measurements of local ducks are presented in Table-3. Positive and highly significant ($P < 0.01$) correlations were observed. The correlation coefficients for body weight and zoometric body measurements ranged from 0.49 to 0.88. The highest correlation value (0.88) was for body length and wing length and the least correlation value (0.49) was femur length and metatarsus length. Between body weight and zoometrical measurements, chest girth and body length, (0.87 and 0.85, respectively) had the highest correlation values.

High and positive correlations have been reported between zoometrical measurements and body weights in African Muscovy ducks (Taguia *et al.,* 2007). They observed that the highest correlation value 0.990 and 0.993 were for body weight and wing length and body weight and chest girth. High and positive correlation has been reported between linear measurements and body weights in local chickens (Ibe and Nwakalor, 1987) and pigeons (Hassan and Adamu, 1997). They also observed that body length as well as chest width were strongly correlated to body weight in pigeons. Lilja (1983) reported that chest girth and chest width were positively correlated with body weight, but the strongest correlations were observed between chest girth and body weight (0.93). Chest measurements are regarded as reliable criteria to evaluate the body weight of most livestock (Szabone, 1997). The correlations in this study (0.49-0.88) are similar to those reported by Lilja (1983).

Regression analysis

Table-4 shows the regression equations and coefficient of determination (R^2) of zoometrical measurements of local ducks. The R^2 (coefficient of determination) values observed in this study ranged from 0.351 to 0.856. The highest value (0.856) was obtained when body length, chest width and chest girth were combined in a multiple regression equation. When chest width and chest girth, body length and chest girth and body length and chest width were used, the R^2 values were 0.797, 0.831 and 0.823 respectively. The least R^2 (0.351) value was determined between body weight and femur length. When used singly, chest girth had the highest R^2 of 0.728 followed by body length and wing length (R^2 = 0.704). Saatci and Tulku (2007) reported similar findings in Turkish geese. In their study, they concluded that regression analyses showed that easily measurable body parts (chest girth and body length) can help in the determination of body weight.

The higher association of body weight with chest girth was possibly due to relatively large contribution to body weight by chest girth consisting of bones, muscles and viscera. It is in concert with the findings of Szabone (1997), and Ngapongara *et al*. (2004).

Table-1. Means and standard error of zoometric measurements of muscovy ducks as affected by sex.

Variable	Male	Female
Metatarsus Length	68.83 ± 0.04^{a}	5.16 ± 0.02^{b}
Metatarsus Circumference	6.12 ± 0.02^{a}	4.56 ± 0.03^{b}
Femur Length	10.47 ± 0.14^{a}	7.00 ± 0.05^{b}
Femur Circumference	12.02 ± 0.07^{a}	9.2 ± 0.06^{b}
Chest Girth	40.57 ± 0.16^{a}	31.43 ± 0.13^{b}
Chest width	14.96 ± 0.50^{a}	13.00 ± 0.03^{b}
Body Length	59.25 ± 0.16^{a}	45.51 ± 0.12^{b}
Bill Length	5.98 ± 0.01^{a}	4.91 ± 0.02^{b}
Body Weight	2.71 ± 0.02^{a}	1.46 ± 0.02^{b}
Wing Length	31.01 ± 0.10^{a}	23.99 ± 0.08^{b}

^{ab}: Means within rows with different superscripts are significantly (P< 0.05) different from each other.

Table-2. Means and standard error of zoometrical measurements of local muscovy ducks affected by plumage color.

Variable	Black	Multicolor	White	Black and white
Metatarsus Length	5.98 ± 0.06^{b}	6.92 ± 0.09^{a}	5.98 ± 0.06^{b}	5.76 ± 0.06^{b}
Metatarsus Circumference	5.37 ± 0.05^{b}	6.12 ± 0.07^{a}	5.31 ± 0.05^{bc}	5.12 ± 0.06^{c}
Femur Length	8.66 ± 0.02^{b}	11.07 ± 0.99^{a}	8.77 ± 0.13^{b}	8.14 ± 0.13^{b}
Femur Circumference	10.40 ± 0.10^{b}	11.77 ± 0.19^{a}	10.79 ± 0.11^{b}	10.39 ± 0.13^{b}
Chest Girth	35.01 ± 0.28^{b}	40.20 ± 0.45^{a}	36.06 ± 0.33^{b}	35.24 ± 0.33^{b}
Chest Width	13.96 ± 0.07^{bc}	14.71 ± 0.11^{a}	14.03 ± 0.08^{b}	13.71 ± 0.08^{c}
Body Length	52.78 ± 0.38^{b}	59.74 ± 0.30^{a}	51.87 ± 0.44^{bc}	50.30 ± 0.46^{c}
Beak length	5.47 ± 0.03^{b}	5.96 ± 0.03^{a}	5.46 ± 0.03^{b}	5.34 ± 0.04^{b}
Body weight	2.05 ± 0.04^{bc}	2.64 ± 0.05^{a}	2.12 ± 0.04^{b}	$1.92 \pm 0.04_{c}$
Wing length	27.40 ± 0.20^{b}	31.02 ± 0.27^{a}	27.46 ± 0.24^{b}	26.66 ± 0.26^{b}

^{abc}. Means within rows with different superscripts are significantly (P< 0.05) different from each other.

Table-3. Correlation matrix of body weight and zoometrical measurements of mature muscovy ducks.

Variable	ML	MC	FL	FC	CG	CW	BL	BK	BW	WL
ML										
MC	0.75**									
FL	0.49**	0.54**								
FC	0.60**	0.70**	0.59**							
CG	0.69**	0.75**	0.56**	0.77**						
CW	0.60**	0.66**	0.56**	0.72**	0.74**					
BL	0.79**	0.83**	0.58**	0.70**	0.80**	0.74**				
BK	0.72**	0.81**	0.55**	0.67**	0.76**	0.69**	0.83**			
BW	0.72**	0.79**	0.59**	0.80**	0.85**	0.81**	0.87**	0.81**		
WL	0.73**	0.81**	0.59**	0.74**	0.81**	0.74**	0.88**	0.80**	0.87**	

** = Significant (P< 0.01)
CW = Chest width
BL = Body length
BK = Bill length
BW = Body weight
FC = Femur circumference
CG = Chest girth
ML = Metatarsus length
MC = Metatarsus circumference
FL = Femur length
WL = Wing length

Table-4. Regression equations and coefficient of determination (R^2) of body weight and body characteristics of muscovy ducks.

Variable	Regression equation	R^2	Signif.	SE of estimate
MC	Y = -1.087 + 0.792 MC	0.627	**	0.433
ML	Y = -0.801 + 0.732 ML	0.535	**	0.483
FL	Y = 0.848 + 0.592 FL	0.351	**	0.571
FC	Y = -0.932 + 0.801 FC	0.641	**	0.424
CG	Y = -1.821 + 0.853 CG	0.728	**	0.370
CW	Y = -3.917 + 0.810 CW	0.656	**	0.416
BL	Y = -2.183 + 0.874 BL	0.704	**	0.344
WL	Y = -2.076 + 0.808WL	0.704	**	0.351
CW,CG	Y = -3.399 + 0.591 CG + 0.393 CW	0.797	**	0.319
BL, CG	Y = -2.474 + 0.428 BL + 0.533 CG	0.831	**	0.292
CW, BL	Y = -3.544 + 0.608 BL + 0.361 CW	0.823	**	0.298
BL, CW, CG	Y = -3.363 + 0.253 CW + 0.322 CG + 0.430 BL	0.856	**	0.296

** Significant (P<0.01)

CONCLUSIONS

The high, positive and significant correlation between body weight and zoometric body measurements indicates that these easily measured parts can be used as criteria for assessment and selection of body weight. Under field conditions, chest girth, chest width and body weight can be combined in a multiple regression equation to predict the body weight of mature Muscovy ducks with some level of accuracy.

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