Growth and Morphometric Relationship in Three Color Lines of Nigerian Indigenous Turkey

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Abstract

Morphometric measurements have been a recurring interest to livestock production either to supplement body weight as a measure of productivity or serve as a vital tool in selection and breeding studies. Hence this study is designed to examine the variability exists occurs between populations of the same specie and different colour phenotypes of turkey. A total of sixty birds were used to evaluate the growth and compare the morphometric performance of three plumage color lines of Nigerian indigenous turkey raised under the same condition. The experiment was conducted at University of Abuja Teaching and Research Farm. The birds comprising of Twenty (20) white turkeys, twenty (20) bronze turkey and twenty (20) black turkeys were used for the experiment and divided into three (3) treatments groups in a completely randomized design (CRD). The experiment lasted for 8 weeks, data were collected on the beak length, head length, neck length, body length, wing span, wing length, drumstick, shank length, tail length and body girth. Dataobtained were subjected to Analysis of Variance (ANOVA) and correlation using SPSS. There was significant difference ($p < 0.05$) in head length, neck length, body length, length of drumstick, body girth and tail length with the turkey bronze having higher values in head length, neck length, drumstick and tail length compared to other colors. While, significant ($p > 0.05$) differences were not observed in body weight, beak length, shank length, wing length and wing span among the treatment's groups. Correlation among morphometric traits revealed positive and perfect correlations between body weight, beak length, head length, neck length, body length, shank length, length of drumstick, body girth, wing length, span and tail length among the three plumage color lines at the 8th week of age. Based on the findings of the study, it was observed that bronze color line was superior for growth and morphometric traits at the 8th week of age compared to other plumage colour lines. Hence, the study suggests, that traits which were significantly correlated (BW, BKL, NKL, BDL, SHL, DM, BGT, WNL and WNS) should be given priority in selection due to their high tendency of influencing body weight of the breeds.

Keywords: *Indigenous turkey, morphometric traits, plumage, correlation*

Croissance et Relation Morphométrique Chez Trois Lignes de Couleur de Dinde Indigène Nigériane

Résumé

Les mesures morphométriques ont toujours suscité l'intérêt de la production animale, soit pour compléter le poids corporel comme mesure de productivité, soit comme outil essentiel dans les études de sélection et de reproduction. Cette étude est donc conçue pour examiner la variabilité qui existe entre les populations de la même espèce et les différents phénotypes de couleur de dinde. Un total de soixante oiseaux a été utilisé pour évaluer la croissance et comparer la performance morphométrique de trois lignes de couleur de plumage de dinde indigène nigériane élevées dans les mêmes conditions. L'expérience a été réalisée à la Ferme d'Enseignement et de Recherche de l'Université d'Abuja. Les oiseaux comprenaient vingt (20) dindes blanches, vingt (20) dindes bronzées et vingt (20) dindes noires, et ont été répartis en trois (3) groupes de traitements dans un plan complètement aléatoire (PCA). L'expérience a duré 8 semaines, des

données ont été collectées sur la longueur du bec, la longueur de la tête, la longueur du cou, la longueur du corps, l'envergure, la longueur de l'aile, le pilon, la longueur du jarret, la longueur de la queue et le tour du corps. Les données obtenues ont été soumises à une analyse de variance (ANOVA) et à une corrélation à l'aide de SPSS. Il y avait une différence significative (p <0,05) dans la longueur de la tête, la longueur du cou, la longueur du corps, la longueur du pilon, le tour du corps et la longueur de la queue, les dindes bronzées ayant des valeurs plus élevées pour la longueur de la tête, la longueur du cou, le pilon et la longueur de la queue par rapport aux autres couleurs. En revanche, des différences significatives (p>0,05) n'ont pas été observées dans le poids corporel, la longueur du bec, la longueur du jarret, la longueur de l'aile et l'envergure parmi les groupes de traitement. La corrélation entre les traits morphométriques a révélé des corrélations positives et parfaites entre le poids corporel, la longueur du bec, la longueur de la tête, la longueur du cou, la longueur du corps, la longueur du jarret, la longueur du pilon, le tour du corps, la longueur de l'aile, l'envergure et la longueur de la queue parmi les trois lignes de couleur de plumage à la 8e semaine d'âge. Sur la base des résultats de l'étude, il a été observé que la ligne de couleur bronze était supérieure pour la croissance et les traits morphométriques à la 8e semaine d'âge par rapport aux autres lignes de couleur de plumage. Par conséquent, l'étude suggère que les traits qui étaient significativement corrélés (BW, BKL, NKL, BDL, SHL, DM, BGT, WNL et WNS) devraient être prioritaires dans la sélection en raison de leur forte tendance à influencer le poids corporel des races.

Mots-clés : Dinde indigène, traits morphométriques, plumage, corrélation

Introduction

Turkey production is an important and profitable agricultural industry, with rising global demand for its products (Liyanage *et al*., 2015). These birds foster the profitable agricultural industry, due to the rising global demand for its products (Dudusola *et al.*, 2020). Despite the increase in demand for turkey, there are no large-scale commercial turkey farms in Nigeria to meet the ever-increasing demand (Ogah, 2011). Turkey breeders have selected birds for fast growth and large body size in order to maximize production (Kranis *et al.*, 2014). The world-wide turkey population has rapidly grown due to increased commercial farming.

The potentials associated with the turkey industry in Nigeria can be exploited to boost its productivity through the evaluation of its production performance through the evaluation of body size and conformation (Adebayo *et al*., 2017). A quantitative measure of conformation will no doubt enable reliable genetic parameters for the traits to be estimated but also make it possible to include conformation in breeding programme. Assessment of body weight and linear body measurements have been found useful in quantifying body size and shape as well as used as an indicator for growth and development of the birds (Fayeye and Jubril, 2016; Adebayo, *et al*. 2017 and Jubril *et al.* 2019). Morphometric measurements in poultry birds have been used to compare the relative performance of different specie of animals and these measurements can serve as a useful tool in selection (Mwacharo *et al*., 2006; Martins *et al.* 2009; Yakubu, 2010 and Jubril *et al.* 2019).

Different studies have exploited correlations of morphometric measurements with body weight to develop techniques for estimating body weight in different livestock and poultry species (Adeoye, *et al*. 2017 and Adeoye, *et al.* 2018). The estimation of body weight using morphometric measurements becomes very useful in smallholder livestock and poultry producers who rarely keep records to monitor the growth and development of their birds. Measurements of morphometric traits are of value in estimating body weight and observe growth and development of birds, because of the relative ease in measurements which can be used as an indirect

method of estimating body weight (Adeoye, *et al*., 2018). These will provide good information on performance and productivity of livestock and poultry. The use of morphometric measurements to evaluate body weight would overcome many problems associated with visual assessment or evaluation. Body weight has a direct relation to the production and profitability of any livestock enterprise. It has been reported by Nwosu *et al.* (1985) that body weight is the best parameter for making management, health and production and marketing decisions. As a result of this, there is need to develop objective means for describing and evaluating body weight and conformation characteristics especially in smallholder livestock and poultry production sector where measuring scales are unavailable. Morphometric characteristics have been a recurring interest to livestock production either to supplement body weight as a measure of productivity or as predictors of some less visible characteristics (Adeoye, *et al.*, 2019).

Body weight measurement is used mostly to evaluate body development in livestock and poultry production (Adeoye *et al.,* 2019), but it is not easily measured in the field. Several studies have shown that body weight has a direct relationship with morphometric characteristics and carcass parameters in poultry (Yakubu, 2010; Ogah, 2011; Adeoye, *et al*. 2018 and Jubril *et al.* 2019). Therefore, this study was carried out to determine the morphometric traits correlations among the three different color lines of Nigerian indigenous turkey.

Materials and Methods

Experimental Site

This experiment was conducted at the Poultry Unit, University of Abuja Teaching and Research Farm, Gwagwalada, FCT-Abuja. Gwagwalada falls within latitude 90° 4'N, longitude 7° 28'E, 1500mm (59.1in) rainfall annually, temperature ranges between 18.45°c (65.21°F) and relative humidity of 67% at 0900GMT (present). The location has a particular rainy and dry season with a unimodal rainfall pattern which for the most part sets up between mid-May to early June, and tops in the long periods of the months of July/August. The total yearly rainfall in the location is between 1284mm-1383mm. However, dry season starts from mid of October to end of April. The area has a daily mean temperature of 30^0C in the raining season and 34^0C in the dry season (Meteorological Station of Nnamdi Azikiwe International Airport (MET), 2018). The experiment last for eight weeks.

Sourcing and Management of Experimental Birds

A total of 60 turkey birds comprising of three different plumage colours were used for the experiment. Twenty (20) birds each per plumage colour (white plumage, black plumage and bronze plumaged) were sourced from a reputable hatchery Nigeria. The birds were fed commercial starter throughout the experimental period. Feed and water were administered ad-libitum. Routine medication and vaccination were followed and administered, using recommended veterinary guidelines. There was strict sampling restriction only to pure plumage colors among the three variants (bronze, black and white) by carefully checking through the feather colors covering the flesh so as to observe equal classification descriptors for all the observed color lines. Adequate sanitation, biosecurity measure was put in place to prevent incidence of diseases.

Experimental Design

The experiment was conducted using a Completely Randomized Design (CRD). Each treatment had four replicates, with a total of four birds per treatment.

Data Collection

The linear body measurements (LBM) were weekly till the week 8th week of age. The body weight was recorded using a digital electronic scale with a capacity of 3000g and sensitivity of 1g, while the body measurements was taken in

centimeters with the use of a measuring tape. The birds were tagged for easy identification.

Measured Traits

The parameters evaluated are beak length, head length, neck length, body length, wing span, wing length, drumstick, shank length, tail length, body girth, body weight. Trait description and measurement followed the guidelines of FAO (2012). The traits measured (in cm) are:

i. Shank length (SL) measured from the back joint and the taros-metatarsus
ii. Beak length (BL) measured from the broader end of the beak (towards the head) to its pointed end
iii. Abdomen circumference (AC) which is the circumference of the breast around the deepest region
iv. Thigh length (TL) measured from the hock to the pelvic joints,
v. Snood length (SN) measured from the base of the head to the end of the fleshy projection
vi. Breast girth (BG) will be taken under the wing at the edge of the sternum
vii. Tail feather (TF) measured from the point of attachment of the base of the tail feather to its terminal
viii. Wing span (WS) is length between tips of right and left wings after both are stretched out in full.
ix. Wing Length (WL) will be taken from the shoulder joint to the extremity of terminal phalanx
x. Toe Length (TL) was taken from the taros-metatarsus digit-3 joins to the tip of the toe nail
xi. Body Length (BL) is the length between the tip of the rostrum maxillae (beak) and that of the cauda (tail, without feathers).

Direct measurement of body weight (BW, Kg) was taken using an electronic weighing scale. All linear measurements were taken in centimeters using graduated flexible tape (Ogah *et al.* 2009).

Statistical Analysis

The data generated was subjected to Analysis of Variance (ANOVA) and *Correlation Analysis* using General Linear Model (GLM) procedure of Statistical Package for Social Science SPSS (2011) version 20. Significant differences among means was separated using Duncan's Multiple Range Test procedure (Duncan, 1955).

Results and Discussion

Comparative Assessment of Morphometric Traits of White, Bronze and Black Turkey

The comparative morphometric traits evaluation of white, bronze and black color line of turkeys is presented in table 1. Body weight, beak length, head length, neck length, body length, shank length, length of drumstick, body girth, wing length, wing span and tail length ranges between 315.20 – 356.59g, 1.87 – 1.96 cm, 5.46 – 6.63 cm, 7.37 – 9.15 cm, 12.36 – 13.65 cm, 5.46 – 5.79 cm, 7.14 – 9.82 cm, 18.23 – 20.58 cm, 21.87 – 23.64 cm, 47.80 - 51.12 cm and 5.63 - 7.24 cm respectively. Body weight, beak length, shank length, wing length and wing span were not significantly ($p > 0.05$) different among the treatments while head length, neck length, body length, length of drumstick, body girth and tail length were significantly ($p < 0.05$) influenced by the treatments. The means values of all the traits obtained in this present study were within the range reported by Samuel *et al.* (2016). Similar results were reported by Gous *et al.* (2020), who reported highest means values for body weight and shank length in bronze type of turkey (5.47kg and 10.31cm) respectively, while black type turkeys attained the lowest body weight (3.79kg). The white type turkeys however, attained (4.14kg) body weight. Also, Das *et al.* (2018) reported highest means values for body weight and other growth traits in bronze color line of turkeys. A broad breasted line of turkey could achieve a body weight of 10.9kg at 24 weeks of age (Austic and Neshein, 1990). Ilori *et al*. (2016) reported similar result for Nigerian indigenous

turkeys. Contrarily, the lower values obtained in this present study on the body (12.36 cm), wing length (21.87 cm) and body girth (18.23 cm) could be attributed to the variation in management practices, diet composition or environmental factors.

Table 1: Comparative Assessment of Morphometric Traits of White, Bronze and Black Turkey

Parameters	White	Bronze	Black	SEM
Body weight (g)	356.59	346.41	315.20	11.23
Beak Length (cm)	1.94	1.96	1.87	0.03
Head Length (cm)	5.85^{b}	6.63^{a}	5.46^{b}	0.11
Neck Length (cm)	7.89^{b}	9.15^{a}	7.37^{b}	0.22
Body Length (cm)	13.65^{a}	12.36^{b}	12.54^{a}	0.22
Shank Length (cm)	5.73	5.79	5.46	0.09
Drumstick (cm)	7.47^{b}	9.82^{a}	7.14^{b}	0.21
Body Girth (cm)	20.58^{a}	18.23^{b}	19.28^{ab}	0.29
Wing Length (cm)	23.64	21.23^{b}	22.45	0.53
Wing Span (cm)	51.12	50.42	47.80	1.08
Tail Length (cm)	7.12^{a}	7.24^{a}	5.63^{b}	0.15

Means in the same row with different superscripts differ significantly ($P < 0.05$) (g) = gram, SEM = Standard error of mean

Correlated Phenotypic Relationship Between Morphometric Trait in White, Bronze and Black plumage Turkeys Color lines at 8th Week of Age.

The correlated relationship between morphometric traits in white, bronze and black plumage color lines at 8th week of age is presented in table 2.1- 2.3. The result shows a positive and significant correlations among all the traits examined in white and black color lines of turkey with the highest correlation between wing span and wing length in white ($r = 0.98^{xx}$: $P < 0.05$) and between wing span and neck length in black ($r = 0.96^{xx}$: $P < 0.05$) showing that each traits influences another.

However, negative and significant correlation between body girth and drumstick was found in Bronze color line (-0.24^{xx}: $P < 0.05$) and (-0.29^{xx}: $P < 0.05$) respectively. It indicated that birds with high body girth tend to have less drumstick.

The results of this study is in agreement with the findings of Ojo *et al*. (2010) high and positive coefficient of correlation at 2 weeks between body weight and back length, shank length and chicken height. This implies that improvement in chicken height can be achieved through selection for increased shank length. Similarly, Okon and Ogundu (2006) obtained high and positive phenotypic correlations between body weight and other body parameters namely: thigh, length, cheek circumference, breast width, keel length and shank length. Also, Okpeku *et al.* (2003) reported that body weight was positively correlated with body length, cheek circumference, femur and crust but obtained negative and low correlation between body weight and tarso-metatasus (shank length) among local birds of Edo state Nigeria. Similarly, according to the findings of Samuel *et al.* (2016) who stated the interrelationship of linear body measurements in Nigerian indigenous turkey birds at 1, 4, 6, 8, 12, 16 and 20 weeks of age also reported that body weight was positively correlated with breast girth, body length, keel length, shank length, thigh length, wing length and wing span. Yakubu and Salako, (2009) reported that correlation between linear type trait and body weight of Nigerian indigenous birds ranged from moderate to high values. They also reported that body length, chest circumference and shank length on body weight were positive and significant. The result of these relationship

also shows that increase in the growth rate of any of the component will correspondingly increase body weight (Ajayi *et al*., 2008). The result of these positive correlations coefficient agrees with the findings of Udeh and Ogbu (2011); Udeh *et al*. (2011) who reported positive and high significant (P<0.01) correlations among traits within each strain. A similar observation was reported by Pundir *et al*. (2011).

Contrary report on the negative correlation on body girth and drumstick (-0.29^{xx}: $P < 0.05$) respectively reported on this study could be attributed to the differences in management practices, breeds, diet composition or environmental conditions Udeh *et al*. (2011).

Table 2.1: Correlated Phenotypic Relationship Between Morphometric Trait (Cm) in White plumage Turkeys Color Lines at 8th Week of Age.

Traits	BW	BKL	NKL	BDL	SHL	DM	BGT	WNL	WNS
BW(g)	1								
BKL	0.92^{xx}	1							
NKL	0.94^{xx}	0.91^{xx}	1						
BDL	0.95^{xx}	0.95^{xx}	0.94^{xx}	1					
SHL	0.92^{xx}	0.93^{xx}	0.87^{xx}	0.92^{xx}	1				
DM	0.89^{xx}	0.85^{xx}	0.84^{xx}	0.85^{xx}	0.88^{xx}	1			
BGT	0.89^{xx}	0.89^{xx}	0.91^{xx}	0.91^{xx}	0.86^{xx}	0.79^{xx}	1		
WNL	0.95^{xx}	0.95^{xx}	0.92^{xx}	0.95^{xx}	0.94^{xx}	0.87^{xx}	0.94^{xx}	1	
WNS	0.95^{xx}	0.96^{xx}	0.94^{xx}	0.96^{xx}	0.94^{xx}	0.86^{xx}	0.95^{xx}	0.98^{xx}	1

BW = Body weight, BKL = Beak length, NKL = Neck length, BDL = Body length, SHL = Shank length, DM = Drumstick, BGT = Body girth, WNL = Wing length, WNS = Span, ^{xx} highly significant (P<0.05) (g) = gram, (cm) centimeters

Table 2.2: Correlated Phenotypic Relationship Between Morphometric Trait (Cm) of Bronze plumage Turkeys Color lines at 8th Week of Age.

Traits	BW	BKL	NKL	BDL	SHL	DM	BGT	WNL	WNS
BW(g)	1								
BKL	0.90^{xx}	1							
NKL	0.46^{xx}	0.51^{xx}	1						
BDL	0.82^{xx}	0.83^{xx}	0.03	1					
SHL	0.81^{xx}	0.84^{xx}	0.83^{xx}	0.55^{xx}	1				
DM	0.32^{xx}	0.36^{xx}	0.97^{xx}	-0.1	0.72^{xx}	1			
BGT	0.65^{xx}	0.68^{xx}	-0.14	0.90^{xx}	0.35^{xx}	-0.29^{xx}	1		
WNL	0.83^{xx}	0.86^{xx}	0.10	0.98^{xx}	0.60^{xx}	-0.07	0.90^{xx}	1	
WNS	0.87^{xx}	0.91^{xx}	0.57^{xx}	0.72^{xx}	0.87^{xx}	0.43^{xx}	0.63^{xx}	0.81^{xx}	1

BW = Body weight, BKL = Beak length, NKL = Neck length, BDL = Body length, SHL = Shank length, DM = Drumstick, BGT = Body girth, WNL = Wing length, WNS = Span, ^{xx} highly significant (P<0.05) (g) = gram, (cm) centimeters

Correlation among Morphometric Traits of White, Bronze and Black Color Lines of Turkey

The correlation among morphometric traits of white, bronze and black color lines of turkeys is presented in table 3. The result shows a positive and significant correlations among all the traits observed in this study. Meanwhile, highest correlation was observed in wing span ($r = 0.98^{xx}$: $P < 0.05$) between White and Black color line of turkeys. Also, a very low but positive correlation was also found in drumstick ($r = 0.27^{xx}$: $P < 0.05$) between Bronze and Black color line of turkeys.

Table 2.3: Correlated Phenotypic Relationship Between Morphometric Trait (Cm) of Black plumage Turkeys Color lines at 8th Week of Age.

Traits	BW	BKL	NKL	BDL	SHL	DM	BGT	WNL	WNS
BW(g)	1								
BKL	0.92^{xx}	1							
NKL	0.93^{xx}	0.92^{xx}	1						
BDL	0.92^{xx}	0.94^{xx}	0.96^{xx}	1					
SHL	0.89^{xx}	0.90^{xx}	0.90^{xx}	0.93^{xx}	1				
DM	0.88^{xx}	0.88^{xx}	0.93^{xx}	0.91^{xx}	0.84^{xx}	1			
BGT	0.85^{xx}	0.87^{xx}	0.88^{xx}	0.91^{xx}	0.90^{xx}	0.82^{xx}	1		
WNL	0.89^{xx}	0.90^{xx}	0.93^{xx}	0.94^{xx}	0.90^{xx}	0.88^{xx}	0.89^{xx}	1	
WNS	0.91^{xx}	0.93^{xx}	0.96^{xx}	0.97^{xx}	0.91^{xx}	0.91^{xx}	0.91^{xx}	0.96^{xx}	1

BW = Body weight, BKL = Beak length, NKL = Neck length, BDL = Body length, SHL = Shank length, DM = Drumstick, BGT = Body girth, WNL = Wing length, WNS = Span, ^{xx} ; highly significant (P<0.05) (g) = gram, (cm) centimeters

The results obtained in this study indicated positive and significant correlation in body weight, beak length, head length, neck length, body length, shank length, drumstick, wing length and wing span among the three plumage color line of turkeys. This result is in line with the findings of Samuel *et al.* (2016) who reported positive phenotypic correlation of growth traits among Nigerian indigenous turkeys. Similarly, this result agrees with the findings of Yahaya *et al.* (2012) who reported correlations coefficients of 0.916, 0.894, 0.861, 0.897, 0.977 and 0.963 between body weight and neck length, shank length, thigh length, keel length, breast width and back length for Hubbard strain, while for Arbor acre strain the correlation values of 0.967, 0.974, 0.882, 0.935, 0.981 and 0.969, respectively was obtained between body weight and neck length, shank length, thigh length, keel length breast width and back length, all indicating a strong positive relationship.

This means that an improvement in the body weight might lead to an improvement in other parameters.

Conclusion and Recommendation

The phenotypic variations among different varieties of turkeys used in this study indicate that these differences serve as basic information for the poultry breeders as well as academia and could be useful for future breeding programs in

Table 3: Correlation among Morphometric Traits of White, Bronze and Black Color Lines of Turkey

Traits	Treatments	White	Bronze	Black
	White			
Body weight	Bronze	0.89^{xx}		
	Black	0.88^{xx}	0.82^{xx}	1.00
	White			
Beak length	Bronze	0.92^{xx}		
	Black	0.89^{xx}	0.89^{xx}	1.00
	White			
	White			
Neck length	Bronze	0.55^{xx}		
	Black	0.92^{xx}	0.56^{xx}	1.00
	White			
Body length	Bronze	0.80^{xx}		
	Black	0.94^{xx}	0.78^{xx}	1.00
	White			
Shank length	Bronze	0.81^{xx}		
	Black	0.91^{xx}	0.82^{xx}	1.00
	White			
Drumstick	Bronze	0.28^{xx}		
	Black	0.81^{xx}	0.27^{xx}	1.00
	White			
Body girth	Bronze	0.55^{xx}		
	Black	0.83^{xx}	0.56^{xx}	1.00
	White			
Wing length	Bronze	0.84^{xx}		
	Black	0.93^{xx}	0.82^{xx}	1.00
	White			
Wing span	Bronze	0.95^{xx}		
	Black	0.98^{xx}	0.94^{xx}	1.00
	White			

order to enhance the existing performances of heritage of turkeys. Low to high positive and negative correlations were observed among the three studied color lines at 8 weeks of age which is an indication of pleiotropic effect, reflecting the effect of some set of genes for the traits. It is recommended that traits that were significantly correlated (BW, BKL, HDL, NKL, BDL, SHL, DM, BGT, WNL and WNS) should be given priority in selection due to their high tendency of influencing body weight of the breeds

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