Phenotypic Correlation Between Body Weight and Morphometric Traits In Noiler Chickens

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Abstract

Body weight is a prime yardstick for determining the value of livestock, and while direct weight measurement is commonplace in commercial chicken production and transaction, body weight measurement is a rarity in small scale farming, and marketing, even more so, in rural production systems, where Noiler production is expanding. This experiment aims to draw on reported correlations between morphometric traits and body weight in other poultry species, and investigate the possible correlations between body weight and morphometric features in Noiler chickens. A 15- week experiment was conducted to investigate the phenotypic correlation between body weight and morphometric traits in Noiler chickens. A total of 210, 1-day-oldNoiler chicks were used for the experiment. The morphometric traits measured were keel length, breast girth, shank length, shank thickness and body length. The birds were separated by sexes at week eight. The data collected were analyzed using Pearson correlation between the body weight and each of the morphometric traits. It was revealed that there exists a significant positive correlation between the keel length, breast girth, shank length, shank thickness, body length and the body weight of Noiler chickens. It can be concluded that at the growing phase (especially weeks three and seven), the females tended to have better positive correlation coefficients between body weight and morphometric traits while at the finishing stage (week fifteen), the males had a better positive correlation between body weight and morphometric traits. For all morphometric traits measured between sexes, high correlation coefficients were obtained between body weight and keel length (significant values range from 0.46 – 0.82), and body weight and breast girth (significant values range from 0.63 – 0.81), and could be used as indicators of body weight in Noiler chickens regardless of age and sex.

Keywords: Noiler, Morphometric Traits, Shank Length, Keel Length, Girth.

Running title: Prediction of Body Weight with Morphometric Traits in Noiler Chickens

Corrélation phénotypique entre le poids corporel et les traits morphométriques chez les poulets Noiler

Résumé

Le poids corporel est un critère important pour déterminer la valeur du bétail, et bien que la mesure directe du poids soit courante dans la production commerciale de poulets et les transactions, elle est rare dans l'agriculture à petite échelle, ainsi que dans la commercialisation, surtout dans les systèmes de production ruraux, où la production de Noiler est en pleine expansion. Cette expérience vise à s'appuyer sur les corrélations rapportées entre les traits morphométriques et le poids corporel chez d'autres espèces de volaille, et à étudier les corrélations possibles entre le poids corporel et les caractéristiques morphométriques chez les poulets Noiler. Une expérience de 15 semaines a été réalisée pour étudier la corrélation phénotypique entre le poids corporel et les traits morphométriques chez les poulets Noiler. Un total de 210 poussins Noiler âgés d'un jour ont été utilisés pour l'expérience. Les traits morphométriques mesurés étaient la longueur du keel, le tour de poitrine, la longueur des tarses, l'épaisseur des tarses et la longueur du corps. Les oiseaux ont été séparés par sexe à la huitième semaine. Les données collectées ont été analysées à l'aide de la corrélation de Pearson entre le poids corporel et chacun des traits morphométriques. Il a été révélé qu'il existe une corrélation positive significative entre la longueur du keel, le tour de poitrine, la longueur des tarses, l'épaisseur des tarses, la longueur du corps et le poids corporel

des poulets Noiler. Il peut être conclu qu'à la phase de croissance (en particulier aux semaines trois et sept), les femelles avaient tendance à avoir de meilleurs coefficients de corrélation positive entre le poids corporel et les traits morphométriques, tandis qu'à la phase de finition (seizième semaine), les mâles avaient une meilleure corrélation positive entre le poids corporel et les traits morphométriques.
Pour tous les traits morphométriques mesurés entre les sexes, de forts coefficients de corrélation ont été obtenus entre le poids corporel et la longueur du keel (les valeurs significatives varient de 0,46 à 0,82), ainsi qu'entre le poids corporel et le tour de poitrine (les valeurs significatives varient de 0,63 à 0,81), et ces traits pourraient être utilisés comme indicateurs du poids corporel chez les poulets Noiler, quel que soit l'âge ou le sexe.

Mots-clés : Noiler, Traits morphométriques, Longueur des tarses, Longueur du keel, Tour de poitrine.

Introduction

The livestock industry worldwide has been on the increase in the past five decades (Atteh, 2004). However, the poultry industry has been on a faster rate of increase compared to its mammalian counterparts due to the current preference for white meat over red meat and the relative ease of management (Atteh, 2015). By far, chicken is the most populous of the poultry species as it is reared both domestically and commercially for meat and egg purposes (FAO, 2020). To meet the ever-increasing demand for meat and eggs derived from chickens, it is imperative to develop strains of chickens that attain market size early with minimum nutrient requirements and least management cost.

The Noiler chicken is a dual-purpose breed of chicken developed by Amo Farm Sieberer Hatchery Limited for small-holders to address the challenges of food insecurity and financial dependency among the rural populace, especially women. Noiler chicken is a hybrid of Nigerian Fulani ecotype chicken and the exotic breeds. It has the hardiness of cockerels and the meat production characteristics of broilers. Noilers\ are a relatively new strain of chicken, borne of the necessity to provide animal protein at a cheap cost. The Noiler birds have been reported to be able to convert kitchen waste to meat more effectively than local chickens, they also share the scavenging capability and hardiness of local chickens. Noilers are known to grow faster and bigger than local chickens, they get to market size at about three to four months, a little longer than the commercial broilers, but with the advantage of being able to be raised extensively on range, thus reducing management expenses. In terms of egg production, local chickens produce about 40 eggs per year while Noilers are reported to produce between 150-200 eggs per year (Agbabiaka, 2018).

Phenotype is the set of all observable characteristics of an organism that result from the interaction of its genotype (total genetic inheritance) with the environment. (Britannica, 2019). The phenotype of an animal is often used in its characterization. It is a yardstick used to rank livestock into grades. The phenotypic expression of an animal offers an immediate look into the genetic potential of the animal. Phenotypic traits such as body weight and body conformation are often the appealing qualities that consumers look out for in market livestock.

Two important criteria for judging market livestock are body size and body conformation and the knowledge of livestock weight assessment remains the backbone on which all animal production management practices are hinged (Otoikhian *et al*., 2008). Traditionally, animals are visually assessed, which is a subjective method of judging (Abanikannda *et al*., 2002). To overcome many of the problems associated with visual evaluation, the development of objective means (linear body measurements) for describing and evaluating body size and conformation characteristics is

important (Jimcy *et al*., 2011; Yakubu and Ibrahim, 2011).

For breeding programmes to be successful, a breeder must take into consideration the interrelationships between body weight and other body conformation traits. Such conformation traits include shank length, body length, breast girth, keel length, and shank thickness.

The body weight of an animal is a phenotypic expression of its genetic makeup under the prevailing environmental or rearing condition. Body weight plays an important role in the determination of the market price of farm animals (Momoh and Kershima, 2008). Variations in body weight within a flock can be attributed to genetic variation and environmental factors that impinge on individuals (Ayorinde and Oke, 1995). According to Ibe (1989), the next approach in livestock characterization apart from the evaluation of its production performance is the evaluation of body size and conformation. Morphometric or quantitative analyses of the form, structure, shape, and size of an animal have been found useful in contrasting the size, and shape of animals (Ajayi *et al*., 2008). According to Maciejowski and Zeiba (1982), morphometric traits such as shank length and shank diameter are good indicators of leg development while body girth is an indicator of breast development. The use of morphometric traits is therefore a practical technique to derive the bird's body weight (Gueye *et al*., 1998; Semacula *et al*., 2011).

Phenotypic correlation between body weight and morphometric traits could be a useful guide to resource-poor rural poultry breeders in the choice of body size traits that can be incorporated into their selection program (Fayeye, 2016).

There is a need for documented evidence on the relationship between body weight and morphometric measurements of Noiler chickens. The possibility of accurately predicting the body weight of Noiler birds would be enhanced if there existed relationships between the bird's weight and its morphometric traits. The objective of this study was to determine the relationship between body weight and morphometric traits (breast girth, body length, keel length, shank length, and shank thickness) of Noiler chickens.

Materials and methods

A total of two hundred and ten 1-day-old Noiler chicks of mixed sexes were purchased from a reliable and dependable hatchery. The chicks were serially wing-tagged, and brooded for four weeks, before transferring them to deep-litter pens. At week eight, the birds were separated into sexes, and housed apart, till the end of the experiment. The birds were fed *ad libitum*, provided with cool clean water, and conventional health care procedures were observed.

Data collection

The birds were gently placed on a weighing scale to take body weight, and securely held in comfortable position in order to take linear measurements.

Body weight measurement

A Metler digital sensitive weighing balance with a maximum capacity of 500g was used to take body weight readings less than 500g. Higher body weights were measured using the Camry digital table-top weighing scale with a maximum capacity of 20kg.

Morphometric traits measurement

The first morphometric measurements were taken at week three and subsequent measurements were taken fortnightly.

Shank length: Shank is the tarsometatarsus length and it was taken from the hock joint to the web of the longest toe. This measurement was taken with the use of measuring tape in centimeters (cm).

Shank thickness: This was measured as the diameter of the tarsometatarsus, just below the spur of the left leg. This measurement was taken with the use of a micrometer screw. Readings were taken in millimeters (mm)

Body length: This is the length from the insertion of the neck into the body through the body trunk

to the tip of the tail. The measurement was taken with the use of measuring tape, with readings in centimeters (cm).

Keel length: The keel is a pronounced bone that extends from the sternum and runs axially over the midline. The length was taken from the Carina apex to the caudal tip along the ventral surface. The measuring tape was employed in taking the measurements in centimeters (cm).

Breast girth: It is also referred to as body girth or breast circumference. It was measured as the circumference of the breast region, taken with a measuring tape with readings in centimeters (cm).

Statistical analysis

The Pearson r correlation statistic model was used. The equation is represented below;

$$r = \frac{N \sum xy - \sum}{\sqrt{N \sum x^2 - \sum (x^2)][}$$

Where;

r = Pearson r correlation coefficient

N = number of observations

∑xy = sum of the products of paired scores

∑x = s/um of x scores

∑y = sum of y scores

∑x2= sum of squared x scores

∑y2= sum of squared y scores

SPSS software package was used to analyze the Pearson correlation between the body weight and each of the morphometric traits (shank length, shank thickness, keel length, breast girth and body length).

Results

Pearson's correlation obtained for the relationship between the five morphometric traits and body weight, over the seven weeks reveals a general positive correlation between each trait and the body weight. Though a negative correlation was observed between body weight and shank length in male Noiler chickens in week 11, there is overwhelming evidence to suggest that this is not the trend. The highest value (0.82**) was obtained between the body weight (BW) and keel length (KL) of female Noilers at week 7. Across the weeks, the breast girth of male and female Noilers show the most consistent relationship with body weight.

Table 1. Correlation between body weight and morphometric traits for weeks 3 to 15

TRAITS	Week 3	Week 5	Week 7	Week 9	Week11	Week13	Week15
BW|KL (M)	0.61**	0.33	0.78**	0.76**	0.73**	0.69**	0.57**
BW|KL (F)	0.61**	0.46**	0.82**	0.76**	0.72**	0.01	0.59**
BW | BG (M)	0.64**	0.35	0.67**	0.74**	0.79**	0.75**	0.81**
BW | BG (F)	0.75**	0.27	0.73**	0.73**	0.76**	0.75**	0.63**
BW | SL (M)	0.50**	0.20	0.74**	0.52**	-0.18	0.66**	0.48**
BW | SL (F)	0.61**	0.19	0.58**	0.56**	0.36	0.40**	0.14

BW | ST (M)	0.58**	0.04	0.40**	0.70**	0.68**	0.30	0.33
BW | ST (F)	0.54**	0.17	0.39**	0.55**	0.45**	0.47**	0.33
BW | BL (M)	0.47**	0.23	0.43**	0.54**	0.11	0.36	0.04
BW | BL (F)	0.54**	0.17	0.64**	0.65**	0.58**	0.59**	0.27

*** Highly significant correlation (P<0.001)*
BW = Body Weight, KL = Keel Length, BG = Breast Girth, SL = Shank Length, ST = Shank Thickness, BL = Body Length, (M) = Male and (F) = Female.

Discussion

The positive correlation between body weight and morphometric traits in Noiler chickens in this study implies that linear body measurements are good indicators of body weight and this is in agreement with the observations of contemporary researchers (Abdul Muumin *et al*., 2020; Nweke-Okorocha *et al*., 2022). While significant positive correlations were obtained across the observed weeks, the strongest relationships were however, noticed between Body weight (BW) and Keel length (KL) as well as Body weight (BW) and Breast girth (BG) in both sexes. According to Olawunmi (2014), linkage gene effects cause a rapid improvement in body weight when selection for growth traits is based on the high phenotypic correlation between body weight and morphometric traits. The phenotypic correlation between body weight and breast girth carried out by Adeyinka *et al*. (2006) gave a correlation coefficient of 0.34 in naked neck broiler chickens at eight weeks. This is much lower compared to the correlation coefficient of 0.96 obtained by Yahaya *et al*. (2012) between body weight and breast girth in both Hubbard and Arbor Acres broiler strains at eight weeks. However, the correlation coefficients of 0.81 obtained at fifteen weeks in this study between body weight and breast girth in male Noiler chickens and 0.63 in female Noiler chickens are higher than that obtained by Adeyinka *et al*. (2006) but lower than the values obtained by Yahaya *et al*. (2012). The observed close relationship between body weight and breast girth in both young (0.64 – 0.75) and adult (0.63 – 0.81) Noiler chickens agrees with the earlier findings of Adebambo *et al*. (1996) who reported that breast girth is a good indicator of meatiness in most poultry chickens. A strong and positive correlation between body weight and shank length would result in improvement in the shank length of native birds which is a desirable trait in free-range or semi-intensive systems of rearing (Haunshi *et al*., 2012). The highly significant positive correlation found between body weight and shank length of Noiler chickens confirms the work of Haunshi *et al*. (2012). The significant positive correlations between body weight and keel length, body weight and breast girth across the observed weeks in this study agree with the report of Adeniji and Ayorinde (1990) who posited that body weight can be predicted from linear measurements (breast girth and keel length) in Cobb broiler strain, as well as the findings of Adeleke *et al*. (2004) for crossbred egg-type. Ajayi *et al*. (2007) also concluded that as body girth, keel length, and thigh length increase through selection, there will be a corresponding increase in body weight. The correlation between body weight and body length in the present study confirms the findings of Ojo

et al. (2013) who reported that body length is one of the best predictors of body weight in Japanese quail (*Coturnix japonica)*. However, body length as seen in the outcome of this study is not one of the best predictors of body weight in Noiler chickens due to its low coefficient of correlation. The best indicators of body weight in Noiler chickens according to this study are keel length and breast girth due to the high coefficient of correlation obtained. As reported by El- Labban (1999), a highly significant phenotypic correlation between morphometric traits suggests a pleiotropic gene action, and gene linkage effects which implies that a selection programme to improve any one of the conformation traits would lead to an improvement in body weight of the animal.

Conclusion

The result of this study underscores the association between certain morphometric traits and the body weight of Noiler chickens. It also highlights the level of association at different levels of growth in relation to their sexes. It was revealed that there exists a significant positive correlation between the morphometric traits measured (keel length, breast girth, shank length, shank thickness, and body length) and the body weight of Noiler chickens. It can be concluded that at the growing phase (especially weeks three, and seven), the females tend to have better correlation coefficients between body weight and morphometric traits while at the finishing stage (week fifteen), the males had a better correlation between body weight and morphometric traits.

For all morphometric traits measured across sexes, high correlation coefficients were obtained between body weight and keel length, and body weight and breast girth and could be used as indicators of body weight in Noiler chickens regardless of age and sex.

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