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COMPARISON OF SOME LINEAR BODY MEASUREMENT TRAITS OF LOCAL AND COMMERCIAL CHICKEN BREEDS OF SOUTH AFRICA

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Linear body measurement traits are used for the estimation of body weight in animal breeding to aid livestock farmers where the weighing scale is not available. The objective of the work was to determine the effect of breed on body weight (BW) and linear body measurement traits such as wing length (WL), keel length (KL), shank circumference (SC), chest circumference (CC) and beak length (BL) of two (Hy-line Silver Brown and Potchefstroom Koekoek) layer chicken layer breeds. A total of 100 layers with 50 for each breed were randomly selected for the study at the age of 22 weeks. Pearson's correlation and Student T-Test were used for data analysis. Correlation was employed to examine the relationship between measured traits in each breed. Correlation findings showed that BW had a highly positive statistical significant correlation ($p < 0.01$) with WL ($r = 0.76$) in Potchefstroom Koekoek breed, while BW had a negative statistical significant correlation ($p < 0.05$) with WL ($r = -0.27$) in Hy-line Silver Brown chicken layer breed. Student T-Test results indicated that Potchefstroom Koekoek chicken layer breed was statistically ($P<0.05$) heavier than Hy-line Silver Brown chicken layer breed. Potchefstroom Koekoek had longer wing length and chest circumference than Hy-line Silver Brown while Hy-line Silver Brown had longer ($P<0.05$) keel length, shank circumference and beak length than Potchefstroom Koekoek. It is concluded that the results suggest that Potchefstroom Koekoek chicken layer breed is a weightier indigenous layer but keel length, shank

circumference and beak length might require improvement. It also suggests that improvement of WL might improve BW of Potchefstroom Koekoek breed while improvement of WL might decrease BW of Hy-line Silver Brown chicken layer breed.

Keywords: *Body weight; beak length; Potchefstroom Koekoek; Hy-line Silver Brown; wing length*

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Introduction

Linear body measurement traits are the predictors of body weight in poultry breeding investigated in Sasso, Kuroilwe and Fulani chicken breeds of Nigeria [1], in Local, Bovans brown, Sasso and Koekoek chicken breeds of Ethiopia [2], in French Broiler Guinea Fowl of Nigeria [3] , in Nigerian Indigenous normal feather chicken breed[4] , in South African non-descript chicken breed [5], in South African Potchefstroom Koekoek chicken breed [6], in Hy-line Siver Brown chicken breed [7], Linear body measurements in chicken breeds can assist for characterization of breeds [1,8]. There are several studies compare linear body measurement traits of chickens [1; 2]. However, based on our knowledge there is not documented information on the comparison of linear body measurement traits in Potchefstroom Koekoek and Hy-line Silver Brown chicken layer breeds. Hence, the objective of the study was to compare linear body measurement traits of Potchefstroom Koekoek and Silver Brown chicken layer breeds. The study will help Potchefstroom Koekoek and Hy-line Silver Brown chicken layer breeds' farmers to recognise the comparison in linear body measurement traits of two chicken layer breeds.

Materials and Methods

Study area

The research was carried out at the University of Limpopo experimental farm, South Africa. The rain, ambient temperatures, latitude, longitude and location of the farm was as explained by [8].

Animal management

All chickens were managed as explained by [9]. Briefly, layers were fed with 16.10% crude protein diet 11.97 MJkg/DM. The diet comprised of ingredients like: maize (64%), maize gluten meal (11.67%), soya Hipro (4.37%), fish meal (5%), full fat soya (4.91%), Di sodium phosphate (1.33%), L-lysine (0.20%), $CaCO_3$ (8.17), DL-methionine (0.20%) and vitamin trace element pre-

mix (0.15%). Water and feed were given to the chickens without restriction. The standard normal management practices were exactly obeyed.

Experimental design

A total of 200 chickens were randomly selected with 100 per chicken breed at the age of 22 weeks. The data was collected in Potchefstroom Koekoek and Hy-line silver brown chicken breeds when they were 22 weeks of age.

Measurement of body weight and linear body measurement traits

Body weight (BW) and linear body measurement traits viz; (cm): wing length (WL), keel length (KL), shank circumference (SC), chest circumference (CC) and Beak length (BL) were collected as described by [10]. Briefly, body weight was calibrated in kilogram (kg). Linear body measurement traits were measured using a measuring tape in centimetres (cm. The linear body measurement traits were collected as follows: Wing length was measured as the length from the humorous-coracoid junction to the distal tip of the phalange digits using a measuring tape. Keel length was recorded as the length between the cranial and the caudal terminals of the keel bone. Shank circumference was recorded as the perimeter of middle shank, Chest circumference was recorded as the circumference of the chest and Beak length which was as the length of the beak with the use of tape rule.

Statistical analysis

Statistical Analysis System (SAS, 2019) software program version 9.4 was used to analyse the data. Pearson's correlation was used to examine the association between measured traits. Student's T-Test was used to determine effect of chicken breed on body weight and linear body measurement traits. All the statistical analysis was performed at the 5% significance level. The following model was used in this study to determine the effect of chicken breed:

$$Y_{ij} = \mu + a_i + e_{ij}$$

Where, Y_{ij}: The j^{th} observation of the i^{th} measured traits (body weight and linear body measurement traits).

μ: The overall mean.

a_i: The fixed effect of the i^{th} chicken breed.

e_{ij}: Residual error.

Results and discussion

Descriptive statistics of measured traits

Boxplot (Figure 1) presented the summary of body weight distribution in Hy-line Silver Brown and Potchefstroom Koekoek chicken layer breeds. Figure

1 indicated the minimum 25th percentile (first quartile), median 75th percentile (third quartile) and maximum values of BW among different chicken layer breeds. Boxplot showed a highly statistical significant difference ($p < 0.01$) in BW with F-statistics of 20.83. Potchefstroom Koekoek chicken layer boxplot showed a minimum of < 1.2kg, first quantile of 1.4kg, median of > 0.4kg, third quartile of 1.6kg and maximum of > 1.8kg, respectively. However, Hy-line Silver Brown chicken layer boxplot showed a minimum of > 1.2kg, first quartile of < 1.4kg, median of < 1.4kg, third quartile of 1.4kg and maximum of < 1.6kg. These findings also indicated that Hy-line Silver Brown chicken layer data had three outliers of 1.6kg, >1.6kg and <1.2kg, respectively.

Descriptive statistics of body weight and body measurement traits including body weight, wing length, keel length, shank circumference, chest circumference and beak length are presented in Table 1. Hy-line Silver Brown chicken layer data summary showed that BW of 1.37kg with 0.13, 0.02 and 9.63 of standard deviation (SD), standard error (SE) and coefficient of variation (CV), respectively. Descriptive statistics of body measurement traits recognised the mean values of WL, KL, SC, CC, and BL was 17.35cm, 2.85cm, 4.48cm, 31.05cm and 37.29cm with CV of 15.80, 13.67, 7.83, 8.25 and 4.39, respectively. Potchefstroom Koekoek chicken layer summary indicated that BW had 1.50kg with CV of 13.651. The summary of linear body measurement traits showed the mean values of WL, KL, SC, CC, and BL was 18.79cm, 0.22cm, 4.69cm, 26.56cm and 33.15cm with CV of 63.27, 29.21, 17.38, 18.65 and 10.37, respectively. Descriptive statistics of the current study showed disagreement with the study of [3] in French Broiler Guinea Fowl of Nigeria. The variation might be due to chicken breed differences.

Phenotypic correlation between measured traits

The correlations between live body weight and linear body measurement traits of Hy-line Silver Brown and Potchefstroom Koekoek are revealed in Table 2. In Hy-line Silver Brown chicken breed, the findings showed that BW had a negative statistical significant correlation with WL ($r = -0.27$) while had no statistical significant correlation with KL ($r = -0.05$), SC ($r = 0.06$), CC (-0.06) and BL ($r = -0.04$), respectively. The highest statistical significant association ($p < 0.01$) was observed between BL and CC ($r = 0.75$). In Potchefstroom Koekoek chicken breed, the results indicated that BW had a highly positive statistical significant correlation ($p < 0.01$) with WL ($r = 0.76$). These results also showed that BW had no statistical significant association with KL ($r = 0.06$), SC ($r = -0.02$) and CC ($r = -0.04$), respectively. The findings showed that BL had a highly positive statistical significant correlation ($p < 0.01$) with CC ($r = 0.56$) and had significant statistical

correlation ($p < 0.05$) with CC ($r = 0.39$). Phenotypic correlation findings of the current study suggest that body weight had a remarkable association with wing length of Potchefstroom Koekoek chicken breed while in Hy-line Silver Brown chicken breed beak length had a significant relationship with chest circumference. Therefore, increasing the wing length might result for genetic improvement of body weight in Potchefstroom Koekoek chicken breed. Whereas, improving beak length might cause the improvement of chest circumference of Hy-line Silver Brown chicken breed. The current study had disagreement with the study of [1] who discovered that body weight had a highly significant statistical association with wing length and shank circumference in Sasso, Kuroiler and Fulani chicken breeds. [3] discovered that body weight of French Broiler Guinea Fowl had a highly remarkable relationship with keel length, chest circumference, body length and wing length. [5] revealed that body weight of South African non-descript chicken breed had a positive highly statistical significant correlation with shank circumference and body length. All these studies are disagreeing with the current study and the differences might be due to breed variations.

Effect of chicken layer breed on measured traits

Results of the effect of breed on the live body weight and morphometric traits of the Hy-line and Potchefstroom Koekoek are shown in Table 3. BW, WL, KL, SC, CC and BL all were significantly ($p<0.05$) influenced by the breed of the birds. Potchefstroom Koekoek were detected to have better ($p<0.05$) body weight, wing length and chest circumference while the Hy-line were observed to have better ($p<0.05$) keel length, shank circumference and beak length. The findings of the current study suggest that there is a breed effects on beak length, wing length, chest circumference, keel length, shank circumference and beak length. Potchefstroom Koekoek chicken breed requires an improvement on Keel length, shank circumference and beak length while Hy-line Silver Brown chicken breed requires an improvement on body weight, wing length and chest length. [1] indicated that there was a statistical significant differences between Sasso, Kuroiler and Fulani chicken breeds in body weight, breast girth, neck circumference, back length, wing length, thigh length, thigh circumference, shank length and shank circumference. [2] suggest that there was a significant difference between Bovans brown, Sasso, Koekoek and local in body weight, body length, wing span, chest width, shank length and shank circumference under lowland and midland agro-ecological zones of Ethiopia.

In conclusion, the study was conducted to firstly determine the relationship between body weight and linear body measurement traits of Potchefstroom Koekoek and Hy-line Silver Brown. Pearson's correlation was used to determine the rela-

tionship and the results show that body weight had a positive highly statistical significant correlation with wing length in Potchefstroom Koekoek and beak length had a positive highly statistical significant correlation with chest circumference in Hy-line Silver Brown chicken breed. Therefore, body weight of Potchefstroom Koekoek might be improved by improving wing length while beak length might be improved by increasing chest circumference. The main objective of the study was to compare some linear body measurement traits between Potchefstroom Koekoek and Hy-line Silver Brown chicken breeds. Analysis of variance was used to determine the effect of chicken breed. The findings suggest that there were statistical significant differences in all measured traits. Potchefstroom Koekoek chicken breed had a better body weight than Hy-line Silver Brown chicken breed.

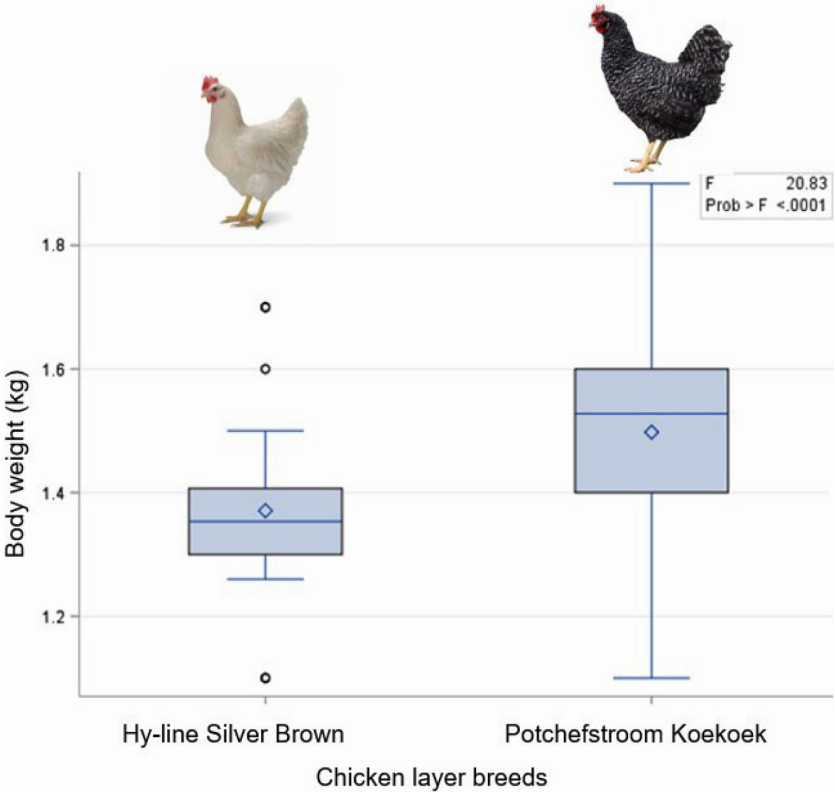

Fig. 1. Boxplot demonstrating the median, minimum, maximum, 25th and 75th percentile values of body weight among different chicken layer breeds

Table 1.

Descriptive statistics of body weight and linear body measurement traits of Hy-line Silver Brown chicken layer

Traits	Mean	SD	SE	CV
Potchefstroom Koekoek				
BW (kg)	1.37	0.13	0.02	9.63
WL (cm)	17.35	2.74	0.31	15.80
KL (cm)	2.85	0.39	0.04	13.67
SC (cm)	4.48	0.35	0.04	7.83
CC (cm)	31.05	2.56	0.29	8.25
BL (cm)	37.29	1.64	0.18	4.39
Hy-line Silver Brown				
BW (kg)	1.50	0.20	0.02	13.65
WL (cm)	18.79	11.89	1.33	63.27
KL (cm)	0.22	0.06	0.01	29.21
SC (cm)	4.69	0.82	0.09	17.38
CC (cm)	26.56	4.95	0.55	18.65
BL (cm)	33.15	3.44	0.38	10.37

SD, Standard deviation; CV, Coefficient of variation; BW, Body weight; WL, Wing length; KL, Keel length; SC, Shank circumference; CC, Chest circumference; BL, Beak length.

Table 2.

Phenotypic correlation between measured traits of Hy-line Silver Brown below the diagonal and Potchefstroom Koekoek chicken breed above the diagonal

Traits	BW	WL	KL	SC	CC	BL
BW		0.76^{**}	0.06^{ns}	-0.02^{ns}	-0.04^{ns}	0.05^{ns}
WL	-0.27^{*}		-0.09^{ns}	0.05^{ns}	-0.05^{ns}	-0.02^{ns}
KL	-0.05^{ns}	-0.11^{ns}		-0.16^{ns}	0.17^{ns}	0.39^{*}
SC	0.06^{ns}	0.11^{ns}	-0.37^{*}		-0.03^{ns}	-0.21^{ns}
CC	-0.06^{ns}	0.31^{*}	-0.45^{*}	0.41^{*}		0.56^{**}
BL	-0.04^{ns}	0.20^{ns}	-0.15^{ns}	0.28^{*}	0.75^{**}	

*Significant at P<0.05; ** Significant at p < 0.01; ns: not significant; SD, Standard deviation; CV, Coefficient of variation; BW, Body weight; WL, Wing length; KL, Keel length; SC, Shank circumference; CC, Chest circumference; BL, Beak length.

Table 3.

The effect of chicken layer breeds on body weight and linear body measurement traits

Traits	Potchefstroom Koekoek	Hy-line Silver Brown
BW (kg)	1.50±0.02[a]	1.37±0.02[b]
WL (cm)	18.79±1.00[a]	17.35±0.31[b]
KL (cm)	2±1.33[b]	8±0.31[a]
SC (cm)	0.22±30[b]	2.85±50[a]
CC (cm)	4.69±0.01[a]	4.48±0.04[b]
BL (cm)	26.56±6[b]	31.05±9[a]

[a-b] Means denoted by different superscripts along the same row differ ($p<0.05$); SD, Standard deviation; CV, Coefficient of variation; BW, Body weight; WL, Wing length; KL, Keel length; SC, Shank circumference; CC, Chest circumference; BL, Beak length.

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Conflict of interest information. The authors declare that they have no conflict of interest.

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