Haryana Vet. (March, 2024) **63(SI),** 61-65 ISSN 0033-4359 (P) **Research Article**

SEXUAL DIMORPHISM OF GROWTH AND MORPHOMETRIC TRAITS IN CARIBRO-DHANRAJA COLOURED BROILERS

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ABSTRACT

Present study aimed to see the effect of sex on growth and morphometric traits in Caribro-Dhanraja coloured broilers. Body weight, body length, shank length and toe length were measured at weekly interval starting from day 1 to day 42, while breast length, breast girth, wing length and thigh length were recorded biweekly. Body mass index value was calculated by taking ratio between body weight (g) and chick length squared (cm^2). There was significant (p 0.05) effect of sex on body weight and body mass index from 14th day. While, from 21st day sex of birds significantly (p 0.05) affected body, shank and toe length. Breast length of the birds showed significant (p 0.05) variation between male and female from 14th day; while, breast girth, wing length and thigh length showed significant variation from day 28 (p 0.05). Body mass index on day 1 showed negative and significant (p 0.05) correlation; while, toe length on day 7 showed positive and significant (p 0.05) correlation with body weight and weight gain on day 42 in male. In females, weight of birds on day 7 and day 14 was positively and significantly (p 0.05) correlated with body weight and weight gain on 42nd day. There was positive and significant (p 0.05) correlation of body length on day 7 with body weight and weight gain on day 42 in females. In females, body mass index on day 7 and day 14 showed positive and significant (p 0.05) correlation with body weight and weight gain on day 42 in females. Breast length of female on day 14 showed a positive and significant (p 0.05) correlation with body weight and weight gain on 42nd day. The results indicated marked sexual dimorphism in certain growth and morphometric trait as well as association of early traits with growth performance of Caribro-Dhanraja coloured broilers from 2nd week of age.

Keywords: Coloured broiler, weight, morphometric traits, growth, sexual dimorphism

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Sexual dimorphism reflects the phenotypic difference in terms of body size, forms and structure between male and female chickens (Fajemilehin, 2017). The sex of the broilers affects their growth performance as well as feed intake and nutrient utilization even under uniform managemental practices (Kalita *et al.*, 2018). The performance, particularly live body weight, gain in body weight, quantity of feed consumed and feed conversion of male broilers are better than their female counterparts (Benyi *et al.*, 2015; Lavania and Verma, 2022). The sex of birds also affects the body morphological traits like body length and girth, wing length, keel length, thigh length, shank length etc. (Sola-Ojo *et al.*, 2011). However, the effect of sex on growth performance, nutrient utilization and body morphometry of broilers varies depending on the genetic potential of the strains. In general males are more competitive at feeder, more aggressive and dominant than the females. These characteristics might be associated with the superior performance of males compared to females. The differential nutritional need and the hormones secreted by males and females may also affect the performance of broilers leading to sexual dimorphism (Zerehdaran *et al.*, 2004; Benyi *et al.*, 2015; England *et al.*, 2023). Thus the male broilers attain market weight earlier than the females. Early prediction of growth performances in broilers using early chick traits like chick weight and body length has been gaining more importance. These traits are also used to evaluate the quality of chick at hatchery. However, Molenaar *et al.* (2008) reported that sex of the broilers affects predictive value while predicting market weight based on early chick weight and body length. They also suggested that gender should be taken into consideration while predicting later growth performance of broilers using early chick traits like body weight and body morphometry.

Slow growing coloured broilers developed from indigenous breeds have greater demand due to better meat quality in terms of appearance, fat content and taste as well as better performance and disease resistance in tropical climate than faster growing broilers (Jiang and Yang, 2007; Lavania and Verma, 2022). Early identification of chicks having better performance in later life is most important for selection. This could be possible only when there is strong correlation of traits at early age with the

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performance of birds at later age. As stated earlier (Molenaar *et al.*, 2008; Benyi *et al.*, 2015), the association of early traits with later performance is not only affected by the sex of the birds, but also the strain of the broilers. Therefore, the present experiment was carried out to see the effect of sex on growth and morphometric traits in Caribro-Dhanraja coloured broilers, and the correlation of early chick traits (weight and morphometry) with growth performance at later age.

MATERIALS AND METHODS

The study was conducted on Caribro-Dhanraja coloured broilers (39 males and 43 females) from June to August 2017 at Livestock Farm Complex, Veterinary College, Junagadh. Day old healthy chicks were numbered by wing band to identify the individual chicks and reared for 6 weeks. Uniform managerial practices were followed during the experimental period. The birds were reared under deep litter house and continuous lighting facilities were provided. The experimental birds were offered adlibitum feed (starter mash of 23% CP and 2800 Kcal ME per kg feed and finisher mash of 20% CP and 2900 Kcal ME per kg) and water. All the birds were vaccinated as a preventive measure for Marek's and New castle diseases as per the guidelines recommended for commercial broilers.

The body weight of the chicks was recorded on day 1 and subsequently at weekly interval up to 6 weeks using electronic weighing balance, and on the same day the linear body morphometric traits like body length (length from tip of beak to length of longest toe excluding its nail), shank length (length from hock joint to bottom of foot pad) and toe length (length of the longest toe excluding nail) were measured as per the standard procedures given by Willemsen *et al.* (2008). The breast length (length of keel from cranium to caudal end), breast girth (circumference of breast at mid line of bird's back), wing length (length from humorous-coracoids joint to the tip of digit or wing) and thigh length (distance between shinbone-femur joint and shinbone-tarsus joint) were measured on day 14, day 28 and day 42 as per the methods followed by Sola-Ojo *et al.* (2011). The linear traits were measured using measuring tape and Vernier calipers. The body weight gain during the experimental period was calculated by subtracting day old chick weight from weight of the birds on day 42. The body mass index was calculated from body weight and chick length using the standard formula given by Willemsen *et al.* (2008).

$$\text{Body mass index} = [\text{body weight}/(\text{chick length})^2]$$

Where, body weight and chick length are measured in gram and centimeter, respectively.

Statistical analysis

The body weight and linear body morphometric traits were recorded from 39 males and 43 female broilers. The results are presented as mean±SE (standard error) for better interpretation. The effect of sex on different parameters was compared by using t-test. The correlation of early traits of chicks with later growth performance (body weight and weight gain at 42 days) of broilers were analysed by correlation. The results were considered as significant when 'p 0.05' (significant at 5%). The statistical analysis was carried out using SPSS software package (Version 16.0, USA).

RESULTS AND DISCUSSION

Growth and morphometric traits

The body weight and linear body morphometric traits of male and female broilers are depicted in Table 1. The sex of the birds did not affect the body weight and body mass index during first week, but from 2nd week onwards the mean value of the traits were significantly (p 0.05) higher in males than females. The body, shank and toe length of birds were similar in male and females during first 2 weeks. These body linear traits showed significant (p 0.05) variation between male and female birds from 3rd week of age, and the values were comparatively higher in males than females. The breast length of the birds showed significant (p 0.05) variation between male and female birds from 14th day; while, breast girth, wing length and thigh length showed significant variation from day 28 (p 0.05).

It is a well-known fact that the sex of the birds affects their growth performance (England *et al.*, 2023) and the same being observed in the present study. The sexual dimorphism of body weight between male and female birds observed in this study is in consonance with previous reports on different chicken breeds. Higher body weight was reported in the males of Ross strain of broilers from 7th day of age by Benyi *et al.* (2015) and from 17th day of age by Da Costa *et al.* (2017). However, in Hansli breed, an indigenous Indian chicken breed the sexual dimorphism of body weight occurred from 3rd week (Behera *et al.*, 2017). In Fulani Ecotype chicken, Sola-Ojo *et al.* (2011) observed the effect of sex on body weight from 6th week of age. The above results reveal that sexual dimorphism of body weight is affected by the strain/breed of the chickens. Benyi *et al.* (2015) reported significant effect of sex on body weight from 7th day in Ross strain but not in Cobb strain under similar management. Similarly under uniform managemental condition, Da Costa *et al.* (2017) reported sexual dimorphism of body weight from day 17 in Ross

Table 1. Body weight and morphometric traits in male (N=39) and female (N=43) coloured broilers

Parameters	Sex of the birds	Age of the broilers						
		Day 1	Day 7	Day 14	Day 21	Day 28	Day 35	Day 42
Body weight (g)	Male	44.66±0.57	154.01±2.86	383.26±6.22^{a}	743.31±9.64^{a}	1111.90±15.23^{a}	1521.91±20.90^{a}	1904.52±29.32^{a}
	Female	44.32±0.52	155.72±2.14	359.86±4.73^{b}	656.49±8.06^{b}	954.58±10.58^{b}	1264.02±15.33^{b}	1558.03±17.96^{b}
Body length (cm)	Male	18.61±0.11	26.01±0.16	33.44±0.18	42.66±0.18^{a}	48.57±0.22^{a}	54.70±0.22^{a}	59.78±0.22^{a}
	Female	18.56±0.07	26.09±0.11	33.54±0.16	41.66±0.15^{b}	47.10±0.16^{b}	52.42±0.18^{b}	57.03±0.21^{b}
Body mass index (g/cm^2)	Male	0.129±0.001	0.227±0.002	0.342±0.005^{a}	0.408±0.003^{a}	0.471±0.005^{a}	0.508±0.006^{a}	0.532±0.007^{a}
	Female	0.128±0.001	0.228±0.002	0.319±0.003^{b}	0.377±0.003^{b}	0.430±0.003^{b}	0.459±0.004^{b}	0.478±0.004^{b}
Shank length (cm)	Male	2.32±0.02	3.93±0.03	5.65±0.05	6.65±0.04^{a}	8.27±0.04^{a}	9.10±0.06^{a}	10.20±0.07^{a}
	Female	2.32±0.02	3.96±0.02	5.57±0.05	6.37±0.05^{b}	7.79±0.03^{b}	8.40±0.04^{b}	9.37±0.03^{b}
Toe length (cm)	Male	2.35±0.01	3.08±0.02	4.29±0.04	5.19±0.03^{a}	5.98±0.05^{a}	6.64±0.04^{a}	7.07±0.04^{a}
	Female	2.33±0.01	3.13±0.03	4.31±0.04	5.01±0.04^{b}	5.60±0.03^{b}	6.19±0.03^{b}	6.53±0.03^{b}
Breast length (cm)	Male	-	-	7.60±0.06^{a}	-	11.48±0.07^{a}	-	13.79±0.08^{a}
	Female	-	-	7.39±0.05^{b}	-	10.78±0.06^{b}	-	13.08±0.08^{b}
Breast girth (cm)	Male	-	-	17.08±0.11	-	24.82±0.18^{a}	-	30.18±0.25^{a}
	Female	-	-	17.01±0.09	-	23.86±0.11^{b}	-	28.47±0.26^{b}
Wing length (cm)	Male	-	-	11.27±0.13	-	17.86±0.12^{a}	-	22.71±0.11^{a}
	Female	-	-	11.03±0.13	-	17.24±0.12^{b}	-	21.46±0.10^{b}
Thigh length (cm)	Male	-	-	7.38±0.07	-	10.67±0.04^{a}	-	13.20±0.08^{a}
	Female	-	-	7.34±0.07	-	10.25±0.06^{b}	-	12.52±0.07^{b}

Mean value of different traits with different superscript (a, b) in male and female birds differed significantly at 5%

Table 2. Correlation of early chick parameters with live weight at 42nd day in male and female broilers

Parameters	Body weight (p-value)	Body length (p-value)	Body mass index (p-value)	Shank length (p-value)	Toe length (p-value)
			Male (N=39)		
X_1. LWT_{42}	-0.045 (0.978)	0.284 (0.079)	-0.330 (0.040)	-0.111 (0.501)	0.310 (0.054)
X_7. LWT_{42}	0.155 (0.347)	0.248 (0.127)	-0.016 (0.922)	0.130 (0.429)	0.355 (0.026)
X_{14}. LWT_{42}	0.278 (0.087)	0.094 (0.571)	0.224 (0.171)	0.110 (0.504)	0.019 (0.906)
			Female (N=43)		
X_1. LWT_{42}	0.233 (0.133)	0.195 (0.209)	0.099 (0.528)	0.156 (0.317)	0.144 (0.357)
X_7. LWT_{42}	0.494 (0.000)	0.377 (0.012)	0.305 (0.046)	0.221 (0.154)	0.158 (0.312)
X_{14}. LWT_{42}	0.717 (0.000)	0.217 (0.163)	0.630 (0.000)	0.247 (0.110)	0.217 (0.163)

X_1. LWT_{42} = Correlation of chick parameters on day 1 with live body weight at 42nd day;
X_7. LWT_{42} = Correlation of chick parameters on day 7 with live body weight at 42nd day;
X_{14}. LWT_{42} = Correlation of chick parameters on day 14 with live body weight at 42nd day;
Figures in parenthesis indicate 'p' value.

308 strain only but not in Ross 708 strain. The higher body weight in males than females chicken might be attributed to better nutrient utilization (Benyi *et al.*, 2015). The performance of broilers may also be influenced by the differential hormones secreted by males and females leading to sexual dimorphism in chickens (Zerehdaran *et al.*, 2004; Benyi *et al.*, 2015). Further, the sexual dimorphism in males and females is also influenced by the social dominance, competitiveness while feeding and aggressiveness including differential nutritional requirements (England *et al.*, 2023).

The gender effect on linear body morphometric traits like body length and girth, wing length, breast length and shank length was observed as significant in Fulani Ecotype chicken from 6 week (Sola-Ojo *et al.*, 2011). In present study, sexual dimorphism for body and shank length in Caribro-Dhanraja broilers was observed from 3rd week which is contradictory to Sola-Ojo *et al.* (2011). The sexual dimorphism of body morphometric traits is obvious in chickens as there were strong and positive correlations of morphometric traits with body weight in broiler chickens (Wolanski *et al.*, 2006). In our study, the body weight showed significant sexual dimorphism from 2nd week onwards which might have resulted in variation of

Table 3. Correlation of early chick parameters with weight gain at 42nd day in male and female broilers

Parameters	Body weight (p-value)	Body length (p-value)	Body mass index (p-value)	Shank length (p-value)	Toe length (p-value)
			Male (N=39)		
X_1. WG_{42}	-0.024 (0.884)	0.272 (0.094)	-0.339 (0.034)	-0.113 (0.492)	0.305 (0.059)
X_7. WG_{42}	0.145 (0.378)	0.240 (0.141)	-0.023 (0.889)	0.125 (0.450)	0.348 (0.029)
X_{14}. WG_{42}	0.269 (0.097)	0.089 (0.586)	0.217 (0.184)	0.101 (0.541)	0.014 (0.934)
			Female (N=43)		
X_1. WG_{42}	0.205 (0.188)	0.184 (0.238)	0.078 (0.617)	0.146 (0.350)	0.135 (0.389)
X_7. WG_{42}	0.481 (0.001)	0.367 (0.015)	0.298 (0.050)	0.213 (0.170)	0.148 (0.345)
X_{14}. WG_{42}	0.711 (0.000)	0.216 (0.164)	0.624 (0.000)	0.244 (0.114)	0.211 (0.174)

X_1. WG_{42} = Correlation of chick parameters on day 1 with live body weight gain at 42nd day;
X_7. WG_{42} = Correlation of chick parameters on day 7 with live body weight gain at 42nd day;
X_{14}. WG_{42} = Correlation of chick parameters on day 14 with live body weight gain at 42nd day;
Figures in parenthesis indicate 'p' value.

Table 4. Correlation of early chick parameters on day 14 with body weight and weight gain at 42nd day in male and female broilers

Parameters	Breast length (p-value)	Breast girth (p-value)	Wing length (p-value)	Thigh length (p-value)
		Male (N=39)		
X_{14}. LWT_{42}	0.209 (0.202)	-0.003 (0.985)	0.167 (0.308)	-0.178 (0.279)
X_{14}. WG_{42}	0.206 (0.208)	-0.009 (0.957)	0.162 (0.325)	-0.180 (0.273)
		Female (N=43)		
X_{14}. LWT_{42}	0.327 (0.032)	0.264 (0.087)	0.186 (0.232)	0.127 (0.419)
X_{14}. WG_{42}	0.318 (0.037)	0.253 (0.102)	0.186 (0.233)	0.122 (0.435)

X_{14}. LWT_{42} = Correlation of chick parameters on day 14 with live body weight at 42nd day;
X_{14}. WG_{42} = Correlation of chick parameters on day 14 with live body weight gain at 42nd day;
Figures in parenthesis indicate 'p' value.

different linear body traits between male and female birds. Variation in results of different studies might be attributed to the strains of birds studied.

Correlation of early traits with growth performance

In males, except body mass index and toe length, the early body weight and morphometry did not show any significant association (p>0.05) with growth performance (body weight and weight gain at 42 days). The body mass index of males on day 1 showed negative and significant (p 0.05) correlation, while toe length on day 7 showed positive and significant (p 0.05) correlation with body weight (Table 2) and weight gain (Table 3) on day 42. However, in females, there was positive and significant (p 0.05) correlation of weight of birds on day 7 and day 14 with body weight (Table 2) and weight gain on 42nd day (Table 3). Body length on day 7 showed a positive and significant (p 0.05) correlation with body weight (Table 2) and weight gain (Table 3) on day 42 in females. Further, in females there was a positive and significant (p 0.05) correlation of body mass index on day 7 and day 14 with body weight (Table 2) and weight gain (Table 3) on day 42. The breast length of females on day 14 only showed a positive and significant (P 0.05) correlation with body weight and weight gain on 42nd day (Table 4).

Molenaar *et al.* (2008) did not observe any association of day old chick weight with their body weight on day 38 in both male and female Ross broilers. Similarly, no association between day-old Caribro-Dhanraja male chicks' weight and body weight at 42 days was noted. However, in females, a positive and moderate to strong association of the body weight of birds on 7th and 14th day with the body weight at 42 days was observed. Wolanski *et al.* (2006) reported a positive and significant correlation of hatch weight with the 14th day body weight (r=0.34, p<0.001) in male broiler breeder strains. Further, without considering gender, Willemsen *et al.* (2008) cited a positive and significant association of hatch weight and weight on the 7th day with market weight on day 42 in Ross and Cobb broilers. These results reflected that association of day-old chick body weight with market weight is inconsistent in different studies and breeds. This might be

attributed to the presence of an unknown quantity of residual yolk in chicks (Wolanski *et al.*, 2006). Thus, day-old chick weight could not be considered as a better predictor of growth and live weight at market age in broilers.

In Hybro male broilers, a trend of positive association (r=0.26, p=0.06) was observed between day-old chick body length and market weight at day 42 by Molenaar *et al.* (2008). They also reported positive and significant association (r=0.30, p<0.05) of body length on day 1 with body weight on day 42 in female Hybro broilers. Contrary to Molenaar *et al.* (2008) we did not observe any association between body length and growth performance in male Caribro-Dhanraja broilers. Moreover, a significant association of body length on day 7 with body weight and weight gain at 42 days was observed in female birds. Contrary to present study, Molenaar *et al.* (2008) observed a positive association (r=0.36, p<0.01) between day old chick body length with body weight at 38 days in male Ross broilers only but no association in females. Wolanski *et al.* (2006) reported low to moderate correlation of chick body length (r=0.38, p<0.001) and shank length (r=0.43, p<0.001) at hatch with 14th day body weight in male broiler breeder strain. Willemsen *et al.* (2008) did not observe any association of day-old chick shank and toe length with market weight on day 42 in Ross and Cobb broilers which is supported by our study. The variation of results in different studies might be attributed to sample size or age or strains of broiler flock (Molenaar *et al.*, 2008). Without considering sex of birds, Willemsen *et al.* (2008) reported a positive but weak association of body mass index of day-old chicks with market weight at 35 and 42 days in Ross strain but markedly affected by the age of the breeder line. However, in this study, the association of body mass index and body weight and weight gain at 42 days showed a marked gender effect. Therefore, sex or gender of the birds should be taken into consideration while predicting market weight of the broilers using morphometric traits of day old chicks.

CONCLUSIONS

Results of this study indicated that gender of the birds did not affect the body weight and morphometric traits during first week. The body weight, body mass index and breast length showed significant sexual dimorphism from 14th day onwards, while the other traits exhibited during later stage of life. In males, the body mass index on day 1 and toe length on day 7 was significantly but moderately correlated with body weight and weight gain at 42 days. While in females, at earliest the body weight and body mass index on day 7 had significant and moderated association with body weight and weight gain at 42 days. Taken together, it may be concluded that sexual dimorphism of certain growth and morphometric trait as well as association of early traits with growth performance of Caribro-Dhanraja coloured broilers occur from second week of age.

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