

RESEARCH PAPER

Certain Morphometric Characters and their Inter-Relationships in Indigenous Chicken of Kerala

P. Girish Kumar, P. Ezhil Praveena and R. Richard Churchill*

Department of Poultry Science, College of Veterinary and Animal Sciences, Kerala Veterinary and Animal Sciences University, Mannuthy, Thrissur, Kerala, India

*Corresponding author: drchurchil@gmail.com (ORCID ID: 0000-0002-1707-1046)

Paper No. 1211

Received: 23-03-2025

Revised: 30-05-2025

Accepted: 09-06-2025

ABSTRACT

The present study aimed to characterize select morphometric traits and assess their inter-relationships in indigenous chickens of Kerala, India. A total of 200 adult birds (36 males and 164 females) were evaluated under field conditions in two agro-climatic zones, namely, Thrippangottur Panchayat in Kannur district and Chekkiad Panchayat in Kozhikode district. Morphometric measurements including body weight, shank length, beak length, wattle size and spur length were recorded and indices of shank and beak lengths relative to body weight) were computed. Results revealed significant sexual dimorphism in all traits except the relative lengths and beak-shank length index. Males exhibited significantly ($P<0.01$) higher values for body weight (1652.65 vs. 1409.34 g), shank length (93.65 mm vs. 79.70 mm), beak length (32.47 mm vs. 29.98 mm) and spur length (4.06 mm vs. 2.12 mm) compared to females. District-wise comparisons showed no substantial differences in absolute trait values except for shank length, which was significantly ($P<0.01$) longer in birds from Kannur. Relative shank and beak lengths were significantly ($P<0.01$) higher in Kozhikode birds, indicating possible regional adaptation. Phenotypic correlations showed strong ($P<0.01$) positive associations between body weight and both shank and beak lengths in both sexes. Additionally, shank and beak lengths were positively correlated ($P<0.01$), while relative shank and beak lengths showed a significant ($P<0.01$) correlation with each other, suggesting proportional appendage development. These findings contribute valuable baseline data for future genetic improvement and conservation strategies targeting indigenous chicken germplasm in Kerala.

HIGHLIGHTS

- Indigenous chickens exhibit sexual dimorphism in morphometric traits.
- Regional variation in relative measurements but not in sex-wise variation indicated possible local adaptation.
- Positive correlations were found between body weight, linear traits, and relative lengths.

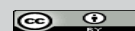
Keywords: Indigenous chicken, Kerala, Morphometric traits, Kerala

India and its neighbouring countries are considered the home tract of the Red Jungle Fowl (*Gallus gallus* Linn.), from which contemporary domestic breeds are believed to have evolved (Crawford, 1990). India is endowed with diverse avian genetic resources, comprising 20 recognized chicken breeds (NBAGR, 2025) and numerous lesser-known ecotypes that are to be characterized. Recent data indicate that approximately 29% of laying hens of commercial and backyard systems put together are of indigenous

type in India (Churchil, 2022). Indigenous breeds and local ecotypes are particularly well-suited for scavenging-based systems under tropical conditions, requiring minimal care for feeding and housing (Azad *et al.* 2015). These birds possess several adaptive features that enhance their survival

How to cite this article: Girish Kumar, P., Ezhil Praveena, P. and Richard Churchill, R. (2025). Certain Morphometric Characters and their Inter-Relationships in Indigenous Chicken of Kerala. *Int. J. Ag. Env. Biotech.*, 18(02): 143-151.

Source of Support: None; **Conflict of Interest:** None





under harsh conditions such as small body size for short-distance flight, long legs that aid in rapid running, and exceptional alertness to evade aerial and terrestrial predators in hilly terrain (Magothe *et al.* 2012).

Tellicherry is one of the indigenous breeds of India, native to the Malabar region of Kerala covering Kannur and Kozhikode districts (Acharya and Bhatt, 1984). Although hens of this breed are moderate layers, they exhibit desirable characters for village farming such as strong broodiness (Kumar *et al.* 2013a), ability to withstand diseases and the instinct to escape from predators (Kumar *et al.* 2016). The farmers typically rear small flocks of averaging around six birds per household in this region as backyard poultry with minimal inputs. The birds are usually housed in small coops at night and are fed kitchen waste and little quantity of household grains. Limited attention is paid to healthcare and disease prevention (Kumar *et al.* 2013b). This system often results in slow growth due to the genetics of the birds and high mortality due to highly prevalent predation in this hilly terrain (Kumar and Churchill, 2025). This low-input system is widespread in Kerala, especially among landless laborers and economically marginalized families, as these chickens rely mainly on scavenged feed resources. Although these birds grow slowly and produce fewer, lighter eggs compared to commercial breeds, their meat and eggs are highly valued as delicacies and command premium market prices, often more than double that of their commercial counterparts (Kumar *et al.* 2013c).

Phenotypic characterization plays a pivotal role in the sustainable use and conservation of animal genetic resources (FAO, 2012). It entails identifying and describing traits of animal populations in the context of their production environments. Morphometric measurements like size and shape variation among breeds and ecotypes (Ajayi *et al.* 2008) and phenotypic variations provide valuable insights in characterization (Lanari *et al.* 2003). Maintaining genetic diversity both within and between indigenous populations is crucial for their long-term improvement and resilience (Benítez, 2002).

Despite earlier studies on flock composition, production traits, mortality patterns and behavioural characteristics conducted by the authors, data on

morphometric characteristics of indigenous chickens of Kerala remain limited. Therefore, the present study was undertaken to record key morphometric traits such as body weight, wattle length, beak length, and shank length of indigenous chickens reared in Kannur and Kozhikode districts and to explore the inter-relationships among these quantitative traits.

MATERIALS AND METHODS

A field study was conducted to estimate the morphometric traits of indigenous chickens in Kannur and Kozhikode districts of Kerala. Preliminary surveys were carried out in both districts to identify representative locations where native chicken populations were reared with minimal genetic influence from exotic breeds. Based on the preliminary survey findings, Thrippangottur Panchayat in Kannur district and Chekkiad Panchayat in Kozhikode district were selected as the study areas. These panchayats are characterized by their geographical isolation and are known to harbor relatively pure populations of native chickens and also had historical absence of exotic germplasm introductions and the observed phenotypic uniformity consistent with indigenous chicken traits.

The primary objective of the study was to document phenotypic and production traits of a total of 200 birds; 100 birds each from Kannur and Kozhikode districts. Since many morphological traits are known to exhibit sexual dimorphism, data were classified separately by sex to account for sex-specific differences. The following morphometric traits were recorded using standardized techniques and appropriate instruments.

Wattle length was measured (in cm) from its point of attachment at the lower beak to the lowest ventral edge. Birds were categorized based on wattle size into three classes, namely small (≤ 1.0 cm), medium (1.1 – 2.0 cm) and large (> 2.0 cm).

Shank length (in mm) was measured using Vernier calipers from the hock joint to the tarso-metatarsophalangeal joint.

Beak length (in mm) was recorded from the angle of the beak to the tip of the upper mandible using Vernier calipers.

Spur length (in mm) was measured using Vernier calipers. Spurs shorter than 1 mm were classified as rudimentary.

Body weight of each bird was recorded using a digital scale with an accuracy of 10 grams.

In order to account for size variation among individual birds, relative lengths shank and beak and beak-shank index were calculated for each bird using the following formulas:

$$\text{Relative shank length } \left(\frac{\text{cm}}{\text{g}} \right) = \frac{\text{Shank length (cm)}}{\text{Body weight (g)}} \times 100$$

$$\text{Relative beak length } \left(\frac{\text{cm}}{\text{g}} \right) = \frac{\text{Beak length (cm)}}{\text{Body weight (g)}} \times 100$$

$$\text{Beak - shank index } \left(\frac{\text{cm}}{\text{cm}} \right) = \frac{\text{Beak length (cm)}}{\text{Shank length (cm)}} \times 100$$

Mean values of both relative shank and relative beak lengths were then calculated separately for males and females.

DATA ANALYSIS

The collected data were grouped into appropriate classes and sex- and district-wise frequency distributions were analyzed using Z-tests to assess variations attributable to sex and region, following the methods described by Zar (2010).

$$Z = \frac{(\hat{p}_1 - \hat{p}_2)}{\sqrt{\hat{p}(1 - \hat{p}) \left(\frac{1}{n_1} + \frac{1}{n_2} \right)}}$$

Where, $\hat{p}_1$: The proportion of sample 1, with sample size n_1 ; $\hat{p}_2$: The proportion of sample 2, with sample size n_2 ; $\hat{p}$: The pooled proportion calculated as $(x_1 + x_2)/(n_1 + n_2)$, where x_1 and x_2 are the number of successes in each sample.

Mean values of morphometric traits were compared between sexes and between regions (Kannur and Kozhikode) using independent sample *t*-tests to determine statistically significant differences, following the method outlined by Zar (2010).

RESULTS AND DISCUSSION

Body weight

Significant differences were observed in the distribution of birds across certain body weight categories between sexes (Table 1). Females were predominantly represented in the 1001–1250 g category, whereas males were more frequently found in the 2251–2750 g range. The overall mean body weight differed significantly ($P < 0.01$) between sexes, with males averaging 1652.65 g and females 1409.34 g, clearly indicating sexual dimorphism (Table 2). Although only the 1501–1750 g category showed a significant difference ($P < 0.05$) in distribution between Kannur and Kozhikode districts, the mean body weights between the two districts were comparable, suggesting no substantial regional variation in this trait.

Comparable findings were reported by Assefa and Melesse (2018) for indigenous chicken populations in the Sheka Zone, southwestern Ethiopia, where male and female body weights were 1.64 vs. 1.35 kg (normal feathered), 1.75 vs. 1.48 kg (naked-neck), and 1.68 vs. 1.42 kg (crest-feathered), respectively. Earlier, Vij *et al.* (2007) also reported similar body weights of 1.62 kg for males and 1.24 kg for females in the same study area. Tadese *et al.* (2024) also reported similar values (1.76 vs. 1.30 kg; $P < 0.05$) in indigenous chickens of Central Ethiopia. In contrast, lower weights were recorded by Tareke *et al.* (2018) in the Bale Zone of Oromia Region (1.40 vs. 1.00 kg; $P < 0.01$), by Tadele *et al.* (2018) in Kaffa Zone (1.49 vs. 1.21 kg; $P < 0.01$), and by Yakubu *et al.* (2009) in Nigeria (1.37 vs. 1.19 kg; $P < 0.05$). On the higher end, Guni *et al.* (2013) reported higher mean body weights of 2.10 kg (males) and 1.50 kg (females) in local chickens from the Southern Highlands of Tanzania. Similarly, Lahlimpua *et al.* (2021) observed wider values (2.02 vs. 1.37 kg) in indigenous chickens of Mizoram, India. All these studies consistently reported significant sexual dimorphism in body weight.

Although the present study did not detect regional variation between Kannur and Kozhikode, significant geographic differences in body weight have been documented elsewhere, including in indigenous chickens of Mostaganem, Relizane, and Mascara

Table 1: Sex- and district-wise classification of observations on morphometric traits of indigenous chicken of Kerala

Sl. No.	Characters	Categories	Sex-wise			District-wise			Overall
			Males % (no.)	Females % (no.)	Z-score	Kannur % & no.	Kozhikode % & no.	Z-score	
1	Body weight (g)	Below 1000	2.78 (1)	4.88 (8)	0.55	3.00	6.00	1.02	4.50 (9)
		1000 to 1250	8.33 (3)	35.37 (58)	3.19**	29.00	32.00	0.46	30.50 (61)
		1251 to 1500	36.11 (13)	29.27 (48)	0.81	26.00	35.00	1.38	30.50 (61)
		1501 to 1750	16.67 (6)	15.85 (26)	0.12	22.00	10.00	2.31*	16.00 (32)
		1751 to 2000	19.44 (7)	8.54 (14)	1.93	11.00	10.00	0.23	10.50 (21)
		2001 to 2250	5.56 (2)	5.49 (9)	0.02	5.00	6.00	0.31	5.50 (11)
		2251 to 2500	8.33 (3)	0.61 (1)	3.00**	4.00	0.00	2.02	2.00 (4)
		2501 to 2750	2.78 (1)	0 (0)	2.14*	0.00	1.00	1.00	0.50 (1)
		Total	100 (36)	100 (164)		100.00	100.00		100.00 (200)
2	Wattle size	Small	0.00 (0)	54.27 (89)	5.93**	49.00	40.00	1.28	44.50 (89)
		Medium	36.11 (13)	38.41 (63)	0.79	34.00	42.00	1.17	38.00 (76)
		Large	63.89 (23)	7.32 (12)	8.09**	17.00	18.00	0.19	17.50 (35)
		Total	100.00 (36)	100.00 (164)		100.00	100.00		100.00 (200)
3	Shank length (mm)	Below 70	0.00 (0)	5.49 (9)	1.44	2.00	7.00	1.71	4.50 (9)
		70 to 75	0.00 (0)	24.39 (40)	3.31**	8.00	32.00	4.24**	20.00 (40)
		76 to 80	8.33 (3)	26.22 (43)	2.31*	18.00	28.00	1.68	23.00 (46)
		81 to 85	2.78 (1)	24.39 (40)	2.91**	30.00	11.00	3.33**	20.50 (41)
		86 to 90	27.78 (10)	13.41 (22)	2.13*	23.00	9.00	2.70**	16.00 (32)
		91 to 95	19.44 (7)	4.88 (8)	3.00**	7.00	8.00	0.27	7.50 (15)
		96 to 100	19.44 (7)	1.22 (2)	4.78**	5.00	4.00	0.34	4.50 (9)
		Above 100	22.22 (8)	0.00 (0)	6.16**	7.00	1.00	2.17*	4.00 (8)
		Total	100.00 (36)	100 (164)		100.00	100.00		100.00 (200)
4	Beak length (mm)	Below 30	5.56 (2)	37.80 (62)	3.76**	32.00	32.00	0.00	32.00 (64)
		30 to 32	55.56 (20)	52.44 (86)	0.34	50.00	56.00	0.85	53.00 (106)
		33 to 35	30.56 (11)	9.76 (16)	3.31**	16.00	11.00	1.03	13.50 (27)
		36 to 38	8.33 (3)	0.00 (0)	3.72**	2.00	1.00	0.58	1.50 (3)
		Total	100 (36)	100 (164)		100	100		100.00 (200)
5	Spur length (mm)	Rudimentary	36.11 (13)	89.02 (146)	7.12**	82.00	77.00	0.88	79.50 (159)
		1 to 5	33.33 (12)	10.98 (18)	3.40**	11.00	19.00	1.58	15.00 (30)
		6 to 10	19.44 (7)	0.00 (0)	5.75**	4.00	3.00	0.38	3.50 (7)
		11 to 15	2.78 (1)	0.00 (0)	2.14*	1.00	0.00	1.00	0.50 (1)
		16 to 20	5.56 (2)	0.00 (0)	3.03**	2.00	0.00	1.42	1.00 (2)
		20 to 25	2.78 (1)	0.00 (0)	2.14*	0.00	1.00	1.00	0.50 (1)
		Total	100 (36)	100 (164)		100	100		100.00 (200)

* Significant ($P < 0.05$); ** Significant ($P < 0.01$).

provinces of northwestern Algeria (Dahloum *et al.* 2016), Gibe and Ameka districts of Ethiopia (Tadese *et al.* 2024), Kolla, Weynadega, and Dega agro-ecological zones of northern Ethiopia (Markos *et al.* 2024), Madda Walabu, Delomena, Barbare, Ginnir, and Sinana districts of Oromia Region of Ethiopia (Tareke *et al.* 2018), various agro-ecological zones of Oman (Al-Qamashoui *et al.* 2014) and Chunya, Njombe, and Songea districts of Tanzania (Guni *et al.* 2013).

Wattle size

A significant difference ($P < 0.01$) was observed between sexes in the distribution of wattle sizes. Small wattles were predominantly found in females (54.27%), whereas large wattles were more common in males (63.89%). In contrast, the medium category did not show a statistically significant difference between sexes. Additionally, there was no significant regional difference in wattle

size distribution between birds from Kannur and Kozhikode districts (Table 1).

The findings of the present study align with previous reports of sexual dimorphism in wattle length among indigenous chickens in various regions, including Southwestern Ethiopia (Assefa and Melesse, 2018), Central Ethiopia (Tadese *et al.* 2024), the Western Tigray Region of Northern Ethiopia (Markos *et al.* 2024), India (Lalhlimpua *et al.* 2021), and Algeria (Dahloum *et al.* 2016). Reports on regional variation in wattle size have been inconsistent. For instance, Lalhlimpua *et al.* (2021) found no significant difference between indigenous chickens from the Aizawl and Mamit districts of Mizoram, India, and Dahloum *et al.* (2016) reported no regional variation among chickens from Mostaganem, Relizane, and Mascara provinces of Algeria. In contrast, Markos *et al.* (2024) observed a significant ($P < 0.05$) difference in wattle size across the Kolla, Weynadega, and Dega agro-climatic zones of Ethiopia.

Shank Length

Shank length showed significant variation between sexes across all categories, except the <70 mm group (Table 1), clearly indicating sexual dimorphism. A greater proportion of females were concentrated in the lower shank length classes (70–85 mm), while most males were distributed in higher categories (>85 mm). Notably, no males were recorded in the lowest length classes (<75 mm), whereas over 80% of females fell in the classes below 85 mm. A significant difference ($P < 0.01$) was observed across multiple categories, with males exhibiting generally longer shanks (Table 1). The mean shank length also differed significantly ($P < 0.01$) between sexes, with males averaging 93.7 mm and females 79.7 mm (Table 2). District-wise comparison revealed significant variation in shank length distribution between Kannur and Kozhikode (Table 1). Birds from Kannur were predominantly represented in the 81–90 mm category, while those from Kozhikode were more frequently observed in the 71–80 mm range. This trend was reflected in the mean values as well, with chickens from Kannur exhibiting significantly ($P < 0.05$) higher average shank length (85.4 mm) compared to their counterparts from Kozhikode (78.9 mm).

Previous studies have reported a wide range of

shank lengths in indigenous chickens, from as low as 6.65 cm in males and 6.25 cm in females in Nigeria (Yakubu *et al.* 2009) to as high as 12.46 cm in males and 9.92 cm in females in Zambia (Liswaniso *et al.* 2024). Indigenous chickens in India (Tantia *et al.* 2005) and other regions such as Southwestern and Central Ethiopia, Northern and Oromia regions of Ethiopia, Oman, and Tanzania have reported values within this range (Assefa and Melesse, 2018; Tadese *et al.* 2024; Markos *et al.* 2024; Tareke *et al.* 2018; Al-Qamashoui *et al.* 2014; Guni *et al.* 2013). All these studies consistently observed sexual dimorphism in shank length.

Similar to the current findings, significant regional differences in shank length have also been reported among indigenous chicken populations in Gibe, Ameka, Madda Delomena, Barbare, Ginnir, and Sinana districts of Ethiopia (Tareke *et al.* 2018; Tadese *et al.* 2024), the Luapula, Lusaka, Muchinga, Northern, and Southern provinces of Zambia (Moono *et al.* 2024), and the Chunya, Njombe, and Songea districts of Tanzania (Guni *et al.* 2013).

The shank lengths observed in the present study lean toward the upper end of the previously reported range. This may be attributed to ecological factors, particularly the hilly terrain and dense forest cover of the study areas, which may favor birds with longer legs that can run swiftly and escape predators. Notably, Kannur and Kozhikode districts are characterized by extensive forest cover, accounting for 55.86% and 61.28% of their total geographical area, respectively.

Beak length

Beak length showed significant variation between sexes ($P < 0.01$) across several categories (Table 1). Although the majority of both males (55.56%) and females (52.44%) were concentrated in the 31–32 mm category, the remaining males were predominantly distributed in the higher length classes (33–38 mm), while most of the remaining females were grouped in the lowest category (<30 mm). This trend was also reflected in the mean beak length, which was significantly ($P < 0.01$) higher in males (32.47 mm) compared to females (29.98 mm) (Table 2), indicating clear sexual dimorphism. However, no significant difference in beak length distribution was observed between chickens from Kannur and Kozhikode districts.



Table 2: Mean $\pm$ SE values and relative lengths of morphometric traits of indigenous chicken of Kerala

Sl. No	Characters	Sex-wise classification			District-wise classification			Overall (n=200)
		Males (34)	Females (166)	t-value	Kannur (n=100)	Kozhikode (n=100)	t-value	
1	Shank length (mm)	93.65 $\pm$ 1.35	79.70 $\pm$ 0.54	10.37**	85.41 $\pm$ 0.8	78.87 $\pm$ 0.84	5.60**	82.10 $\pm$ 0.63
2	Beak length (mm)	32.47 $\pm$ 0.40	29.98 $\pm$ 0.22	4.89**	30.35 $\pm$ 0.36	30.46 $\pm$ 0.20	0.23	30.41 $\pm$ 0.20
3	Spur length (mm)	4.06 $\pm$ 0.56 (n=18)	2.12 $\pm$ 0.21 (n=17)	3.19**	2.64 $\pm$ 0.62 (n=14)	3.43 $\pm$ 0.39 (n=21)	1.13	3.11 $\pm$ 0.34 (n=35)
4	Body weight (g)	1652.65 $\pm$ 72.12	1409.34 $\pm$ 26.48	3.64**	1476.73 $\pm$ 38.38	1425.69 $\pm$ 34.93	0.99	1450.70 $\pm$ 25.90
5	Relative shank length (mm/g)	5.63 $\pm$ 0.21	6.03 $\pm$ 0.11	1.68	5.65 $\pm$ 0.12	6.26 $\pm$ 0.15	3.25**	5.94 $\pm$ 0.09
6	Relative beak length (mm/g)	2.09 $\pm$ 0.08	2.24 $\pm$ 0.04	0.94	2.11 $\pm$ 0.04	2.32 $\pm$ 0.06	2.92**	2.21 $\pm$ 0.04
7	Beak– shank index (mm/mm)	37.16 $\pm$ 0.39	37.36 $\pm$ 0.34	0.05	37.48 $\pm$ 0.32	37.18 $\pm$ 0.47	0.53	37.32 $\pm$ 0.29

** Significant ($P < 0.01$).

The mean beak lengths recorded in the present study (3.25 cm in males and 3.00 cm in females) were comparatively higher than values previously reported in indigenous chicken populations from Mizoram, India (Lalhlimpuia *et al.* 2021), Ethiopia (Tadese *et al.* 2024; Markos *et al.* 2024), Algeria (Dahloum *et al.* 2016), and Nigeria (Yakubu *et al.* 2009). Significant regional variation in beak length was reported by Markos *et al.* (2024) among indigenous Kolla, Weynadega, and Dega chicken ecotypes in the Western and Tigray regions of Ethiopia. In contrast, no regional variation in beak length was observed among indigenous chickens from the Mostaganem, Relizane, and Mascara provinces of Algeria (Dahloum *et al.* 2016) or between the Aizawl and Mamit districts of Mizoram, India (Lalhlimpuia *et al.* 2021).

Spur length

The distribution of spur length differed significantly ($P < 0.01$) between sexes across all categories (Table 1). While the majority of females (89.02%) and a notable proportion of males (36.11%) possessed rudimentary spurs (< 1 mm), male spur lengths extended up to the 20–25 mm category. In contrast, female spur development was limited to the 1–5 mm range. For the analysis of mean spur length, only birds with measurable spurs (> 1 mm) were considered, excluding rudimentary values. Based on the data from 35 such birds, the mean spur length was significantly ($P < 0.01$) higher in males

(4.06 mm) than in females (2.12 mm), further reinforcing sexual dimorphism in this trait. District-wise comparison revealed no significant differences in either the frequency distribution of spur length categories or the mean spur lengths between Kannur and Kozhikode districts.

Chen *et al.* (2024) reported spur lengths of 19.48 mm in males and 20.21 mm in females of Rhode Island Red (RIR) chickens, which are substantially higher than the values observed in the present study on indigenous chickens. Furthermore, in contrast to the current findings, Markos *et al.* (2024) observed significant variation in spur length among indigenous chickens from different agro-climatic zones in Northern Ethiopia, reporting values of 1.43 cm in Kolla, 0.93 cm in Weynadega, and 1.14 cm in Dega zones.

Relative lengths and length ratio

Interestingly, although the mean absolute values of beak and shank lengths exhibited significant ($P < 0.01$) sexual dimorphism, their relative lengths, expressed as a proportion of body weight, did not differ significantly between males and females. This finding suggests that, despite males being generally larger in size, both sexes maintain a similar proportional relationship between body size and appendage length. In contrast, a reverse trend was observed in the district-wise comparison. While the absolute lengths of beak and shank showed no significant regional variation, the relative lengths

Table 3: Phenotypic correlation among the body weight, linear measurements and relative lengths of males (below diagonal divide; $n = 36$) and females (above diagonal divide; $n = 164$) of indigenous chicken of Kerala

Traits	BWT	SHL	BKL	SPL	RSL	RBL
BWT		0.55**	0.44*	-0.47	-0.92**	-0.91**
SHL	0.35**		0.69**	-0.06	-0.29	-0.41*
BKL	0.23**	0.21**		-0.08	-0.29	-0.22
SPL	0.18	-0.21	0.28		0.47*	0.45
RSL	-0.87**	0.03	-0.16*	-0.31		0.97**
RBL	-0.90**	-0.25**	0.08	-0.13	0.91**	

* Significant ($P < 0.05$); ** Significant ($P < 0.01$); BWT = Body weight; SHL = Shank length; BKL = Beak length; SPL = Spur length; RSL = Relative shank length; RBL = Relative beak length.

were significantly ($P < 0.01$) higher in birds from Kozhikode than those from Kannur. This suggests that chickens in Kozhikode possess relatively longer appendages in proportion to their body weight, which may represent an evolutionary adaptation to local environmental conditions, such as terrain or predator pressure. The analysis of the beak-shank length ratio further revealed no significant differences between sexes or districts (Table 2), indicating a stable proportional relationship between beak and shank lengths, regardless of sex or geographic origin. In other words, the relative size of these two appendages appears to be conserved across biological and regional variables.

Relative shank and beak lengths, the proportion of shank and beak lengths relative to body weight, and beak-shank index represent providing a standardized comparison across birds of different sizes. Literature on relative morphometric indices remains limited. Apart from a single study by Tadele *et al.* (2018), which reported no significant difference in body weight to shank length ratio among indigenous Decha, Chena, and Gimbo chicken ecotypes of Kaffa Zone, Southwestern Ethiopia, no other comparative data appear to be available in the published literature. This highlights the need for further research on proportional morphometrics in indigenous poultry populations.

Phenotypic correlations

Body weight exhibited a significant ($P < 0.01$) positive correlation with shank length, beak length, and both relative shank and beak lengths in males and females. While shank length was significantly ($P < 0.01$) correlated with beak length in positive direction, neither of these linear morphometric traits

showed any notable association with spur length or the relative appendage lengths. Interestingly, spur length exhibited a significant positive correlation with relative shank length, but only in males. A strong ($P < 0.01$) positive correlation was noted between relative shank length and relative beak length in both sexes, suggesting that the proportional development of these appendages is conserved irrespective of sex.

The positive association between body weight and shank length observed in this study aligns with earlier findings in indigenous chicken populations of Ethiopia ($r = 0.28$; $P < 0.05$; Tadele *et al.* 2018), Zambia ($r = 0.68$; $P < 0.01$; Moono *et al.* 2024), and Tanzania ($r = 0.59$; $P < 0.01$; Guni *et al.* 2013). Similar trends were reported in Nigerian indigenous chickens, where body weight showed strong ($P < 0.01$) positive correlations with shank length in normal feathered ($r = 0.77$), naked-neck ($r = 0.85$), and frizzle ($r = 0.75$) varieties (Yakubu *et al.* 2009). In the same study, beak length also correlated positively ($P < 0.01$) with body weight in all three feather types; normal ($r = 0.56$), naked-neck ($r = 0.61$), and frizzle ($r = 0.55$). Additionally, shank and beak lengths themselves showed significant ($P < 0.01$) positive correlations in these groups (ranging from 0.51 to 0.63), supporting the present findings on coordinated growth of these appendages.

It may be concluded that clear sexual dimorphism exists in the morphometric traits of indigenous chickens of Kerala, aligning with general patterns observed in chickens. To the best of the authors' knowledge, this is the first study to compare relative measurements (adjusted to body weight), which showed no significant sex-wise differences, indicating proportional appendage development.



District-wise, birds from Kozhikode exhibited higher relative lengths, suggesting possible local adaptations. Positive correlations between body weight and linear traits, as well as between relative lengths, are in expected lines and confirm coordinated growth patterns. These findings offer valuable baseline data for conservation, selective breeding, and sustainable management under low-input poultry systems.

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