Original Research

A Comparison of Morphological and Morphometric Traits of Known and Lesser Known Sheep Populations of Karnataka in the Farmers' Flocks*

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Abstract

This study is an attempt to characterize lesser known sheep genetic groups viz. Mouli and Yalaga, which are popular among farmers for its meat production and also to compare with Kenguri sheep which is considered as heaviest among Karnataka sheep breeds. Data on morphological and morphometric traits were recorded in these three genetic groups at 2 tooth, 4 tooth, 6 tooth and 8 tooth stage in both the sexes from farmer's flocks. Mouli sheep were taller, polled in both sexes, possess long tail, long drooping ears, convex face with roman nose when compared to Kenguri and Yalaga sheep. Analysis of variance revealed that Mouli sheep had higher values and found significantly (P<0.01) different from Kenguri and Yalaga sheep with respect to body length, height at withers, flank width, face length and body weight. Age wise analysis of morphometric traits in three genetic traits indicated higher values in Mouli sheep for all traits studied than Kenguri and Yalaga sheep.

Key words: Farmers' Flocks, Morphometric Traits, Phenotypic Characterization, Sheep

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Introduction

Documentation of existing genetic resources, including the description of the population phenotypic characteristics, cultural importance and genetic uniqueness is one of the main areas of the livestock conservation activities (Ruane, 1999; Duchev and Groeneveld, 2006) and Lanari *et al.* (2003) emphasized

characterization of livestock breeds as the first approach to a sustainable use of animal genetic resources. The first phase of characterization involves the identification of populations based on morphological descriptors (Gizaw *et al*., 2007). The morphometric characterization of Indian sheep is limited to single breed/population. However, Yadav *et al.* (2012) have given a comparative analysis of morphometric traits of Muzaffarnagri sheep with Munjal sheep. Similarly, Jain *et al.* (2014) have given comparative analysis of morphometric traits of sheep breeds of Karnataka.

Karnataka state with tropical monsoon type climate, hosts four well adapted indigenous sheep breeds viz. Bellary, Kenguri, Hassan and Mandya. Deccani sheep are also seen in few districts of north Karnataka and Bellary sheep is the most closely related breed in appearance to Deccani breed (Acharya, 1982). These sheep reared primarily for meat, play significant socio-economic roles in the rural dwellers. Kenguri, a popular mutton breed is mainly distributed in Raichur, Koppal and Yadgir districts. The distribution, characteristics and management of Kenguri sheep is described by Jain *et al*. (2006a). Appannavar *et al.* (2010) studied growth pattern and meat characters of Kenguri sheep. Apart from these sheep breeds, there are two lesser known sheep populations *viz.* Mouli and Yalaga reared by farmers in Vijayapura and Bagalkote districts of Karnataka, respectively. These genetic groups could be outcome of several years of continuous natural selection and are very popular among local farmers for their adaptability. Further the meat of these animals is well cherished by the farmers. The morphometric characterization of Indian sheep is limited to single breed/population. Jain *et al.* (2014) compared the morphometric traits of sheep breeds of Karnataka in the farmers' flocks and reported that Kenguri is heaviest among sheep breeds of Karnataka. The present study was aimed at characterization and comparison of morphometric traits of this heaviest Kenguri sheep with lesser known Mouli and Yalaga sheep genetic groups of Karnataka. Such phenotypic comparisons can provide a reasonable representation of genetic differences among populations to an extent. The information generated would enable inter-breed comparisons of morphometric traits that would assist in development of conservation and breed improvement programs of these genetic groups.

Materials and Methods

Data on morphological features, *viz*. coat colour, hoof colour, horn pattern, ear pattern, tail pattern, wattles, face/forehead pattern and morphometric traits, *viz.* body weight (in kilograms), body length, height at withers, chest girth, flank width, face length, ear length, horn length, distance between horns and tail length (in centimeters) were recorded in random on 265, 279, 278 ewes, and 82, 78 and 91 rams of Kenguri, Mouli and Yalaga sheep, respectively from different flocks distributed throughout the home tract (Fig. 1). The body weights (in Kg) were recorded with a weighing balance and the morphometric traits were measured (in cm) with a measuring tape after making the animal stand squarely on an even ground in the morning before the animals were let out for grazing.

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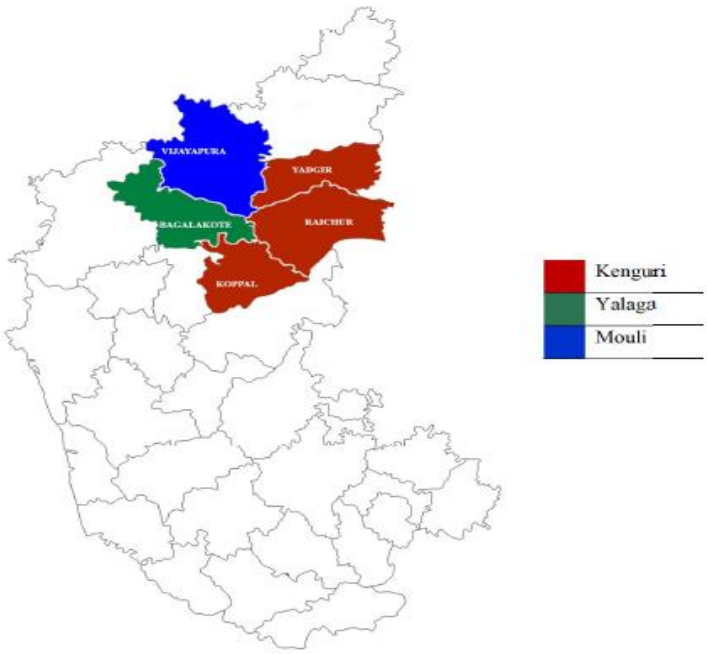

Fig. 1: Home tracts of Kenguri, Mouli and Yalaga sheep

In the case of adult ewes, body weight was taken only in non-pregnant animals. The measurements were taken by same individual in order to avoid inter-individual error. Since the particulars of the exact date of birth of animals were not possible in the field conditions, the eruption of permanent incisor teeth was taken as an indicator of age of the animal. All the animals having two permanent incisors were considered as one and half to two-year-old, four incisors as three-year-old, six incisors as four-year-old and those with eight permanent incisors were regarded as five years and above in age (Banerjee, 1991). The mean differences between traits of the breeds were tested using one-way ANOVA procedure with Tukay's HSD as implemented in SPSS (V.20)**.**

Results and Discussion

In Kenguri sheep, four types of coat colors are observed. Majority of the animals were brown in color with a white patch on forehead **(**80.49% of rams and 56.98% ewes), followed by brown coloured body and white patch on forehead and extremities (30.49 % ewes), brown colored (13.41 % rams and 29.43 % ewes) and brown & black belly (6.09% of rams and 4.15 %). In Mouli sheep, coat colour of majority of rams (85.90%) and ewes (86.37 %) is white with brown patches. However, few (12.82% of rams and 13.62% of ewes) were having pure white coat colour and 1.28% of the rams were white with black spots all over the body. In case of Yalaga sheep, a large proportion of animals were completely white in color (81.31% of rams and 80.21% of ewes). Animals with white coat color with black rings around eyes and ear (3.29% of rams and 3.23 % of ewes), white coat with black extremities (7.69% of rams and 7.55% of ewes), white coat color

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with brown patches (2.19% of rams and 2.51% of ewes) and white coat color with brown extremities (5.49% of rams and 2.88% of ewes). Males in general were horned and females were polled in Kenguri and Yalaga sheep, whereas the Mouli sheep were polled in both sexes. A small button like structure in place of horns was observed in few Mouli males. With regard to face/head pattern, typical convex face/bowed forehead with Roman nose was observed in Mouli sheep. The Kenguri and Yalaga rams and ewes were having straight face/forehead or nose line. The details about other morphological features of three genetic groups are presented in Table 1.

Table 1: Morphological traits of Kengu Mouli and Yalaga sheep

Trait	Observations	Kenguri					Mouli					Yalaga				
		Male		Female		Overall	Male		Female		Overall	Male		Female		OverAll
		(N=82)		(N=265)		(N=347)	(N=78)		(N=279)		(N=357)	(N=91)		(N=278)		(N=369)
		N	%	N	%	%	N	%	n	%	%	N	%	n	%	%
Hoof	Black	73	89	226	85.3	86.16	4	5.12	19	6.81	6.44	86	94.5	255	19.78	92.41
Colour	White	--	--	--	--	--	14	18	56	20.1	19.6	5	5.49	23	8.27	7.59
	Black and White	9	11	39	14.7	13.83	60	76.9	204	73.1	73.95	--	--	--	--	--
Horn pattern	Horned	73	89	261	98.5	96.25	--	--	--	--	--	87	95.6	3	1.07	24.39
	Polled	9	11	4	1.5	3.75	78	100	279	100	100	4	4.39	275	98.92	75.6
Ear	Long & Drooping	--	--	--	--	--	78	100	277	99.3	99.44	91	100	274	98.56	98.91
Pattern	Medium drooping	81	98.8	265	100	99.71	--	--	--	--	--	--	--	--	--	--
	Short & tubular	1	1.21	--	--	0.28	--	--	2	0.71	0.56	--	--	4	1.43	1.08
Tail	Short	82	100	265	100	100	--		--	--	--	82	90.1	274	98.56	96.47
Pattern	Long	--	--	--	--	--	78	100	279	100	100	9	9.89	4	1.43	3.52
Wattles	Present	45	54.9	177	66.8	63.98	46	59	173	62	61.34	60	65.93	202	72.66	71
	Absent	37	45.1	88	33.2	(%)	32	41	106	38	38.65	31	34.06	76	27.33	28.99

The pooled (over different ages and sexes) averages for different morphometric traits in Kenguri, Mouli and Yalaga adult sheep are presented in Table 2. Mouli had higher values and found significantly ($P<0.01$) different from Kenguri and Yalaga sheep with respect to body length, height at withers, flank width, face length and body weight. With respect to chest girth, no significant difference was observed among three genetic groups. Significant difference ($P<0.01$) was observed among three genetic groups with respect to ear length, ear width and tail length. For these traits also, Mouli had higher values than Kenguri and Yalaga sheep. Mouli sheep were polled in both sexes; however, few sheep had rudimentary button like structures and distance between them, taken as poll length, was found to be 7.08±0.05cm. No significant difference seen between Yalaga and Kenguri sheep for distance between horns. Horn length was found to be more in Yalaga sheep (33.22±1.50 cm) than Kenguri sheep (24.43±1.56 cm). Mouli sheep had longer tail than Kenguri and Yalaga sheep, although no significant difference is seen among three genetic groups. Body

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weight of Mouli sheep was significantly (44.39±0.45kg) more than Kenguri (41.59±0.41 kg) and Yalaga (41.20±0.53kg).

Table 2: Pooled averages for different morphometric traits in Kenguri, Mouli and Yalaga adult sheep

Genetic group	N	Body length (cm)	Height at withers (cm)	Chest girth (cm)	Flank width (cm)	Face length (cm)	Ear length (cm)	Ear width (cm)	Horn length (cm)	Tail length (cm)	Body weight (kg)
Kenguri	347	69.50± 0.26^{a}	76.21± 0.25^{a}	82.16 ±0.28	16.15± 0.09^{a}	22.10± 0.11^{a}	15.47± 0.06^{a}	8.35± 0.03^{a}	24.43±1.56 (77)	10.50± 0.08^{a}	41.59± 0.41^{a}
Mouli	357	76.24± 0.28^{b}	80.18± 0.27^{b}	82.41 ±0.31	16.95± 0.10^{b}	26.02± 0.12^{b}	18.70± 0.09^{b}	9.23± 0.05^{b}	Polled	18.48± 0.10^{c}	44.39± 0.45^{b}
Yalaga	369	70.19± 0.31^{a}	77.03± 0.31^{a}	81.68 ±0.4	16.35± 0.09^{a}	22.42± 0.10^{a}	15.19± 0.07^{c}	8.02± 0.05^{c}	33.22±1.5 (95)	11.99± 0.09^{b}	41.20± 0.53^{a}

Means with different superscripts within a column indicate significant difference for the trait (P<0.01); Values in parenthesis for horn length and distance between horns indicate number of observations.

Mean and standard errors for different morphometric traits of rams and ewes belonging to three genetic groups studied are presented in Table 3 & 4, respectively. It is to be noted that Mouli ewes had higher values and found significantly different (P<0.01) from Kenguri and Yalaga ewes with respect to body length, height at withers, flank width, face length and body weight. With respect to chest girth, no significant difference was observed among Kenguri and Mouli ewes. Significant difference (P<0.01) was observed among three genetic groups with respect to ear length, ear width and tail length and body weight. Mouli ewes had higher values for all these parameters compared to Kenguri and Yalaga ewes. The adult body weight of Mouli ewe was 41.72±0.37 kg whereas the adult body weight of Kenguri and Yalaga ewe was 38.86±0.27 kg and 36.93±0.34 kg, respectively. But same trend is not seen in rams of three genetic groups. Significant difference (P<0.01) was observed among three genetic groups with respect to body length and height at withers. Yalaga rams had significantly more chest girth than Kenguri and Mouli rams. Mouli rams had significantly higher values compared to other genetic groups with respect to flank width, face length, ear length, ear width and tail length. With respect to body weight of rams, the Mouli (53.92±1.01 kg) and Yalaga (54.28±1.02 kg) had significantly (P<0.01) higher body weight than Kenguri (50.43±1.03 kg). However, in a comparative study conducted by Jain *et al.* (2014) considering Kenguri, Bellary, Hassan and Mandya sheep of Karnataka, Kenguri has been recorded significantly higher body weight.

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Table 3: Mean and Standard errors of morphometric traits for three genetic groups at different ages for rams

Age	Genetic group	N	Body length (cm)	Height at withers(cm)	Chest girth (cm)	Flank width (cm)	Face length (cm)	Ear length (cm)	Ear width (cm)	Horn length# (cm)	Tail length (cm)	Body weight (kg)
2T	Kenguri	23	69.26± 1.30^{a}	76.95± 0.83^{a}	82.13± 0.95^{a}	16.73± 0.43^{a}	23.69± 0.25^{a}	15.91± 0.17^{a}	8.04± 0.14a	21.81±1.82 (21)	12.39± 0.31^{a}	39.58± 1.11^{a}
	Mouli	22	81.45± 0.72^{c}	85.52± 0.80^{c}	86.20± 0.75^{c}	18.02± 0.21^{a}	27.95± 0.37^{b}	18.95± 0.21^{b}	9.54± 0.18^{b}	Polled	19.97± 0.43^{b}	48.38± 2.26^{b}
	Yalaga	24	74.79± 1.34^{b}	80.87± 1.03^{b}	86.12± 1.04^{b}	16.68± 0.51^{a}	23.16± 0.41^{a}	15.04± 0.44^{a}	8.04± 0.22a	21.02±2.38	13.25± 0.46^{a}	43.60± 2.16^{ab}
4T	Kenguri	20	77.50± 1.28^{a}	81.95± 1.25^{a}	88.75± 1.59^{a}	18.05± 0.38^{a}	24.15± 0.43^{a}	15.85± 0.33^{a}	8.62± 0.13a	21.25±3.69	12.05± 0.29^{a}	53.70± 2.12^{a}
	Mouli	19	83.31± 1.05^{b}	87.26± 0.87^{b}	90.05± 0.67^{a}	19.26± 0.31^{b}	28.15± 0.42^{b}	19.10± 0.20^{b}	9.63± 0.19b	Polled	20.15± 0.30^{b}	54.21± 1.61^{a}
	Yalaga	25	75.64± 0.61^{a}	84.48± 0.66^{ab}	92.20± 0.86^{a}	18.04± 0.26^{a}	24.18± 0.21^{a}	15.10± 0.30^{a}	8.14± 0.18a	40.02±0.74	12.70± 0.26^{a}	54.12± 0.99^{a}
6T	Kenguri	18	77.00± 0.65^{a}	84.27± 0.87^{a}	91.13± 0.58^{a}	18.11± 0.22^{a}	24.44± 0.38^{a}	14.05± 0.41^{a}	7.97± 0.21a	33.66 ±3.38 (15)	11.66± 0.36^{a}	54.82± 0.97^{a}
	Mouli	15	83.33± 1.18^{b}	87.33± 1.15^{a}	91.53± 1.05^{a}	19.40± 0.56^{b}	28.60± 0.66^{b}	18.93± 0.55^{b}	9.26± 0.31b	Polled	20.73± 0.61^{b}	58.13± 1.95^{a}
	Yalaga	19	78.94± 0.89^{a}	85.84± 0.75^{a}	93.68± 0.96^{a}	18.05± 0.24^{a}	24.47± 0.23^{a}	15.42± 0.39^{a}	8.31± 0.24a	37.27±3.05 (18)	13.05± 0.38^{a}	58.94± 1.38^{a}
8T	Kenguri	21	75.21± 0.56^{a}	83.28± 0.47^{a}	90.85± 0.95^{a}	17.14± 0.17^{a}	25.14± 0.24^{a}	15.26± 0.19^{a}	8.28± 0.15a	26.11±3.24 (21)	13.14± 0.14^{a}	55.42± 1.25^{a}
	Mouli	22	84.95± 0.82^{c}	88.38± 0.72^{b}	90.77± 0.71^{a}	19.52± 0.53^{b}	29.22± 0.49^{c}	19.38± 0.38^{b}	9.29± 0.19b	Polled	20.47± 0.27^{b}	56.36± 1.50^{a}
	Yalaga	23	82.13± 0.66^{b}	87.34± 0.70^{b}	94.21± 0.37^{b}	18.73± 0.25^{b}	26.52± 0.41^{b}	15.21± 0.22^{a}	7.95± 0.30a	41.63±3.00 (22)	12.82± 0.42^{a}	61.73± 0.80^{b}
Pooled	Kenguri	82	74.49± 0.63^{a}	81.40± 0.54^{a}	87.95± 0.67^{a}	17.46± 0.17^{a}	24.34± 0.17^{a}	15.32± 0.15^{a}	8.23± 0.08^{a}	25.36±1.57 (73)	12.34± 0.15^{a}	50.43± 1.03a
	Mouli	78	83.25± 0.47^{c}	87.10± 0.44^{c}	89.45± 0.45^{a}	19.01± 0.21^{b}	28.48± 0.24^{b}	19.10± 0.16^{b}	9.44± 0.10b	Polled	20.30± 0.20^{b}	53.92± 1.01b
	Yalaga	91	77.74± 0.55^{b}	84.53± 0.47^{b}	91.41± 0.54^{b}	17.86± 0.18^{a}	24.56± 0.21^{a}	15.18± 0.17^{a}	8.10± 0.11a	34.74±1.46 (89)	12.95± 0.19^{a}	54.28± 1.02^{b}

Means with different superscripts within a column indicate significant difference for the trait (P<0.01); Values in parenthesis for horn length and distance between horns indicate number of observations; #Since some of the individuals are polled, the 'N' is different for the horn length and is indicated in parenthesis

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Table 4: Mean and Standard errors of morphometric traits for three genetic groups at different ages for ewes

Genetic group	N	Body length (cm)	Height at withers (cm)	Chest girth (cm)	Flank width (cm)	Face length (cm)	Ear length (cm)	Ear width (cm)	Horn length (cm)	Tail length (cm)	(kg)
Kenguri	62	67.75± 0.50^{b}	73.58± 0.44^{b}	73.71± 0.28^{c}	15.12± 0.21^{a}	21.01± 0.26^{a}	15.57± 0.13^{a}	8.37± 0.06^{b}	--	9.98± 0.12^{a}	34.96± 0.45^{b}
Mouli	71	73.16± 0.40^{c}	76.05± 0.39^{c}	78.78± 0.39^{b}	15.79± 0.17^{b}	24.21± 0.20^{b}	17.93± 0.21^{b}	9.14± 0.17^{c}	--	17.97± 0.22^{c}	37.9± 0.58^{c}
Yalaga	68	64.99± 0.44^{a}	71.40± 0.48^{a}	76.93± 0.45^{a}	14.87± 0.21^{a}	21.34± 0.20^{a}	15.09± 0.15^{a}	7.86± 0.09^{a}	--	11.48± 0.16^{b}	31.89± 0.51^{a}
Kenguri	68	67.91± 0.43^{a}	75.16± 0.44a	80.83± 0.33a	15.92± 0.18^{a}	21.02± 0.24^{a}	16.23± 0.18^{b}	8.34± 0.07^{a}	12.0±0 (1)	9.88± 0.18^{a}	39.97± 0.48^{b}
Mouli	65	73.39± 0.55^{b}	78.53± 0.47^{b}	81.10± 0.65^{a}	16.38± 0.17^{a}	24.72± 0.23^{b}	18.26± 0.24^{c}	9.20± 0.12^{b}	--	17.74± 0.24^{c}	40.89± 0.88^{b}
Yalaga	63	68.56± 0.53^{a}	74.07± 0.47^{a}	78.20± 0.45^{a}	16.04± 0.17^{a}	21.50± 0.21^{a}	15.02± 0.20^{a}	7.96± 0.15^{a}	2.0±0(1)	11.37± 0.21^{b}	35.46± 0.51^{a}
Kenguri	66	68.69± 0.43^{a}	75.46± 0.35a	82.18± 0.50a	15.53± 0.12^{a}	22.18± 0.15^{a}	15.01± 0.09^{a}	8.46± 0.06^{b}	--	9.95± 0.14^{a}	40.64± 0.50^{a}
Mouli	69	75.11± 0.49^{b}	78.25± 0.33^{b}	81.72± 0.54^{a}	16.47± 0.17^{b}	25.55± 0.16^{b}	19.02± 0.20^{b}	9.21± 0.12^{c}	--	18.05± 0.20^{c}	44.43± 0.72^{b}
Yalaga	76	68.65± 0.39^{a}	75.94± 0.41^{a}	81.54± 0.41^{a}	16.18± 0.13^{b}	21.98± 0.14^{a}	15.25± 0.16^{a}	8.09± 0.09^{a}	--	11.83± 0.23^{b}	39.37± 0.55^{as}
Kenguri	69	67.51± 0.33^{a}	74.19± 0.35^{a}	79.60± 0.29^{a}	16.36± 0.16^{a}	21.41± 0.21^{a}	15.27± 0.10^{a}	8.39± 0.08^{b}	--	9.94± 0.16^{a}	39.58± 0.46^{a}
Mouli	74	75.35± 0.38^{b}	80.09± 0.36c	82.02± 0.48b	16.83± 0.22^{a}	26.74± 0.22^{b}	19.09± 0.19^{b}	9.16± 0.10^{c}	--	18.09± 0.21c	43.60± 0.56^{b}
Yalaga	71	68.60± 0.39^{a}	76.60± 0.43^{b}	81.80± 0.40^{b}	16.26± 0.16^{a}	22.00± 0.14^{a}	15.40± 0.16^{a}	8.02± 0.12^{a}	--	11.97± 0.17^{b}	40.44± 0.59^{a}
Kenguri	265	67.96± 0.21^{a}	74.61± 0.20^{a}	80.37± 0.20^{b}	15.75± 0.091^{a}	21.41± 0.11^{a}	15.52± 0.07^{b}	8.39± 0.03^{b}	7.5±2.32 (4)	9.94± 0.07^{a}	38.86± 0.27^{b}
Mouli	279	74.28± 0.23^{b}	78.24± 0.21^{b}	80.44± 0.29^{b}	16.37± 0.096^{b}	25.33± 0.11^{b}	18.58± 0.11^{c}	9.17± 0.06^{c}	--	17.97± 0.11^{c}	41.72± 0.37^{c}
Yalaga	278	67.72± 0.23^{a}	74.57± 0.25^{a}	78.50± 0.33^{a}	15.85± 0.092^{a}	21.72± 0.08^{a}	15.20± 0.08^{a}	7.99± 0.05^{a}	10.75±1.81 (6)	11.68± 0.10^{b}	36.93± 0.34^{a}

On comparing the results of present study with other South Indian sheep breeds, it is understood that body length of Kenguri rams and ewes is in accordance with the earlier reports of Jain *et al.* (2006a). Body length of Mouli and Yalaga sheep is more than the other sheep breeds of Karnataka (Jain *et al.*, 2014), Height at withers of three genetic groups (in both sexes) recorded in this study was more than the height at withers reported in Deccani and Nellore (Narasimham, 2002), Mandya (Jain *et al.*, 2005b and Vasundaradevi, 2013), Bellary (Jain *et al.*, 2005a), Hassan sheep (Jain *et al.*, 2006b). Broader chest girth is observed in ewes of Macherla Brown (Choudhary, 2013), Madgyal (Yadav *et al.*, 2015) compared to the ewes of three genetic groups under study. Smaller chest girth is reported earlier compared to the results of the present study in Nellore and Deccani (Narasimham, 2002), Mandya (Jain *et al.*, 2005b; Vasundaradevi, 2013), Bellary (Jain *et al.*, 2005a), Hassan sheep (Jain *et al.*, 2006b). The face length of Vembur (Chandran *et al.*,

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2009; Selvakkumar *et al.*, 2016), Macherla Brown sheep (Choudhary, 2013) is almost same as of Kenguri and Yalaga sheep. However, face length lesser than Kenguri and Yalaga sheep was also observed in Chevadu, Katchikatty, Kilakarsal and Ramnad White sheep (Ravimurugan *et al.,* 2012). The ear length in both the sexes of Kenguri sheep is similar to the observation done by Jain *et al.* (2006a) and also in other South Indian breeds like Vembur sheep (Chandran *et al.*,2009), Macherla Brown sheep (Choudhary, 2013). However, the smaller ears when compared to Kenguri, Mouli and Yalaga were reported in Bellary (Jain *et al.*, 2005a), Mandya (Jain *et al.*, 2005b), Mecheri (Karunanithi *et al.*, 2005), Hassan sheep (Jain *et al.*, 2006b). The ear width in three genetic groups was more when compared to ear width in Coimbatore sheep of Tamil Nadu (Devendran *et al.,* 2009). Kenguri and Yalaga ewes were polled. However, few ewes were with horns. Ewes belonging to Coimbatore (Devendran *et al.,* 2009), Kilakarsal, Chevadu, Katchakatty, Pattanam (Ravimurugan *et al.,* 2012) and Vembur sheep (Selvakkumar *et al.,* 2016) were also polled. Longer horns were reported when compared to results of present study in Kenguri (Jain *et al.,* 2006a), Ramnad White (Raja *et al.,* 2012). The Mouli sheep were polled in both the sexes. Similar observations were made by Jain *et al*. (2005b) in Mandya sheep where both the sexes are polled. The average horn length of Kenguri and Yalaga rams was 25.36 ± 1.57 cm and 34.74 ± 1.46 cm, respectively. Horns of similar length were reported in rams of Bellary (Jain *et al.,* 2005a), Kenguri (Jain *et al.,* 2006a), Coimbatore (Devendran *et al.,* 2009), Vembur (Chandran *et al.,* 2009), Katchakatty (Ravimurugan *et al.,* 2012) and Ramnad White sheep (Raja *et al.,* 2012). Tail length of Mouli sheep in the present was more followed by Yalaga and Kenguri sheep. Such long tail is also reported in Madgyal (Yadav *et al.*, 2015) and other North Indian breeds like Jaisalmeri sheep (Rams: 30.19 ± 0.27 and Ewes: 26.97 ±0.14 cm (Arora *et al*., 2007) and Muzaffaranagari sheep (Rams: 55.49 ± 1.07 and Ewes: 49.77 ±0.39 cm (Yadav *et al*., 2012). No increase in ear length, ear width and tail length was observed in all three genetic groups across both sexes. Similar observation was recorded by Jain *et al.* (2014) in his study on comparison of morphometric traits in Kenguri, Bellary, Hassan and Mandya sheep. Significant difference ($P<0.01$) was seen among ewes of three genetic groups with respect to body weight. The average body weight of Kenguri ewe is more than the earlier report of Jain *et al*.(2014) but more than the Bellary, Hassan and Mandya. Body weight of Kenguri rams was significantly ($P<0.01$) lower than Mouli and Yalaga rams. The average body weight of Kenguri ram is less than the earlier report of Jain *et al.* (2014) but more than the Bellary, Hassan and Mandya. The trends with regard to various morphometric measurements show some differences with respect to sex and also with respect to three genetic groups under study. The possible reason for this difference in trend could be huge difference among farmers towards selection and management of rams and ewes, also varying climatic conditions prevailing in their home tracts. Each genetic group is having its own importance in their respective socio-economic milieu. The observed differences in morphometric traits can be used for objective differentiation of animals of these sheep genetic groups. The results of such comparative studies

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will be helpful in understanding their importance in their respective habitats, also for selection, improvement and prioritization of breeds for conservation.

Conclusion

The present study showed that the lesser known sheep genetic groups of Karnataka *i.e.* Mouli and Yalaga sheep were phenotypically distinct with respect to their morphological and morphometric measures and can be distinguished from other breeds of the state. The present information on phenotypic comparison, if complemented with further genetic analysis may serve a basis for designing appropriate conservation, breeding and selection strategies of these mutton sheep populations of Karnataka. However, a comparative study on meat quality parameters of these sheep genetic groups may also give critical input in setting out conservation priority among them and framing breeding programs for their genetic improvement and sustainable use, thereby improving the farmers' economy.

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