

Studies on linear body measurements of Red Kandhari calves in their breeding tract of Maharashtra

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ABSTRACT

The body measurements and body weight of Red Kandhari calves at various stages of growth were studied for both male and female at different locations in the breeding tract. The idea is to obtain the real picture of the breed in the breeding tract. The body measurements play an important role in judging calves and often help in predicting probable value of the calves. Body length and height at withers are the measures of bone growth while chest girth is a measure of development of muscles, bones and fat and it has close relationship with the live weight.

Key words: Body measurements, Judging, Live weight, Skeletal growth.

INTRODUCTION

Indian cattle population is an integral part of the agriculture. The cattle biodiversity in India constitutes 40 well defined breeds of cattle, 13 breeds of buffaloes, 26 breeds of goat and 42 breeds of sheep (NBAGR, 2017). The livestock sector alone contributes nearly 25.6% of value of output at current prices of total value of output in Agriculture, Fishing and Forestry sector. The overall contribution of livestock sector in total GDP is nearly 4.11% at current prices during 2012-13. The total Bovine population is 299.9 million in 2012 which shows a decline of 1.57% over previous census (Livestock Census, 2012). Red Kandhari is one of the important breed of Marathwada region of Maharashtra State (Chauhan *et al.*, 2008). The Red Kandhari breed is reared mainly for draught purpose. Animals are medium in size, strong, compact and good looking. Body colour is dull red to almost dark brown. Cows are low milk producers and bullocks of the breed are preferred over the Deoni breed for better draught ability and smaller size (Pundir and Singh, 2008). Therefore, the present study has been conducted with the following objectives:

1. To study body measurements and body weight at different age groups
2. To study the block effect on various characteristics.

MATERIALS AND METHODS

Selection of calves: The data on body measurements of 267 Red Kandhari calves irrespective of sex was collected by taking actual measurements of each individual in different villages as mentioned below. From each tehsils on an average 29 calves / individuals with different age group (0-3 months and 4-6 months) and sex were chosen randomly for present study.

Tools and techniques of data collection: The basic instrument for the present study was measuring tape and visual examination. The data was collected by measuring different body part and also by the visual examination. Efforts were made to avoid mechanical error, while recording the measurements. Arrangement was made to stand the calves on even surface and in normal position at the time of recording body measurement. The body measurements were measured with the help of standard metallic tape. The body measurement was recorded in centimetre. The data on morphometric characteristics of Red Kandhari calves were collected by actual measurements and interview with the livestock owners with the help of model questionnaire.

The collected data of 267 Red Kandhari calves on body measurements and body weights were subjected to the Least Squares Analysis Technique as outlined by Harvey (1990). The body weights at various age groups in Red Kandhari calves were estimated by using Agarwal's formula as outlined below.

$$\text{Live body weight (in pound)} = \frac{\text{Length} \times \text{Chest Girth}}{Y}$$

Where,

- Y= 9.0 if girth is less than 1.62 meters
- Y= 8.5 if girth is between 1.62-2.00 meters
- Y= 8.0 if girth is more than 2 meters

RESULTS AND DISCUSSION

Body measurements and body weights of Red Kandhari cattle at 0-3 months of age

Body weight: It is observed from Table 2 that the overall least squares mean for body weight of Red Kandhari calves at 0-3 months of age group was 51.65 ± 0.62 kg. The least

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Table 1: List of villages randomly selected for collection of data.

Name of the District	Name of the Tehsils	Name of the Villages
Nanded (D ₁)	Kandhar Loha	Bori (Khu.), Umaraj, Jambhulwadi, Dagadsangavi, Ghodaj Dhanora (Makta), Subhashnagar, Chitali, Malakoli, Malegaon
Latur (D ₂)	Ahmedpur Jalkot	Sangavi (Su.), Sunegaon (Sa.), Babaldara, Hippalgaon, Sawargaon (Thot) Kunki, Wanjarwada, Hawarga, Jirga, Jagalpur
Parbhani (D ₃)	Palam Gangakhed	Kerwadi, Shirpur, Sayal, Kapsi, Pethshivani Dhavalkewadi, Kaudgaon, Malewadi, Maradasgaon, Naralad
Hingoli (D ₄)	Vasmat Aundha	Aaral, Darephal, Bori, Aadgaon, Kalamba Barashiv, Ranjala, Purjal, Sirla, Aajarsonda
Beed (D ₅)	Parli	Tokwadi, Sangam, Waghbet, Belamba, Injeaon

Table 2: LSM and SE for body measurements (cm) and body weights (kg) of Red Kandhari cattle in 0-3 months age.

Sources	Code	N	LSM ± SE						
			Body weight (kg)	Chest girth (cm)	Body length (cm)	Height at wither (cm)	Belly girth (cm)	Height at hip bone (cm)	Length of body at trunk (cm)
Population mean	μ	120	51.65 ± 0.62	73.44 ± 0.51	63.13 ± 0.44	71.56 ± 0.58	76.45 ± 0.50	72.19 ± 0.56	60.36 ± 0.28
Sex									
Male	S ₁	59	51.82 ± 0.85	73.65 ± 0.70	63.16 ± 0.61	72.28 ± 0.80	76.65 ± 0.68	72.54 ± 0.77	60.47 ± 0.38
Female	S ₂	61	51.47 ± 0.85	73.23 ± 0.71	63.10 ± 0.61	70.84 ± 0.80	76.24 ± 0.69	71.84 ± 0.78	60.26 ± 0.39
District									
Nanded	D ₁	38	55.71 ± 1.03	74.63 ± 0.85	67.03 ± 0.74	70.08 ± 0.97	77.53 ± 0.83	70.68 ± 0.94	58.95 ± 0.47
Latur	D ₂	23	48.63 ± 1.33	70.21 ± 1.10	62.27 ± 0.96	69.62 ± 1.25	73.04 ± 1.08	70.23 ± 1.21	60.58 ± 0.60
Parbhani	D ₃	26	49.95 ± 1.25	72.04 ± 1.03	62.27 ± 0.90	72.35 ± 1.17	75.69 ± 1.01	73.08 ± 1.13	61.54 ± 0.57
Hingoli	D ₄	20	50.97 ± 1.42	73.62 ± 1.18	62.10 ± 1.03	72.87 ± 1.34	76.42 ± 1.15	73.48 ± 1.30	60.21 ± 0.65
Beed	D ₅	13	52.97 ± 1.76	76.71 ± 1.46	62.00 ± 1.27	72.90 ± 1.66	79.55 ± 1.42	73.49 ± 1.61	60.55 ± 0.80

squares means of body weight for Red Kandhari calves for S₁ and S₂ sex averaged 51.82 ± 0.85 and 51.47 ± 0.85 kg, respectively. The least squares means of body weight for D₁, D₂, D₃, D₄, and D₅ districts were 55.71 ± 1.03, 48.63 ± 1.33, 49.95 ± 1.25, 50.97 ± 1.42 and 52.97 ± 1.76 kg, respectively. The least squares analysis of variance has revealed non-significant effect of sex and district on body weight of Red Kandhari calves at 0-3 months of age. Lower body weight than the present finding were reported Ghafoor *et al.* (1980) as 39.78 kg and by Magar (2013) as 44.23 ± 1.63 kg in Red Kandhari calves.

Chest girth: It is observed from Table 2 that the overall least squares mean for chest girth of Red Kandhari calves at 0-3 months of age group was 73.44 ± 0.51 cm. The least squares means of chest girth for Red Kandhari calves for S₁ and S₂ sex averaged 73.65 ± 0.70 and 73.23 ± 0.71 cm, respectively. The least squares means of chest girth for D₁, D₂, D₃, D₄, and D₅ districts were 74.63 ± 0.85, 70.21 ± 1.10, 72.04 ± 1.03, 73.62 ± 1.18 and 76.71 ± 1.46 cm, respectively. The least squares analysis of variance has revealed non-significant effect of sex and district on chest girth of Red Kandhari calves at 0-3 months of age. Similar findings for chest girth were reported by Nikam (2013) as 72.57 ± 0.50 cm, Kakade (2013) as 72.69 ± 0.45 cm in Red Kandhari calves, respectively.

Body length: It is observed from Table 2 that the overall least squares mean for body length of Red Kandhari calves

at 0-3 months of age group was 63.13 ± 0.44 cm. The least squares means of body length for Red Kandhari calves for S₁ and S₂ sex averaged 63.16 ± 0.61 and 63.10 ± 0.61 cm, respectively. The least squares means of body length for D₁, D₂, D₃, D₄, and D₅ districts were 67.03 ± 0.74, 62.27 ± 0.96, 62.27 ± 0.90, 62.10 ± 1.03 and 62.00 ± 1.27 cm, respectively. The least squares analysis of variance has revealed non-significant effect of sex and district on body length of Red Kandhari calves at 0-3 months of age. Similar findings for body length were reported by Yadav (2008) as 64.20 ± 0.90 cm in Deoni calves and Das (2016) as 64.06 ± 0.69 cm in Red Kandhari calves, respectively.

Height at wither: It is observed from Table 2 that the overall least squares mean for height at wither of Red Kandhari cattle at 0-3 months of age group was 71.56 ± 0.58 cm. The least squares means of height at wither for Red Kandhari calves for S₁ and S₂ sex averaged 72.28 ± 0.80 and 70.84 ± 0.80 cm, respectively. The least squares means of height at wither for D₁, D₂, D₃, D₄ and D₅ districts were 70.08 ± 0.97, 69.62 ± 1.25, 72.35 ± 1.17, 72.87 ± 1.34 and 72.90 ± 1.66 cm, respectively. The least squares analysis of variance has revealed non-significant effect of sex and district on height at wither of Red Kandhari calves at 0-3 months of age. Similar findings for height at wither were reported by Nikam (2013) as 70.21 ± 0.68 cm, Kakade (2013) as 69.13 ± 0.47 cm and Das (2016) as 69.00 ± 0.63 cm in Red Kandhari calves, respectively.

Belly girth: It is observed from Table 2 that the overall least squares mean for belly girth of Red Kandhari calves at 0-3 months of age group was 76.45 ± 0.50 cm. The least squares means of belly girth for Red Kandhari calves for S_1 and S_2 sex averaged 76.65 ± 0.68 and 76.24 ± 0.69 cm, respectively. The least squares means of belly girth for D_1 , D_2 , D_3 , D_4 and D_5 districts were 77.53 ± 0.83 , 73.04 ± 1.08 , 75.69 ± 1.01 , 76.42 ± 1.15 and 79.55 ± 1.42 cm, respectively. The highest belly girth was observed in male (S_1) followed by female (S_2). The least squares analysis of variance has revealed non-significant effect of sex and district on belly girth of Red Kandhari calves at 0-3 months of age. Higher belly girth has been reported by Salim (2014) as 114.47 ± 1.08 and 111.47 ± 1.37 cm in male and female Dhofari calves respectively. The lower belly girth has been reported by Das (2016) as 72.27 ± 0.78 cm in Red Kandhari calves than the observed values.

Height at hip bone: It is observed from Table 2 that the overall least squares mean for height at hip bone of Red Kandhari calves at 0-3 months of age group was 72.19 ± 0.56 cm. The least squares means of height at hip bone for Red Kandhari calves for S_1 and S_2 sex averaged 72.54 ± 0.77 and 71.84 ± 0.78 cm, respectively. The least squares means of height at hip bone for D_1 , D_2 , D_3 , D_4 and D_5 districts were 70.68 ± 0.94 , 70.23 ± 1.21 , 73.08 ± 1.13 , 73.48 ± 1.30 and 73.49 ± 1.61 cm, respectively. The least squares analysis of variance has revealed non-significant effect of sex and district on height at hip bone of Red Kandhari calves at 0-3 months of age. The lower height at hip bone has been reported by Das (2016) as 69.44 ± 0.66 cm in Red Kandhari calves respectively than the observed values.

Length of body at trunk: It is observed from Table 2 that the overall least squares mean for length of body at trunk of Red Kandhari calves at 0-3 months of age group was 60.36 ± 0.28 cm. The least squares means of length of body at trunk for Red Kandhari calves for S_1 and S_2 sex were averaged 60.47 ± 0.38 and 60.26 ± 0.39 cm, respectively. The least squares means of Length of body at trunk for D_1 , D_2 , D_3 , D_4 and D_5

districts were 58.95 ± 0.47 , 60.58 ± 0.60 , 61.54 ± 0.57 , 60.21 ± 0.65 and 60.55 ± 0.80 cm, respectively. The least squares analysis of variance has revealed non-significant effect of sex and district on length of body at trunk of Red Kandhari calves at 0-3 months of age.

Body measurements of Red Kandhari calves at 0-3 months age

Face measurement: It is observed from Table 3 that the overall least squares mean for face measurement of Red Kandhari calves at 0-3 months of age group was 23.70 ± 0.19 cm. The least squares means of face measurement for Red Kandhari calves for S_1 and S_2 sex averaged 23.73 ± 0.26 and 23.68 ± 0.26 cm, respectively. The least squares means of face measurement for D_1 , D_2 , D_3 , D_4 and D_5 districts were 25.92 ± 0.32 , 23.38 ± 0.41 , 23.19 ± 0.39 , 23.25 ± 0.44 and 22.77 ± 0.55 cm, respectively. The least squares analysis of variance has revealed non-significant effect of sex and district on the face measurement of Red Kandhari calves at 0-3 months of age. Similar findings for face measurements were reported by Pundir *et al.* (2012) as 21.27 ± 0.94 and 21.18 ± 0.94 in male and female in Hill calves and Das (2016) as 23.21 ± 0.32 cm in Red Kandhari calves respectively.

Tail length: It is observed from Table 3 that the overall least squares mean for tail length of Red Kandhari calves at 0-3 months of age group was 37.88 ± 0.62 cm. The least squares means of tail length for Red Kandhari calves for S_1 and S_2 sex averaged 38.12 ± 0.86 and 37.64 ± 0.86 cm, respectively. The least squares means of tail length for D_1 , D_2 , D_3 , D_4 and D_5 districts were 35.76 ± 1.04 , 37.36 ± 1.35 , 39.58 ± 1.26 , 38.43 ± 1.44 and 38.29 ± 1.78 cm, respectively. The least squares analysis of variance has revealed non-significant effect of sex and district on tail length of Red Kandhari calves at 0-3 months of age. Similar findings for tail length were reported by Pundir and Singh (2008) 38.3 ± 1.8 and 43.2 ± 1.8 cm in male and female in Red Kandhari calves respectively.

Ear length: It is observed from Table 3 that the overall least squares mean for ear length of Red Kandhari calves at 0-3

Table 3: LSM and SE for body measurements (cm) of Red Kandhari calves in 0-3 months age.

Sources	Code	N	LSM \pm SE				
			Face measurement (cm)	Tail length (cm)	Ear length (cm)	Fore legs length (cm)	Hind legs length(cm)
Population mean	μ	120	23.70 ± 0.19	37.88 ± 0.62	18.66 ± 0.22	58.90 ± 0.31	38.05 ± 0.17
			Sex				
Male	S_1	59	23.73 ± 0.26	38.12 ± 0.86	18.82 ± 0.30	59.25 ± 0.42	38.52 ± 0.23
Female	S_2	61	23.68 ± 0.26	37.64 ± 0.86	18.49 ± 0.30	58.55 ± 0.42	37.58 ± 0.23
			District				
Nanded	D_1	38	25.92 ± 0.32	35.76 ± 1.04	17.89 ± 0.36	56.95 ± 0.51	37.31 ± 0.28
Latur	D_2	23	23.38 ± 0.41	37.36 ± 1.35	18.49 ± 0.47	59.27 ± 0.66	38.51 ± 0.36
Parbhani	D_3	26	23.19 ± 0.39	39.58 ± 1.26	18.50 ± 0.44	59.77 ± 0.62	38.77 ± 0.34
Hingoli	D_4	20	23.25 ± 0.44	38.43 ± 1.44	19.47 ± 0.50	59.33 ± 0.71	38.10 ± 0.39
Beed	D_5	13	22.77 ± 0.55	38.29 ± 1.78	18.93 ± 0.62	59.18 ± 0.88	37.57 ± 0.48

months of age group was 18.66 ± 0.22 cm. The least squares means of ear length for Red Kandhari calves for S_1 and S_2 sex averaged 18.82 ± 0.30 and 18.49 ± 0.30 cm, respectively. The least squares means of ear length for D_1 , D_2 , D_3 , D_4 and D_5 districts were 17.89 ± 0.36 , 18.49 ± 0.47 , 18.50 ± 0.44 , 19.47 ± 0.50 and 18.93 ± 0.62 cm, respectively. The least squares analysis of variance has revealed non-significant effect of sex and district on ear length of Red Kandhari calves at 0-3 months of age. Similar findings for ear length were reported Pundir and Singh (2008) as 15.6 ± 0.8 and 15.6 ± 0.6 cm and Magar (2013) 16.36 ± 0.25 cm in Red Kandhari calves, respectively.

Fore legs length: It is observed from Table 3 that the overall least squares mean for fore legs length of Red Kandhari calves at 0-3 months of age group was 58.90 ± 0.31 cm. The least squares mean of fore legs length for Red Kandhari calves for S_1 and S_2 sex averaged 59.25 ± 0.42 and 58.55 ± 0.42 cm, respectively. The least squares means of fore legs length for D_1 , D_2 , D_3 , D_4 and D_5 districts were 56.95 ± 0.51 , 59.27 ± 0.66 , 59.77 ± 0.62 , 59.33 ± 0.71 and 59.18 ± 0.88 cm, respectively. The least squares analysis of variance has revealed non-significant effect of sex and district on fore legs length of Red Kandhari cattle at 0-3 months of age.

Hind legs length: It is observed from Table 3 that the overall least squares mean for hind legs length of Red Kandhari calves at 0-3 months of age group was 38.05 ± 0.17 cm. The least squares means of hind legs length for Red Kandhari calves for S_1 and S_2 sex averaged 38.52 ± 0.23 and 37.58 ± 0.23 cm, respectively. The least squares means of hind legs length for D_1 , D_2 , D_3 , D_4 and D_5 districts were 37.31 ± 0.28 , 38.51 ± 0.36 , 38.77 ± 0.34 , 38.10 ± 0.39 and 37.57 ± 0.48 cm, respectively. The highest hind legs length observed in D_3 district (38.77 ± 0.34 cm) followed by D_2 , D_4 , D_5 and D_1 , respectively. The least squares analysis of variance has revealed non-significant effect of sex and district on hind legs length of Red Kandhari calves at 0-3 months of age.

Body measurements and body weights of Red Kandhari calves at 4-6 months of age

Body weight: It is observed from Table 4 that the overall least squares mean for body weight of Red Kandhari calves at 4-6 months of age group was 114.15 ± 1.09 kg. The least squares means of body weight for Red Kandhari calves for S_1 and S_2 sex averaged 118.06 ± 1.62 and 110.24 ± 1.29 kg, respectively. The least squares means of body weight for D_1 , D_2 , D_3 , D_4 and D_5 districts were 117.14 ± 1.71 , 118.20 ± 1.76 , 112.93 ± 3.10 , 114.55 ± 2.19 and 107.93 ± 2.88 kg, respectively. The highest body weight was observed in male (S_1) followed by female (S_2). The highest body weight was observed in D_2 district (118.20 ± 1.76 kg) followed by D_1 , D_4 , D_3 and D_5 , respectively. The Least Squares Analysis of Variance has revealed highly significant ($P < 0.01$) effect of sex and significant ($P < 0.05$) effect of district on body weight of Red Kandhari cattle at 4-6 months of age. Higher body weight was reported than observed by Salim (2014) as 122.53 ± 2.78 kg at 3 - 6 months of age in Dhofari calves and lower body weight has been reported by Ghafoor *et al.* (1980) as 66.53 kg at 6 months of age in Red Kandhari calves respectively.

Chest girth: It is observed from Table 4 that the overall least squares mean for chest girth of Red Kandhari calves at 4-6 months of age group was 107.25 ± 0.53 cm. The least squares means of chest girth for Red Kandhari calves for S_1 and S_2 averaged 109.05 ± 0.79 and 105.46 ± 0.63 cm, respectively. The least squares means of chest girth for D_1 , D_2 , D_3 , D_4 and D_5 districts were 108.80 ± 0.83 , 108.77 ± 0.86 , 106.34 ± 1.52 , 107.01 ± 1.07 and 105.35 ± 1.41 cm, respectively. The Least Squares Analysis of Variance has revealed non-significant effect of sex and district on chest girth of Red Kandhari calves at 4-6 months of age. The higher chest girth was reported than observed by Salim (2014) as 117.47 ± 1.26 and 113.58 ± 1.57 cm at 3 - 6 months of age in male and female calves of Dhofari calves respectively and

Table 4: LSM and SE for body measurements (cm) and body weights (kg) of Red Kandhari calves in 4-6 months age.

Sources	Code	N	LSM \pm SE						
			Body weight (kg)	Chest girth (cm)	Body length (cm)	Height at wither (cm)	Belly girth (cm)	Height at hip bone (cm)	Length of body at trunk (cm)
Population mean	μ	147	114.15 ± 1.09	107.25 ± 0.53	95.64 ± 0.68	96.03 ± 0.45	113.47 ± 0.52	97.87 ± 0.45	72.68 ± 0.44
Sex									
Male	S_1	56	$118.06^a \pm 1.62$	109.05 ± 0.79	97.32 ± 1.01	96.76 ± 0.67	115.28 ± 0.78	98.56 ± 0.68	73.73 ± 0.66
Female	S_2	91	$110.24^b \pm 1.29$	105.46 ± 0.63	93.95 ± 0.81	95.31 ± 0.53	111.66 ± 0.62	97.18 ± 0.54	71.64 ± 0.52
District									
Nanded	D_1	46	$117.14^a \pm 1.71$	108.80 ± 0.83	96.91 ± 1.07	99.79 ± 0.70	114.89 ± 0.82	101.45 ± 0.71	74.99 ± 0.69
Latur	D_2	43	$118.20^a \pm 1.76$	108.77 ± 0.86	97.61 ± 1.10	96.45 ± 0.73	115.10 ± 0.85	98.21 ± 0.73	72.89 ± 0.71
Parbhani	D_3	14	$112.93^a \pm 3.10$	106.34 ± 1.52	95.36 ± 1.93	94.31 ± 1.28	112.42 ± 1.49	96.29 ± 1.29	71.66 ± 1.26
Hingoli	D_4	28	$114.55^a \pm 2.19$	107.01 ± 1.07	96.16 ± 1.37	95.03 ± 0.90	112.80 ± 1.05	96.91 ± 0.91	72.19 ± 0.89
Beed	D_5	16	$107.93^b \pm 2.88$	105.35 ± 1.41	92.15 ± 1.79	94.59 ± 1.18	112.16 ± 1.38	96.46 ± 1.20	71.69 ± 1.16

Note: Means connected by same superscripts do not differ significantly.

lower chest girth was reported by Patil and Mitkari (1999) as 84.56 ± 3.88 cm at 6 months of age in Deoni calves. The higher chest girth in the present study may be attributed to animal reared in different managemental condition and feeding practices.

Body length: It is observed from Table 4 that the overall least squares mean for body length of Red Kandhari calves at 4-6 months of age group was 95.64 ± 0.68 cm. The least squares means of body length for Red Kandhari calves for S_1 and S_2 sex averaged 97.32 ± 1.01 and 93.95 ± 0.81 cm, respectively. The least squares means of body length for D_1 , D_2 , D_3 , D_4 and D_5 districts were 96.91 ± 1.07 , 97.61 ± 1.10 , 95.36 ± 1.93 , 96.16 ± 1.37 and 92.15 ± 1.79 cm, respectively. The Least Squares Analysis of Variance has revealed non-significant effect of sex and district on body length of Red Kandhari calves at 4-6 months of age. Higher body length was reported than observed by Salim (2014) as 102.76 ± 1.40 and 98.42 ± 1.26 cm at 3-6 months of age in male and female calf of Dhofari calves, respectively. Lower body length has been reported by Patil and Mitkari (1999) as 78.00 ± 1.86 cm at 6 months of age in Deoni calves.

Height at wither: It is observed from Table 4 that the overall least squares mean for height at wither of Red Kandhari calves at 4-6 months of age group was 96.03 ± 0.45 cm. The least squares means of height at wither for Red Kandhari calves for S_1 and S_2 sex averaged 96.76 ± 0.67 and 95.31 ± 0.53 cm, respectively. The least squares means of height at wither for D_1 , D_2 , D_3 , D_4 and D_5 districts were 99.79 ± 0.70 , 96.45 ± 0.73 , 94.31 ± 1.28 , 95.03 ± 0.90 and 94.59 ± 1.18 cm, respectively. The Least Squares Analysis of Variance has revealed non-significant effect of sex and district on height at wither of Red Kandhari calves at 4-6 months of age. Similar findings for height at wither have been reported by Salim (2014) as 98.71 ± 0.59 and 96.42 ± 1.16 cm at 3-6 months of age in male and female calf of Dhofari calves respectively. Lower height at wither was reported by Patil and Mitkari (1999) as 86.40 cm at 6 months of age in Deoni calves.

Belly girth: It is observed from Table 4 that the overall least squares mean for belly girth of Red Kandhari calves at 4-6 months of age group was 113.47 ± 0.52 cm. The least squares means of belly girth for Red Kandhari calves for S_1 and S_2 sex averaged 115.28 ± 0.78 and 111.66 ± 0.62 cm, respectively. The least squares means of belly girth for D_1 , D_2 , D_3 , D_4 and D_5 districts were 114.89 ± 0.82 , 115.10 ± 0.85 , 112.42 ± 1.49 , 112.80 ± 1.05 and 112.16 ± 1.38 cm, respectively. The Least Squares Analysis of Variance has revealed non-significant effect of sex and district on the belly girth of Red Kandhari calves at 4-6 months of age. Higher belly girth was reported by Salim (2014) as 121.65 ± 1.50 and 118.47 ± 1.62 cm at 3-6 months of age in male and female calf of Dhofari calves respectively. Lower value was reported by Pundir *et al.* (2014) as 76.77 ± 1.76 and 73.50 ± 1.84 cm at 3-6 months of age in male and female of Hill calves of Garhwal Region of Uttarakhand.

Lower belly girth reported by various authors in indigenous cattle breeds might be due to difference in their genetic makeup coupled with differences in their management and environment to which they are exposed.

Height at hip bone: It is observed from Table 4 that the overall least squares mean for height at hip bone of Red Kandhari calves at 4-6 months of age group was 97.87 ± 0.45 cm. The least squares means of height at hip bone for Red Kandhari calves for S_1 and S_2 sex averaged 98.56 ± 0.68 and 97.18 ± 0.54 cm, respectively. The least squares means of height at hip bone for D_1 , D_2 , D_3 , D_4 and D_5 districts were 101.45 ± 0.71 , 98.21 ± 0.73 , 96.29 ± 1.29 , 96.91 ± 0.91 and 96.46 ± 1.20 cm, respectively. The Least Squares Analysis of Variance has revealed non-significant effect of sex and district on height at hip bone of Red Kandhari calves at 4-6 months of age.

Length of body at trunk: It is observed from Table 4 that the overall least squares mean for length of body at trunk of Red Kandhari calves at 4-6 months of age group was 72.68 ± 0.44 cm. The least squares means of length of body at trunk for Red Kandhari calves for S_1 and S_2 sex averaged 73.73 ± 0.66 and 71.64 ± 0.52 cm, respectively. The least squares means of Length of body at trunk for D_1 , D_2 , D_3 , D_4 and D_5 districts were 74.99 ± 0.69 , 72.89 ± 0.71 , 71.66 ± 1.26 , 72.19 ± 0.89 and 71.69 ± 1.16 cm, respectively. The Least Squares Analysis of Variance has revealed non-significant effect of sex and district on length of body at trunk of Red Kandhari calves at 4-6 months of age.

Body measurements of Red Kandhari calves at 4-6 months age

Face measurement: It is observed from Table 5 that the overall least squares mean for face measurement of Red Kandhari calves at 4-6 months of age group was 34.22 ± 0.17 cm. The least squares means of face measurement for Red Kandhari calves for S_1 and S_2 sex averaged 34.48 ± 0.25 and 33.95 ± 0.20 cm, respectively. The least squares means of face measurement for D_1 , D_2 , D_3 , D_4 and D_5 districts were 34.19 ± 0.26 , 34.61 ± 0.27 , 34.11 ± 0.48 , 34.32 ± 0.34 and 33.84 ± 0.45 cm, respectively. The least squares analysis of variance has revealed non-significant effect of sex and district on the face measurement of Red Kandhari calves at 4-6 months of age. Lower length of face was reported by Pundir *et al.* (2014) as 21.66 ± 0.21 and 21.36 ± 0.89 cm in male and female at 3-6 months of age in Indigenous calves of Tripura.

Tail length: It is observed from Table 5 that the overall least squares mean for tail length of Red Kandhari calves at 4-6 months of age group was 60.91 ± 0.16 cm. The least squares means of tail length for Red Kandhari calves for S_1 and S_2 sex averaged 61.65 ± 0.23 and 60.18 ± 0.19 cm, respectively. The least squares means of tail length for D_1 , D_2 , D_3 , D_4 and D_5 districts were 60.09 ± 0.25 , 60.78 ± 0.25 , 60.81 ± 0.45 , 62.10 ± 0.32 and 60.78 ± 0.42 cm, respectively. The least squares analysis of variance has revealed non-significant effect of

Table 5: LSM and SE for body measurements (cm) of Red Kandhari calves in 4-6 months age.

Sources	Code	N	LSM ± SE				
			Face measurement (cm)	Tail length (cm)	Ear length (cm)	Fore legs length (cm)	Hind legs length (cm)
Population mean	μ	147	34.22 ± 0.17	60.91 ± 0.16	19.14 ± 0.13	70.12 ± 0.36	42.78 ± 0.14
Sex							
Male	S ₁	56	34.48 ± 0.25	61.65 ± 0.23	19.14 ± 0.19	70.55 ± 0.53	42.79 ± 0.21
Female	S ₂	91	33.95 ± 0.20	60.18 ± 0.19	19.13 ± 0.15	69.70 ± 0.42	42.76 ± 0.17
District							
Nanded	D ₁	46	34.19 ± 0.26	60.09 ± 0.25	18.89 ± 0.20	72.09 ± 0.56	43.42 ± 0.22
Latur	D ₂	43	34.61 ± 0.27	60.78 ± 0.25	19.77 ± 0.21	70.74 ± 0.58	43.28 ± 0.23
Parbhani	D ₃	14	34.11 ± 0.48	60.81 ± 0.45	19.00 ± 0.37	69.11 ± 1.02	42.43 ± 0.41
Hingoli	D ₄	28	34.32 ± 0.34	62.10 ± 0.32	19.14 ± 0.26	69.62 ± 0.72	42.57 ± 0.29
Beed	D ₅	16	33.84 ± 0.45	60.78 ± 0.42	18.87 ± 0.34	69.05 ± 0.94	42.19 ± 0.38

sex and district on tail length of Red Kandhari calves at 4-6 months of age. Lower tail length have been reported by Pundir *et al.* (2014) as 40.00±1.93 and 40.00±2.03 cm in male and female at 3-6 months of age in Indigenous calves of Tripura.

Ear length: It is observed from Table 5 that the overall least squares mean for ear length of Red Kandhari calves at 4-6 months of age group was 19.14 ± 0.13 cm. The least squares means of ear length for Red Kandhari calves for S₁ and S₂ sex were averaged 19.14 ± 0.19 and 19.13 ± 0.15 cm, respectively. The least squares means of ear length for D₁, D₂, D₃, D₄ and D₅ districts were 18.89 ± 0.20, 19.77 ± 0.21, 19.00 ± 0.37, 19.14 ± 0.26 and 18.87 ± 0.34 cm, respectively. The least squares analysis of variance has revealed non-significant effect of sex and district on ear length of Red Kandhari calves at 4-6 months of age. Lower ear length was reported by Pundir *et al.* (2014) as 14.16±0.60 and 13.27±0.50 cm in male and female at 3-6 months of age in Indigenous calves of Tripura.

Fore legs length: It is observed from Table 5 that the overall least squares mean for fore legs length of Red Kandhari calves at 4-6 months of age group was 70.12 ± 0.36 cm. The least squares mean of fore legs length for Red Kandhari calves for S₁ and S₂ sex averaged 70.55 ± 0.53 and 69.70 ± 0.42 cm, respectively. The least squares means of fore legs length for D₁, D₂, D₃, D₄ and D₅ districts were 72.09 ± 0.56, 70.74 ±

0.58, 69.11 ± 1.02, 69.62 ± 0.72 and 69.05 ± 0.94 cm, respectively. The least squares analysis of variance has revealed non-significant effect of sex and district on fore legs length of Red Kandhari calves at 4-6 months of age.

Hind legs length: It is observed from Table 5 that the overall least squares mean for hind legs length of Red Kandhari calves at 4-6 months of age group was 42.78 ± 0.14 cm. The least squares means of hind legs length for Red Kandhari calves for S₁ and S₂ sex averaged 42.79 ± 0.21 and 42.76 ± 0.17 cm, respectively. The least squares means of hind legs length for D₁, D₂, D₃, D₄ and D₅ districts were 43.42 ± 0.22, 43.28 ± 0.23, 42.43 ± 0.41, 42.57 ± 0.29 and 42.19 ± 0.38 cm, respectively. The least squares analysis of variance has revealed non-significant effect of sex and district on hind legs length of Red Kandhari calves at 4-6 months of age.

CONCLUSION

The effect of sex and block was found to be highly significant on body weight in 4-6 months of age in Red Kandhari calves, whereas the effect of sex and block was found non-significant on rest of the traits in both sexes. Hence it is concluded that geo-ecological situations of surveyed area and management practices followed there played an important role on physical measurements parameters of Red Kandhari calves.

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