

# ANALYSIS OF HAIR QUALITY ATTRIBUTES OF MEWARI AND JALORI CAMELS MANAGED UNDER NATURAL HABITAT

S.C. Mehta and S.S. Dahiya

ICAR-National Research Centre on Camel, Post Box-07, Bikaner-334001, Rajasthan, India

## ABSTRACT

The hair quality attributes of two important Indian dromedary breeds viz. Mewari and Jalori, managed under natural habitat were analysed. Fifty and 49 samples were collected from the mid body side region of Mewari and Jalori camels, respectively. The average fibre diameter was  $40.44 \pm 2.14 \mu$  in Mewari breed as compared to  $42.49 \pm 2.31 \mu$  in Jalori breed. The fibre diameter was significantly ( $P < 0.05$ ) less among calves up to 1 year of age ( $31.55 \pm 2.72 \mu$ ) as compared to the higher age groups of 1-4 years' age ( $43.68 \pm 2.84 \mu$ ) and above 4 years' age ( $43.41 \pm 2.20 \mu$ ). The quality of fibre was assessed on the basis of medullation. The pure fibres were  $4.87 \pm 0.73\%$  in Mewari and  $8.17 \pm 2.08\%$  in Jalori with non-significant ( $P > 0.05$ ) effect of breed, sex and age groups. The hetero and hairy fibres were  $25.46 \pm 2.21\%$  and  $69.67 \pm 2.82\%$  in Mewari camels and  $38.37 \pm 2.95\%$  and  $53.32 \pm 3.62\%$  in Jalori camels, respectively with significant ( $P < 0.01$ ) effect of breed. The average staple length was  $5.65 \pm 0.23$  cm in Mewari ( $n=47$ ) and  $6.66 \pm 0.35$  cm in Jalori ( $n=33$ ) with significant ( $P < 0.01$ ) effect of breed. The study reveals that the quality of fibre produced by Jalori breed is better than that of the Mewari breed. In general, the calf hair can be optimally utilised in making outer wear and decorative handicraft items. The medium quality clippings can be used for making blankets, carpets, rugs and wall hangings whereas the clippings rich in hairy fibre can be utilised in making strings and lace for making designer garments. The study presents the fibre attributes of the two Indian dromedary breeds for the first time.

**Key words:** Camel hair, fibre characteristics, Jalori, medullation, Mewari

The population of dromedary camel in Rajasthan state has declined to 0.25 million (Livestock Census, 2019). The draught utility of camel is decreased due to mechanised farming. Nevertheless the therapeutic utility and development of various products of camel milk got significant attention (Mehta *et al*, 2009; 2014a; Govindasamy *et al*, 2019). However, in Indian context, the camel hair has been used extensively by the camel rearing families in making blankets, carpets, bags, ropes and other day to day use items for their own household use (Mehta *et al*, 2007). At several places in Rajasthan and Gujarat, it has taken the shape of rural cottage Industry (Sahani and Khanna, 1993). The finest natural fibre is produced by a camelid, i.e., Vicuna with the fibre diameter of 6-10  $\mu$ . Even the well-known producer of fine wool viz. Merino sheep and Angora rabbit has an average fibre diameter of 12-20  $\mu$  and 13  $\mu$ , respectively. Furthermore, the New World camelids viz. Guanaco, Alpaca and Llama too produce fibre with 10-30  $\mu$  diameter (Mehta *et al*, 2014b). Nevertheless, the dromedary hair is much coarser, hence utilised in different manner. Efforts were made to prepare the blends of camel hair with

wool, silk waste and polyester with encouraging results (Gupta *et al*, 1987; 1989). Patni and Dhillon (1988) also evaluated the blends of camel hair with wool, silk waste and polyester and found it worthwhile. However, the use of camel hair in textile industry has several limitations due to the reduced number of camels in the country (Livestock Census, 2019) and limited production potential of the Indian dromedary breeds (Bhakat *et al*, 2002; 2003). There is tremendous scope of utilisation of camel fibre in the making handicraft items such as wall hangings, hair bands, purse, winter wears (Jackets), camel decoration items, ancient clothing, kurtas, cushion covers, embroidery items, patch work etc. The success of Ruma Devi ([https://en.wikipedia.org/wiki/Ruma\\_Devi](https://en.wikipedia.org/wiki/Ruma_Devi)) model from the western Rajasthan gave wings to this thought. The use of camel hair under such model would certainly add to the income of the camel farmers and would support the conservation and propagation efforts of the scientists and stakeholders. In light of above facts, the hair quality and production of Mewari and Jalori camel reared under the natural habitat was evaluated.

SEND REPRINT REQUEST TO S.C. MEHTA email: [scmehta64@gmail.com](mailto:scmehta64@gmail.com)

## Materials and Methods

### Hair samples

The hair samples were collected from the breeding tract of Mewari and Jalori camel. The breeding tract of Mewari camel encompassed Mewar (Udaipur, Chittorgarh, Rajsamand districts), Vagad (Dungarpur, Banswara) and Hadoti (Kota, Bundi and Jhalawar) regions of Rajasthan state and the breeding tract of Jalori camel encompassed Jalore and Sirohi districts of state. For the assessment of hair quality; 50 and 49 hair samples from mid body side region were collected randomly from Mewari and Jalori camel, respectively while reording the age and sex of the animal. The hair production figures were collected from the camel householders in response to a questionnaire from Mewari and Jalori camel breeding tracts.

### Hair quality

Fifty and 49 samples were analysed for assessment of hair diameter and type of fibre based on medullation, i.e., non-medullated (Pure) and medullated (hetero and hairy). However, 47 and 33 samples of Mewari and Jalori camels were assessed for staple length and the were measured before washing with petroleum ether. However, for rest of the parameters, the hair samples were cleaned and degreased in liquid petroleum ether thoroughly and dried overnight. The individual samples were mixed thoroughly to prepare a representative sample. The cleaned samples were loaded in the sample holder of microtome for the preparation of snippet. The snippet was put on a glass slide with the help of mounting media and covered with a glass cover slip. The images of short pieces of fibres in the glass slide were projected on screen and the diameters of fibres were measured by using a graduated scale on a projection microscope. The classification of type of fibre was also carried out at the same time. In each slide 300 observations were recorded to minimise the error.

### Statistical analysis

Univariate analysis of variance by using general linear model was carried out by utilising SPSS version 26 (IBM Corp. Released 2019) for studying the effect of breed, sex, age and their interaction for each of the fibre characteristics under investigation.

## Results and Discussion

The analysed fibre diameter, staple length and medullation of collected hair samples are presented in Table 1.

### Fibre diameter

The average fibre diameter was  $40.44 \pm 2.14 \mu$  in Mewari camel as compared to  $42.49 \pm 2.31 \mu$  in Jalori camel with non-significant effect of breed ( $P > 0.05$ ). Pooled over breed, the average fibre diameter was  $38.72 \pm 3.61 \mu$  in males and  $41.98 \pm 1.74 \mu$  in females. The effect of sex was non-significant ( $P > 0.05$ ). However, it was noticed that the fibre diameter in Jalori males ( $26.98 \pm 1.28 \mu$ ) was quite less than the one observed for Mewari males ( $44.06 \pm 4.36 \mu$ ). The examination of data revealed that this difference was mainly due to the fact that all of the Jalori males ( $n=5$ ) belonged to the less than one year age group. The fibre diameter in the females of the two breeds were quite comparable. The effect of age on fibre diameter was significant ( $P < 0.05$ ). The mean separation analysis showed that the fibre diameter of calves aging less than one year ( $31.55 \pm 2.72 \mu$ ) was significantly ( $P < 0.05$ ) less as compared to the animals of 1 to 4 years of age ( $43.68 \pm 2.84 \mu$ ) and adult camels ( $43.41 \pm 2.20 \mu$ ) of more than 4 years' age. However, relatively smaller fibre diameter in the three Indian dromedary breeds managed at the Institute have been reported by Bhakat *et al* (2001). The fibre diameter in Bikaneri, Jaisalmeri and Kachchhi breeds have been reported as  $32.76 \pm 0.52$ ,  $35.52 \pm 0.59$  and  $38.19 \pm 1.07 \mu$ , respectively. Accordingly, these differences were evident in the two sexes ( $34.05 \pm 0.59 \mu$  in males and  $36.93 \pm 0.55 \mu$  in females) and the three age groups ( $26.05 \pm 0.72 \mu$  in 1-year,  $31.72 \pm 0.68 \mu$  in 4-year and  $48.70 \pm 0.66 \mu$  in 8-year age group), respectively (Bhakat *et al*, 2001). These differences were obvious because in the present study the samples were collected only from mid body side region whereas in the study done by Bhakat *et al* (2001), the samples were collected from neck, shoulder, hump and mid body side. In spite of this, the differences in the two studies even for the mid body side were also large, which could be due to the breeds involved, selective breeding of farm animals for about 2-3 decades versus breeding by different camel owners as per their choice and limitations, difference in the management of an institutional herd (semi-intensive system) versus camel owners' herds (extensive system) belonging to different districts of the state, difference in the sample size and the differences in vegetation, rainfall, temperature and associated features of different breeding tracts and the Institute.

The fibre diameter is a single most important criteria in deciding its cost and use in the textile industry. The natural fibres having less than  $25 \mu$  diameter are used in apparel making and are one

among the costliest fibre. The second category of 25 to 35  $\mu$  diameter is also used in textile but for the preparation of outer wear. The next category consists of fibres having the diameter in the range of 35 to 45  $\mu$  is considered best for the preparation of carpets and other similar products (Teasdale, 1995; Singh and Mehta, 2002). The other closely link criteria of importance in the textile industry are the type of fibre, staple length and the production, i.e., the quantity that can be available for product making (Teasdale, 1995). The average fibre diameter of the calves (<1 yr.) was  $31.55 \pm 2.72 \mu$  with 88% of the animals having the fibre diameter in the range of 19.53-39.82  $\mu$  which shows that the calf fibre can optimally be utilised in making outer wear items like coat, jacket and day to day use

items like cushion covers, embroidery and patch work items. However, since the production of hair from camels of this group has been reported to be  $630 \pm 26$  gm per annum (Bhakat *et al*, 2003), so the utilisation in textile industry would certainly require blending with other natural or artificial fibres. However, this can better be utilised in making handicraft items which can fetch better remuneration to the camel stakeholders.

The fibre diameter in the camels of 1-4 years' age group ( $43.68 \pm 2.84 \mu$ ) and that of the camels of greater than 4 years' age groups ( $43.41 \pm 2.20 \mu$ ) differed non-significantly (Table 1) and about 95 % of the values were covered in the range of 25.30-63.71  $\mu$ . Bhakat *et al* (2001) reported fibre diameter of

**Table 1.** Hair quality attributes with effect of breed, sex and age in the two Indian dromedary breeds.

Trait			Mewari	Jalori	Pooled
Fibre diameter ( $\mu$ )	Breed		40.44 $\pm$ 2.14 (50)	42.49 $\pm$ 2.31 (49)	41.46 $\pm$ 1.57 (99)
	Sex	Male	44.06 $\pm$ 4.36 (11)	26.98 $\pm$ 1.28 (5)	38.72 $\pm$ 3.61(16)
		Female	39.42 $\pm$ 2.45 (39)	44.25 $\pm$ 2.43 (44)	41.98 $\pm$ 1.74 (83)
	Age*	<1 yr.	27.93 $\pm$ 3.15 (4)	32.67 $\pm$ 3.42 (13)	31.55 $\pm$ 2.72 <sup>a</sup> (17)
		1-4 yr.	44.53 $\pm$ 2.95 (18)	42.41 $\pm$ 5.72 (12)	43.68 $\pm$ 2.84 <sup>b</sup> (30)
		>4 yr.	39.60 $\pm$ 3.14 (28)	47.85 $\pm$ 2.85 (24)	43.41 $\pm$ 2.20 <sup>b</sup> (52)
Pure fibre (%)	Breed		4.87 $\pm$ 0.73 (50)	8.17 $\pm$ 2.08 (49)	6.50 $\pm$ 1.10 (99)
	Sex	Male	1.46 $\pm$ 0.59 (11)	16.94 $\pm$ 7.75 (5)	6.29 $\pm$ 2.93 (16)
		Female	5.83 $\pm$ 0.87 (39)	7.18 $\pm$ 2.13 (44)	6.54 $\pm$ 1.20 (83)
	Age	<1 yr.	2.42 $\pm$ 1.48 (4)	11.26 $\pm$ 3.70 (13)	9.18 $\pm$ 2.97 (17)
		1-4 yr.	3.50 $\pm$ 0.99 (18)	5.89 $\pm$ 2.75 (12)	4.46 $\pm$ 1.24 (30)
		>4 yr.	6.09 $\pm$ 1.09 (28)	7.64 $\pm$ 3.53 (24)	6.81 $\pm$ 1.71 (52)
Hetero fibre (%)	Breed**		25.46 $\pm$ 2.21 (50)	38.37 $\pm$ 2.95 (49)	31.85 $\pm$ 1.94 (99)
	Sex	Male	17.48 $\pm$ 3.94 (11)	56.13 $\pm$ 7.99 (5)	29.56 $\pm$ 5.81 (16)
		Female	27.71 $\pm$ 2.51 (39)	36.35 $\pm$ 3.04 (44)	32.29 $\pm$ 2.04 (83)
	Age	<1 yr.	26.67 $\pm$ 7.40 (4)	51.38 $\pm$ 5.82 (13)	45.57 $\pm$ 5.36 <sup>b</sup> (17)
		1-4 yr.	20.81 $\pm$ 3.41 (18)	40.03 $\pm$ 5.96 (12)	28.50 $\pm$ 3.54 <sup>a</sup> (30)
		>4 yr.	28.27 $\pm$ 3.07 (28)	30.48 $\pm$ 3.52 (24)	29.29 $\pm$ 2.30 <sup>a</sup> (52)
Hairy fibre (%)	Breed**		69.67 $\pm$ 2.82 (50)	53.32 $\pm$ 3.62 (49)	61.58 $\pm$ 2.42 (99)
	Sex	Male	81.06 $\pm$ 4.48 (11)	26.93 $\pm$ 2.48 (5)	64.14 $\pm$ 7.19 (16)
		Female	66.46 $\pm$ 3.22 (39)	56.32 $\pm$ 3.76 (44)	61.09 $\pm$ 2.55 (83)
	Age	<1 yr.	70.92 $\pm$ 8.78 (4)	37.36 $\pm$ 5.76 (13)	45.25 $\pm$ 5.92 <sup>a</sup> (17)
		1-4 yr.	75.69 $\pm$ 4.27 (18)	53.86 $\pm$ 7.52 (12)	66.96 $\pm$ 4.35 <sup>b</sup> (30)
		>4 yr.	65.63 $\pm$ 3.95 (28)	61.71 $\pm$ 4.88 (24)	63.82 $\pm$ 3.08 <sup>b</sup> (52)
Staple length (cm)	Breed**		5.65 $\pm$ 0.23 (47)	6.66 $\pm$ 0.35 (33)	6.07 $\pm$ 0.21 (80)
	Sex	Male	5.20 $\pm$ 0.38 (13)	9.15 $\pm$ 2.75 (2)	5.72 $\pm$ 0.55 (15)
		Female	5.83 $\pm$ 0.29 (34)	6.50 $\pm$ 0.33(31)	6.15 $\pm$ 0.22 (65)
	Age	<1 yr.	3.88 $\pm$ 0.48 (3)	7.43 $\pm$ 0.95 (7)	6.36 $\pm$ 0.86 (10)
		1-4 yr.	5.62 $\pm$ 0.50 (11)	6.88 $\pm$ 0.38 (4)	5.95 $\pm$ 0.40 (15)
		>4 yr.	5.82 $\pm$ 0.27 (33)	6.38 $\pm$ 0.43 (22)	6.05 $\pm$ 0.24 (55)

\*Significant (P<0.05); \*\*Significant (P<0.01); Figures with different superscripts differ significantly

31.72±0.68  $\mu$  in camels of 4 years age and 48.70±0.66  $\mu$  in camels of 8 years' age. Since, in present study these two age groups were clubbed together, so the reported values are slightly less to almost comparable because of factors discussed above. The values suggest that the quality carpet cannot be made out of this kind of fibre but the felts, carpets, rugs, blankets, bags, foot mats, wall hangings, decorative items, ropes etc. can be made out of this kind of hair.

### **Pure fibre**

The utilisation of any natural fibres in the textile and associated industries also depend on the extent and type of medullation in the fibre and the per cent sharing of different fibres in the sample. The pure fibres were 4.87±0.73% in Mewari and 8.17±2.08% in Jalori. However, the effect of breed was non-significant ( $P>0.05$ ). The percentage of pure fibres also did not differ significantly ( $P>0.05$ ) among the two sexes. However, it was observed that the pure fibres were only 1.46% in Mewari males as compared 16.94% in Jalori males but this difference was observed mainly due to the fact that all Jalori males ( $n=5$ ) belonged to youngest age group (<1 year) whereas the Mewari males ( $n=11$ ) belonged to all the 3 age groups. Although, the effect of age group was non-significant but pure fibres in age group one (<1 year) were relatively higher than that in the higher age groups (Table 1). Significantly higher percentage of pure fibres in Indian dromedary breeds have been reported by Bhakat *et al* (2001), where the Bikaneri, Jaisalmeri and Kachchhi breeds have been shown to have 36.60±0.63, 36.31±0.71, and 40.68±1.28% pure fibres. These differences were obvious because in the present study the samples were collected only from mid-body side region whereas in the study done by Bhakat *et al* (2001), the samples were collected from neck, shoulder, hump and mid-body side. In spite of this, the differences in the two studies even for the mid body side were also large; which could be due to the breeds involved, management practices, breeding pattern, sample size, meteorological features of the breeding tract etc., as discussed above. The morphological structure of the natural fibres consists of the cuticle, the outer most layer of scales; the cortex, the intermediate portion consisting of ortho- and para-cortical cells; and the Medulla, hollow or partially filled central canal running continuously or in fragmented form along the length of the fibre (McGregor, 2012). The pure fibres do not have any medulla or hollow cavity in the inner core. The fibres having medulla has three different categories viz. hetero, hairy and kemp. The hetero-type fibres have

interrupted or fragmented medulla and irregular scale pattern. The hairy type fibres have continuous medulla covering less than 50% width of the fibre, mosaic scale pattern and complete absence of crimps. The kemp fibres are chalky white in colour and tapering towards the tip, the medulla occupies  $\geq 50\%$  width and they are comparatively brittle, lack resiliency and has very thin walls that collapse to a flat ribbon (McGregor, 2012; Baxter, 2001; 2002). Hence, the clippings having higher proportion of pure fibres is considered better for apparel production.

### **Hetero fibre**

The hetero fibres were significantly ( $P<0.01$ ) less in Mewari (25.46±2.21%) as compared to Jalori breed (38.37±2.95%). These differences are clearly reflected in the animals of two sexes and three age groups (Table 1). However, pooled over breed, the hetero fibres differed non-significantly among males (29.56±5.81%) and females (32.29±2.04%). Further, the hetero fibres were 17.48% in Mewari males as compared to 56.13% in Jalori males for the reasons explained about their belongingness to only youngest age group in case of Jalori breed. The mean separation analysis indicated significant differences among the age groups with 45.57±5.36% hetero fibres in calves (<1 yr.) and 28.50±3.54 % and 29.29±2.30% hetero fibres, respectively in 1-4 yr. age group and adult animals (>4 yr.). Slightly higher values of hetero fibres have been reported by Bhatak *et al* (2001) where the Bikaneri, Jaisalmeri and Kachchhi breeds 39.68±0.53, 38.41±0.60, and 42.15±1.08 % hetero fibres. These differences can well be attribute to the reasons discussed above. The hetero fibres were significantly more in Jalori breed as compared to the Mewari breed making it relatively more suitable for carpet making. The hetero fibres are very important as the medullation in them imparts resiliency, which is one among the most important properties of the natural fibres which makes them suitable for carpet making. The pure and hetero fibres of the camel are thus suitable for the making of carpets and other types of floor covers.

### **Hairy fibre**

The hairy fibres were significantly ( $P<0.01$ ) higher in Mewari (69.67±2.82%) as compared to Jalori breed (53.32±3.62%). These differences were clearly reflected in the animals of two sexes and three age groups (Table 1). However, pooled over breed, the hairy fibres differed non-significantly among males (64.14±7.19%) and females (61.09±2.55%). Further, the hetero fibres were 81.06% in Mewari males as

compared to 26.93% in Jalori males for the reasons explained about their belongingness to only youngest age group in case of Jalori breed. The mean separation analysis indicated significant differences among the age groups with  $45.25 \pm 5.92$  % hairy fibres in calves (<1 yr.) and  $66.96 \pm 4.35$  % and  $63.82 \pm 3.08$  % hairy fibres, respectively in 1-4 yr. age group and adult animals (>4 yr.). Significantly lower values of hairy fibres have been reported by Bhakat *et al* (2001) where the Bikaneri, Jaisalmeri and Kachchhi breeds have been shown to have  $20.49 \pm 0.57$  %,  $23.85 \pm 0.64$  % and  $14.99 \pm 1.15$  % hairy fibres, respectively. These differences could be due to the site of collection of samples, breed, selective breeding, difference in management, difference in breeding tract etc. as discussed above. Further, in present study the hairy and kemp fibres have been presented in this class of fibre. Also, it has been observed that the Mewari breed has significantly higher percentage of hairy fibres as compared to the Jalori breed, though the total medullation in the two breeds ( $95.13 \pm 0.73$  % in Mewari and  $94.75 \pm 1.08$  % in Jalori) is quite comparable. Higher percentage of hairy and kemp fibres is not a desirable trait for the use of fibre in textile and other industries. However, products like ropes, strings, lace and other similar products can be made and used in the handicraft industry to make designer products.

### Staple length

The Mewari breed ( $5.65 \pm 0.23$  cm) has significantly ( $P < 0.01$ ) lower staple length as compared to the Jalori breed ( $6.66 \pm 0.35$  cm). These differences were clearly reflected in the animals of two sexes and three age groups (Table 1). However, pooled over breed, the staple length differed non-significantly ( $P > 0.05$ ) among the two sexes and three age groups. Almost similar staple length was reported by Bhatak *et al* (2001) where the Bikaneri, Jaisalmeri and Kachchhi breeds had  $6.68 \pm 0.21$ ,  $6.16 \pm 0.24$  and  $4.65 \pm 0.42$  cm staple length, respectively. The staple length is also one among the important criteria in considering suitability of fibres for textile and other product making. Longer the fibre; stronger, smoother and perfect will be the yarn with better tenacity (Parsi *et al*, 2016). The present results suggest that the Jalori breed is relatively better in terms of staple length.

### Hair production

Efforts were made to record the hair production of Mewari and Jalori camel in the breeding tract. It was observed that the farmers do clipping once in a year and some of them still use the camel hairs

in making daily use house hold items but they do not weigh and record the production of hairs from each camel. Hence, it was not possible to give exact figures of the hair production in the two breeds. However, a rough estimate of 700 gm per adult animal per year was construed in both the breeds. Almost similar production figures have been reported in Bikaneri ( $933.85 \pm 17.99$  gm and  $976 \pm 31$  gm), Jaisalmeri ( $733.43 \pm 17.84$  gm and  $746 \pm 15$  gm) and Kachchhi ( $623.22 \pm 25.97$  gm and  $587 \pm 46$  gm) breeds of Indian dromedary in the year 2002 and 2003 by Bhakat *et al* (2002) and Bhakat *et al* (2003), respectively.

The study reveals that the quality of fibre produced by Jalori breed is better than that of the Mewari breeds. In general, the calf hair can be optimally utilised in making outer wear and decorative handicraft items. The medium quality clippings can be used for making blankets, carpets, rugs and wall hangings whereas the clippings rich in hairy fibres can be utilised in making strings and lace for designer products.

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