

Tricho-taxonomic studies of dorsal guard hairs of Indian Cervids (Artiodactyla: Mammalia) for species identification

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ABSTRACT

Tricho-taxonomic studies have been carried out by many workers on different orders of class Mammalia. But meagre information is available on the study of hairs of species under the family Cervidae in India. To have the basic surface architecture, the hair samples collected from the mid-dorsal region of four species of family Cervidae present in the Zoological Survey of India were processed for microscopic examination. Hairs were examined with help of the digital camera fitted on optical light microscope. Based on the tricho-taxonomic characters, the four species under family Cervidae can be identified. This study will help in different wildlife enforcement agencies engaged to stop illegal trade of wildlife and its derivatives under the Indian Wildlife (Protection) Act, 1972.

Key words: dorsal guard hair, Indian Cervids, tricho-taxonomy, key characters.

INTRODUCTION

Tricho-taxonomy is the classification of animals based on hair structure study, which is appropriate in the study of mammalian identification along with ecology, food habit and control of illegal trade of wildlife and its derivatives. While, the morpho-taxonomy is unable to give a proper result, the tricho-taxonomy is helpful in the identification of respective species on the basis of hair structure of respective species from small part of skins, brushes, bags, wallets and etc. This methodology has been developed by many workers of the world (Hausman, 1920; Adorjan & Kolenosky, 1969; Mathiak, 1938; Moore et al., 1974; Keogh, 1983). In India, tricho-taxonomical works on different mammal orders of class Mammalia; Carnivora (Chakraborty & De,

2010), Primates (De, 1993; Sarkar et al., 2011) and Rodentia (Bahuguna, 2008) have been done and few works on hairs of Artiodactyla species of India except the studies of De & Chakraborty (2013), Joshi et al. (2012) and Dharaia & Soni (2012) are recorded. But very meagre information is available on the hair structure of species under Cervidae family.

Out of seven Indian Cervid species, the four number of species namely Spotted Deer *Axis axis* (Erxleben 1777), Hog Deer *Axis porcinus* (Zimmermann 1780), Barking Deer *Muntiacus muntjak* (Zimmermann 1780) and Sambar Deer *Rusa unicolor* (Kerr 1792) are dealt in the present study. All the four species are listed in Schedule III of the Indian Wildlife (Protection) Act, 1972. As per the IUCN Red List category the *Axis porcinus* is Endangered, *Rusa unicolor* is Vulnerable, *Axis axis* and *Muntiacus muntjak* are Least Concern. The main objective of the present study is to provide a detailed account of hair structure of above mentioned species for its identification. This study would be helpful for different wildlife enforcement agencies engaged to stop illegal trade of wildlife and its derivatives, and also for the prey-predator food habit analysis.

MATERIALS AND METHODS

The guard hairs were collected from the mid-dorsal region of three dry skin of each species

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present in the National Zoological Collections, Mammal & Osteology Section, Zoological Survey of India, Kolkata, India. The samples were washed thoroughly with Acetone and Carbon tetra chloride after by Chakraborty *et al.* (1995) to remove the dirt of exogenous materials. Physical characters of hairs such as profile, colour, bands were recorded and total length were measured by dial calliper. Microscopic characters such as scale position in relation to longitudinal direction of the hair, scale pattern, structure of scale margin and distance between scales margins were examined with help of the digital camera fitted on optical light microscope (Olympus BX41). The medullary configuration such as width composition, structure and form of margins of the medulla were also observed. Nomenclature of different parameters was followed by Bruner & Coman (1974); Moore *et al.* (1974); Teerink (1991) and Chakraborty *et al.* (1995).

RESULTS AND DISCUSSION

The dorsal guard hairs of the species under family Cervidae can be identified on the basis of following characters.

Physical characters:

The profile of *Axis axis* and *Muntiacus muntjak* are shielded and shaft, and *Axis porcinus* and *Rusa unicolor* are straight and stiff. The coat colour of the species belonging to the family Cervidae possess different shades of brown in colour. The colour of dorsal guard hair of *R. unicolor* is more dark brown than the other species. *A. axis* is having rufous- fawn with profusely white spot, *A. porcinus* and *M. muntjak* are possess olive brown and glossy brown colours, respectively. All four species are devoid of any bands. The total length of dorsal guard hair of *A. axis*, *A. porcinus*, *M. muntjak* and *R. unicolor* were observed as 23-35.9, 21-37.6, 14.1-26 and 31.8-60.3 mm, respectively (Table 2).

Surface structure (Cuticular patterns):

The cuticular patterns, from the proximal- medial- distal points were studied. The scale patterns of *A. axis* and *R. unicolor* (Image 1,2, 22 & 23) are regular wave in proximal and medial points and irregular wave in distal points (Image 3 & 24), whereas *A. porcinus* (Image 7,8 &9) possesses regular wave at all points but *M. muntjak* (Image 13,14 &15) possesses irregular wave at all points. The structure of scale margins of hairs of all four species (2, 8, 14 & 20) are smooth at all points except proximal and distal points of *A. axis* and *R. unicolor* (Image 1, 3, 7, 9, 13, 15, 19 & 21), where it is rippled. The distance between scales margins of hairs of all the four species are near (Image 1-3, 7-9, 13-15, 20 & 21) except proximal point of *R. unicolor* (Image 19), where it is distant (Table 2).

Medullary configuration:

The structure of the medulla is almost filled in all the species but the cells are interrupted in distal part of *A. axis* (Image 6) and crescent in distal point of *A. porcinus* and *M. muntjak* (Image 12 & 18). The width composition of medulla is multi cellular in rows of medial and distal points of hairs all species (Image 5,6, 11,12, 17, 18, 23 & 24), where proximal point is unicellular irregular, multicellular, unicellular regular and multicellular in the hair of *A. axis* (Image 4), *A. porcinus* (Image 10), *M. muntjak* (Image 16) and *R. unicolor* (Image 22), respectively. The form of the medulla margins is scalloped in proximal, medial and distal points of *A. axis* (Image 4-6), proximal and distal points of *M. muntjak* (Image 16 & 18) and proximal points of *R. unicolor* (Image 22), and proximal, medial and distal part of hairs of *A. porcinus* (Image 10-12), medial point of *M. muntjak* (Image 17) and medial and distal points of hairs of *R. unicolor* (Image 23 & 24) are straight (Table 2).

Joshi *et al.* (2012) have done a comparative tricho study of four deer species namely *Moschiola indica*, *Axis axis*, *Muntiacus muntjak* and *Rusa unicolor*. However, this study has been reported only the hair colour and medulla structures of the species. The physical characters and surface structure (cuticular pattern) have not been studied and the key characters of medulla configuration has not been exhaustively discussed, and also the characters of medullary configuration is not clearly visible in the pictures provided in the document. Dharaiya & Soni (2012) reported only transverse sections of hairs of *Axis axis* and *Rusa unicolor*, but not medulla and cuticular structure of the species. And none of the tricho study has been carried out on *Axis porcinus*. Hence, the present study gives a detailed account of hair structure (Table 2) and key characters (Table 1) of species of *Axis axis*, *Axis porcinus*, *Muntiacus muntjak* and *Rusa unicolor*.

Table 1. Key characters to the species

Species	Key characters
<i>Axis axis</i>	Rippled structure of scale margins (P & D), interrupted structure of medulla (P) and scalloped form of the medulla margins
<i>Axis porcinus</i>	regular wave of scale patterns, smooth structure of scale margins and straight form of the medulla margins
<i>Muntiacus muntjak</i>	irregular scale patterns, unicellular regular (P) width composition of medulla and crescent structure (P) of medulla
<i>Rusa unicolor</i>	The regular wave (P & D), multicellular in rows and filled cells structure of medulla

P= Proximal; M= Medial; D= Distal

Table 2. Findings of the dorsal guard hair characters of *Axis axis*, *Axis porcinus*, *Muntiacus muntjak* and *Rusa unicorn*.

Species	Physical characters				Surface structure			Medullary configuration			
	Profile	Colour	No. of band	Length (mm)	Scale position	Scale patterns	Structure of scale margins	Distance between scale margins	Width composition of the medulla	Structure of medulla	Form of the medulla margins
<i>Axis axis</i>	Shield & shaft	Rufous-fawn with white spotted hairs	None	23-35.9	Transversal (P) Transversal (M) Transversal (D)	Regular wave (P) Regular wave (M) Irregular wave (D)	Rippled (P) Smooth (M) Rippled (D)	Near (P) Near (M) Near (D)	Unicellular irregular (P) Multicellular in rows (M) Multicellular in rows (D)	Interrupted (P) Filled (M) Filled (D)	Scalloped (P) Scalloped (M) Scalloped (D)
<i>Axis porcinus</i>	Straight & stiff	Olive brown	None	21-37.6	Transversal (P) Transversal (M) Transversal (D)	Regular wave (P) Regular wave (M) Regular wave (D)	Smooth (P) Smooth (M) Smooth (D)	Near (P) Near (M) Near (D)	Multicellular (P) Multicellular in rows (M) Multicellular in rows (D)	Crescent (P) Filled (M) Filled (D)	Straight (P) Straight (M) Straight (D)
<i>Muntiacus muntjak</i>	Shield & shaft	Glossy brown	None	14.1-26	Transversal (P) Transversal (M) Transversal (D)	Irregular wave (P) Irregular wave (M) Irregular wave (D)	Smooth (P) Smooth (M) Smooth (D)	Near (P) Near (M) Near (D)	Unicellular regular (P) Multicellular in rows (M) Multicellular in rows (D)	Crescent (P) Filled (M) Filled (D)	Scalloped (P) Straight (M) Scalloped (D)
<i>Rusa unicorn</i>	Straight & stiff	Dark brown	None	31.8-60.3	Transversal (P) Transversal (M) Transversal (D)	Regular wave (P) Regular wave (M) Irregular wave (D)	Smooth (P) Smooth (M) Rippled (D)	Distant (P) Near (M) Near (D)	Multicellular (P) Multicellular in rows (M) Multicellular in rows (D)	Filled (P) Filled (M) Filled (D)	Scalloped (P) Straight (M) Straight (D)

P= Proximal; M= Medial; D= Distal

Figure-1. Surface structure of dorsal guard hair of *Axis axis*

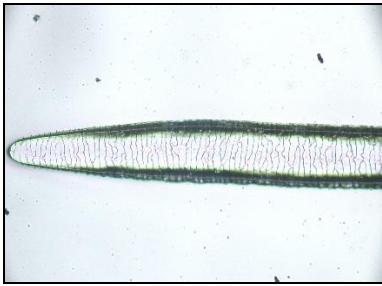


Image 1. *Proximal*

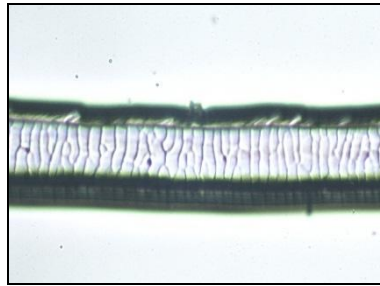


Image 2. *Medial*

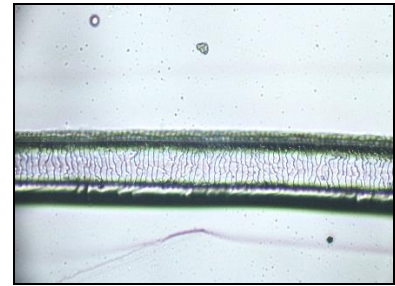


Image 3. *Distal*

Figure-2 Medulla structure of dorsal guard hair of *Axis axis*

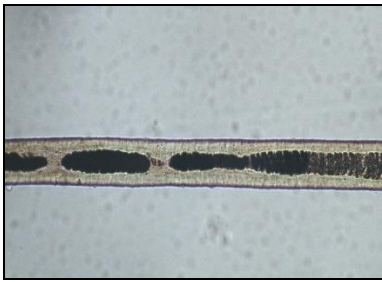


Image 4. *Proximal*



Image 5. *Medial*

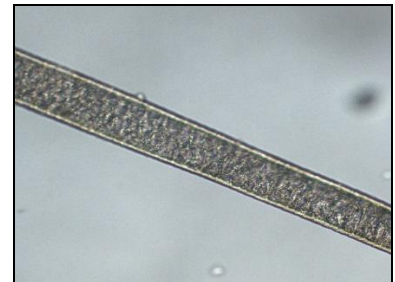


Image 6. *Distal*

Figure-3. Surface structure of dorsal guard hair of *Axis porcinus*

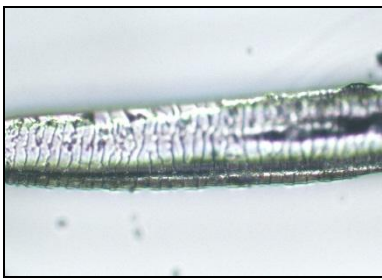


Image 7. *Proximal*

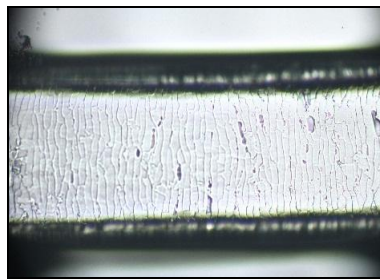


Image 8. *Medial*

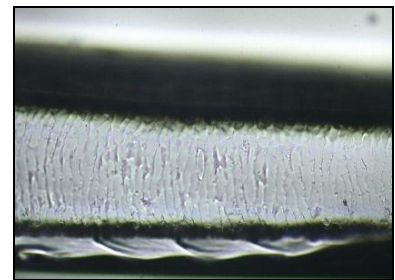


Image 9. *Distal*

Figure-4 Medulla structure of dorsal guard hair of *Axis porcinus*

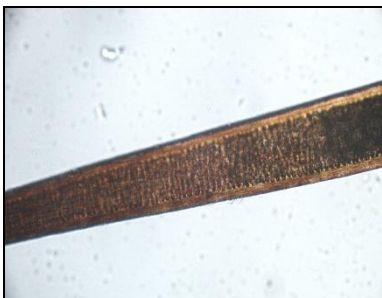


Image 10. *Proximal*



Image 11. *Medial*



Image 12. *Distal*

Figure-5. Surface structure of dorsal guard hair of *Muntiacus muntjak*

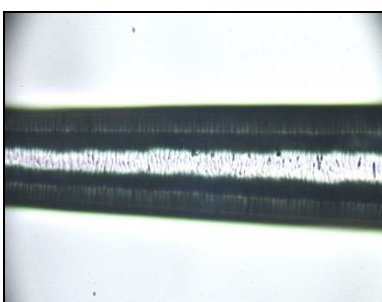


Image 13. *Proximal*

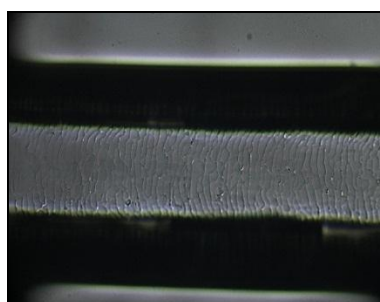


Image 14. *Medial*

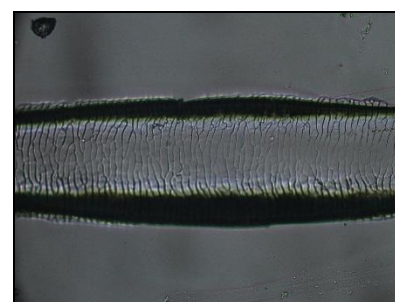
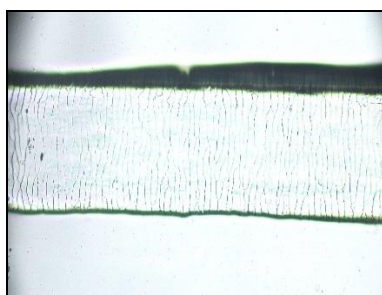
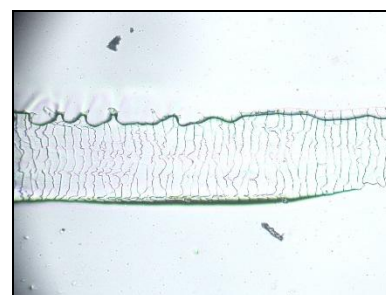
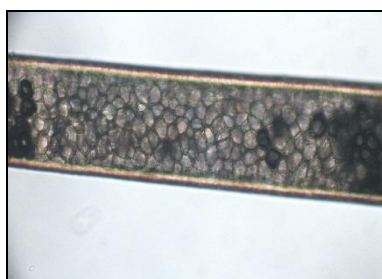


Image 15. *Distal*

Figure-6. Medulla structure of dorsal guard hair of *Muntiacus muntjak*Image 16. *Proximal*Image 17. *Medial*Image 18. *Distal***Figure-7 Surface structure of dorsal guard hair of *Rusa unicolor***Image 19. *Proximal*Image 20. *Medial*Image 21. *Distal***Figure-8. Medulla structure of dorsal guard hair of *Rusa unicolor***Image 22. *Proximal*Image 23. *Medial*Image 24. *Distal*

CONCLUSION

Tricho-taxonomy study of dorsal guard hairs of 4 species with detailed analysis of physical characters, surface structure and medullary configuration from the tip to base *i.e.* proximal-medial-distal of have been studied. Based on the above distinguished key characters of dorsal guard hair of four species under family Cervidae of class Mammalia namely *Axis axis*, *Axis porcinus*, *Muntiacus muntjak* and *Rusa unicolor* can be identified.

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CONFLICT OF INTERESTS

The authors declare that there is no conflict of interests regarding the publication of this paper.

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