



Tricho-taxonomic studies for identification of two Indian antelope species Blackbuck, *Antelope cervicapra* (Linnaeus, 1758) and Indian Gazelle or Chinkara, *Gazella bennettii* (Sykes, 1831) by dorsal guard hairs

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ABSTRACT: The dorsal guard hairs of two antelope species Blackbuck, *Antelope cervicapra* (Linnaeus, 1758) and Indian Gazelle or Chinkara, *Gazella bennettii* (Sykes, 1831) were examined using optical and scanning electron microscopes. Both morphological and microscopic characters of hairs had shown a significant variations between the species. The profile of dorsal guard hairs were straight in *A. cervicapra* and slightly wavy in *G. bennettii*. The measurement data of the species observed as (mean value): scale count per millimetre length of hair- 205.1±26.2 and 149.1±3.7 mm; length of cuticular scales- 64.4±3.8 and 58.6±2.2 µm; width of cuticular scales: 10.6±1.5 and 11.7±2.5 µm in *A. cervicapra* and *G. bennettii*, respectively. The structure of medulla of the species was observed as 'wide aeriform lattice' in *A. cervicapra* and as 'reversed cloisonné' in *G. bennettii*. The shape of the cross-section was observed as: 'Concavo convex' in *A. cervicapra* and 'oval' in *G. bennettii*. Based on a combination characters of dorsal guard hairs, the two Indian antelope species can be identified. The micro-photographs and characters of dorsal guard hairs are presented here can be used in forensic science as well as prey-predator food analysis as an appropriate reference for the species identification.

Key words: Tricho-taxonomy, dorsal guard hair, antelopes, blackbuck, Chinkara, morphological and microscopic characters.

INTRODUCTION

The tricho-taxonomy mainly used for identification of species on the basis of combination characters of hairs of species, when the morpho-taxonomy is unable to provide a fruitful result in case of small part of skin of mammal. Review of literature reveals that the major workers has done tricho-taxonomy studies and identification of species by different hair characters of mammals are Mayer (1952), Stains (1958), Brunner and Coman (1974), Moore *et al.* (1974), Koppikar and Sabins (1975), Teerink (1991), Wallis (1993), Chakraborty and De (2010). Adequate and systematic knowledge of structure of dorsal guard hair is necessary to identify the species and data generated from macroscopic and microscopic characteristics of dorsal guard hair will provide for a preparation of

identification keys for respective species. Some hair studies on Indian ungulates has been done by different workers *i.e.* Gopal *et al.* (1993) on Hard-ground Barasingha, Chatterjee *et al.* (2005) on Yak, Bahuguna and Mukherjee (2000) on Tibetan Antelope, Bahuguna *et al.* (2010) on selected carnivores and artiodactyls, Sahajpal *et al.* (2010) on Tibetan Antelope and *Capra sp.*, Joshi *et al.* (2012) on 4 species of deer and Dharaiya and Soni (2012) on cross-section of ungulates in India. However, hair studies for the identification of species Blackbuck, *Antelope cervicapra* and Indian Gazelle or Chinkara, *Gazella bennettii* is less known. The two species are listed in Schedule I of the Indian Wildlife (Protection) Act, 1972 and as per the IUCN Red List of Threatened Species (2014.3), *Antelope cervicapra* is listed as

near Threatened and *Gazella bennettii* as Least Concern. The present study was carried out to provide a complete combination characters such as morphological, cuticular, medullary and cross-sectional characteristics of hair with high resolution micro-photographs and detailed descriptions using optical and scanning electron microscopes for the identification of above mentioned two antelope species.

MATERIAL AND METHODS

The guard hairs were collected from the mid-dorsal region of three dry skin of each species present in the National Zoological Collection of Mammal and Osteology Section, Zoological Survey of India, Kolkata, India. The samples were washed thoroughly with Acetone [(CH₃)₂CO = 58.08] and Carbon tetrachloride (CCl₄ = 153.82) to remove the dirt of exogenous materials. The morphological characters of hairs (n = 20) such as shape, colour, bands were recorded, and total lengths (mm) and diameters (µm) were measured using Dial calliper (Mitutoyo) and optical microscope (Olympus BX41), respectively. The cuticular characters of hair such as scale position, scale patterns, structure of scale margins and distance between scale margins and medullary characters such as width composition, structure and form of margins of the medulla, and shape of cross-section of hair were examined under 400 X magnification with help of the digital camera fitted on optical microscope (Olympus BX41) and the observed microscopic characters of hair were photographed. To obtain the three dimensional structure and a more detailed examination of cuticular scales of hair, the scanning electron microscope (ZEISS Evo18 - Special edition) was used. The cuticular structures of hairs were observed under the high magnifications 1630 and 2600 X, and the observed cuticular structures of hairs were photographed.

All the measurements of cuticular scales were through the optical microscope and the mean values were taken into the consideration for analysis. The methodology and nomenclature of morphological, cuticular, medullary and cross sectional characteristics of dorsal guard hairs were followed according to the descriptions provided by

Brunner and Coman (1974), Moore *et al.* (1974), Teerink (1991). The description of different terms of patterns used in the results and discussion have been given herewith were followed from the Brunner and Coman (1974), Teerink (1991).

Cuticle characteristics: *Transversal*– the position of scales lie at right angles and their width is greater than their length. *Regular wave*– the pattern of scales are non-overlapping, wavy in appearance and usually continuous, with the length of the waves on the same and different scales equal. *Smooth*– the structure of scale margins have no interruptions, irregularities or indentations. *Near*– the distance between the margins of the two consecutive scales are neither too close nor too away from each other.

Medulla characteristics: *Multicellular in rows*– the medulla is composed of a continuous two or more columns of cells. *Wide aeriform lattice*– the structure of medulla is filled with air spaces appear as a network or lattice enclosing aggregations of shrunken wide medullary cells. *Straight*– the form of the medulla margins have a smooth and straight line.

RESULTS AND DISCUSSION

The dorsal guard hairs of the two species studied under the subfamily Antilopinae can be identified on the basis of following combination morphological and microscopic characters of dorsal guard hair.

A. Morphological Characters

The profile of dorsal guard hairs were straight in *A. cervicapra* and slightly wavy in *G. bennettii*. The coat colour of two species shown different shades of brown, *i.e.*, dark brown to velvet black (♂), fawn or tan (♀) in *A. cervicapra* and sandy or tawny brown in *G. bennettii*, whereas the single dorsal guard hair was observed as russet and tan in *A. cervicapra* and *G. bennettii*, respectively. The dorsal guard hairs of the two species were unbanded. The length size of hairs were almost similar between the species and recorded as mean 11.4±4.8 mm in *A. cervicapra* and 12.2±4.4 mm in *G. bennettii*. The diameter of hair were observed in *A. cervicapra* as 60.7±13.4µm and 68.4±19.6 µm in *G. bennettii* (Table 1).

Table 1: Morphological characteristics of the dorsal guard hairs of species.

Species	Morphological characteristics					
	Coat colour	Colour of dorsal guard hair	Profile	No. of bands	Length (mm)	Diameter (µm)
<i>A. cervicapra</i>	Dark brown to velvet black (♂), Fawn or tan (♀)	Russet	Straight	Unbanded	6.3–20.9	36.5–71.6
					11.4±4.8	60.7±13.4

The morphological characters of hairs of mammals may differ due to the age, sex, season, climate and geographical variations, etc. However, the profile, colour, length and diameter of dorsal guard hair are presented here may be helpful for the preliminary investigations of hair and can be used as one of the combination characters of hair for the identification of species.

B. Microscopic Characters

Cuticular characteristics. The cuticular characteristics of the two species studied had shown a small variations. Although the scale positions and structure of scale margins of two

species were similar as 'transversal' and 'smooth' in both *A. cervicapra* and *G. bennettii*, the scale patterns, and distance between scale margins were recorded as 'broad petal' and 'regular wave', and 'distant' and 'near' in relation to the longitudinal direction of the hair. However, measurement data of the species observed as (mean value): scale count per millimetre length of hair- 205.1±26.2 and 149.1±3.7 mm; length of cuticular scales- 64.4±3.8 and 58.6±2.2 µm; width of cuticular scales: 10.6±1.5 and 11.7±2.5 µm in *A. cervicapra* and *G. bennettii*, respectively (Table 2).

Table 2: Cuticular characteristics of the dorsal guard hairs of species.

Species	Cuticular characteristics						
	Scale position	Scale patterns	Structure of scale margins	Distance between scale margins	Scale count/mm length of hair	Length of cuticular scale	Width of cuticular scale
A. cervicapra	Transversal	Broad petal	Smooth	Distant	156–247 205.1±26.2	60.4–70.9 64.4±3.8	8.3–13.5 10.6±1.5
G. bennettii	Transversal	Regular wave	Smooth	Near	143–156 149.1±3.7	56.6–61.4 58.6±2.2	8.9–13.6 11.7±2.5

Medullary and Cross-sectional characteristics.

The width composition of medulla and form of the medulla margins had shown no variations between the species and it was filled with as 'multicellular in rows' and 'straight', in both *A. cervicapra* and *G. bennettii* and the structure of medulla of the species was observed as 'wide aeriform lattice' in *A. cervicapra* and as 'Reversed cloisonné' in *G. bennettii*. The shape of cross-section of the species had shown significant variation between the two species. The shape of the cross-section was observed as: 'Concavo convex' in *A. cervicapra* and 'oval' in *G. bennettii* (Table 3). Dharaiya and Soni (2012) have documented only the transverse sections of hairs of *A. cervicapra* and *G. bennettii* in the subfamily Antilopinae. Some studies of species under subfamily Antilopinae are mainly based on the predator's scat-hair (diet) analysis. The species identification through scat-hair analysis may lead

to the incorrect identification, as the hair structures are often damaged in the digestion process (Rajaram and Manon, 1975; Dharaiya and Soni, 2012).

Methods of hair identification need exact identification keys. The single character of hair does not help for the species identification, as the hair characters often show high variance, but the combination characters may give significant values for identification of species (Brunner and Coman, 1974; Teerink, 1991). On the basis of morphological and microscopic characters dorsal guard hairs, the key characters of hair to identifying the two species studied under the subfamily Antilopinae is presented in Table 1-3 along with adult photographs, piece of skin with hairs and microscopic photographs of Blackbuck, *Antelope cervicapra* (Figs. a-e) and Chinkara, *Gazella bennettii* (Figs. f-j).

Table 3: Medullary characteristics and cross-section of the dorsal guard hairs of species.

Species	Medullary characteristics			Cross-section
	Width composition of medulla	Structure of medulla	Form of medulla margins	Shape
A. cervicapra	Multicellular in rows	Wide aeriform lattice	Straight	Concavo convex
G. bennettii	Multicellular in rows	Reversed cloisonné	Straight	Oval

The two species of antelopes studied here such as *Antelope cervicapra* and *Gazella bennettii* are the antelopes used in the illegal trade for local bushmeat consumption and for their skin, and on the other hand, they are the chief prey to the large

carnivores. Therefore, the micro-photographs are presented here can be used in forensic science as well as prey-predator food analysis as an appropriate reference for the species identification.

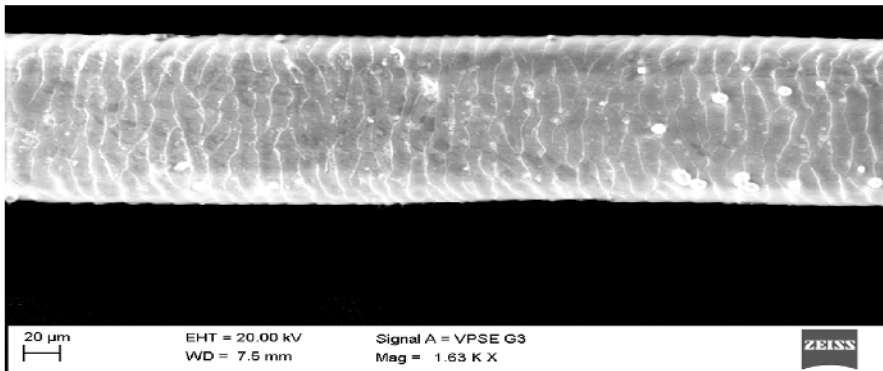
Tricho-taxonomic studies for identification of Blackbuck, *Antelope cervicapra* (Linnaeus, 1758) by dorsal guard hair



(a). Adult Male



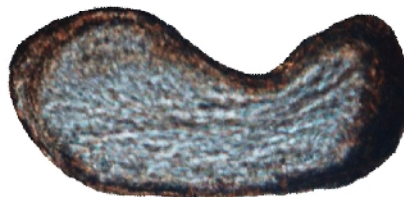
(b). Piece of Skin with hairs



(c). Scanning electron micrographs of cuticula of dorsal guard hair



(d). Medulla of dorsal guard hair of Blackbuck (400 x)



(e). Cross-section of dorsal guard hair of Blackbuck (400 x)

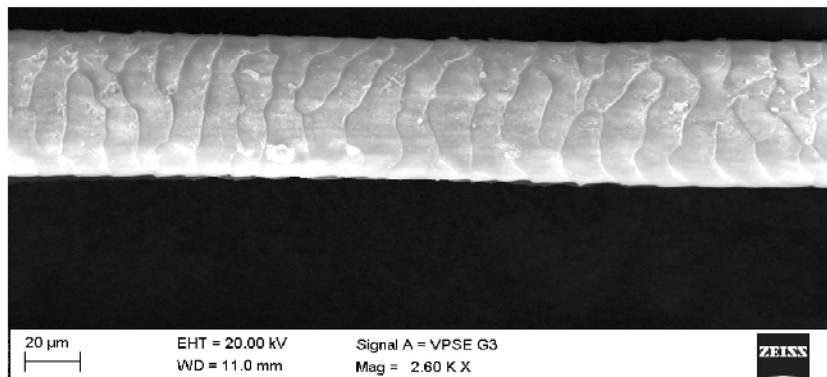
Tricho-taxonomic studies for identification of Chinkara, *Gazella bennettii* (Sykes, 1831) by dorsal guard hair



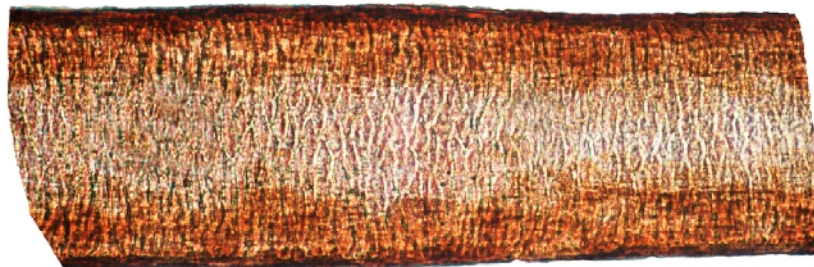
(f). Adult Male



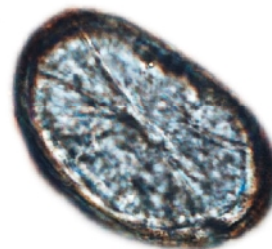
(g). Piece of Skin with hairs



(h). Scanning electron micrographs of cuticula of dorsal guard hair



(i). Medulla of dorsal guard hair of Chinkara (400 x)



(j). Cross-section of dorsal guard hair of Chinkara (400 x)

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