



## **Identification Of Dorsal Guard Hairs of Nilgai *Boselaphus tragocamelus* (Pallas, 1766) (Bovidae: Artiodactyla: Mammalia)**

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### **ABSTRACT**

The dorsal guard hairs of the antelope *Boselaphus tragocamelus* were examined using the optical and scanning electron microscopes. Based on a combination characters of dorsal guard hairs, the antelope 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 WORD:** tricho-taxonomy, dorsal guard hair, Nilgai, morphological and microscopic characters

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### **INTRODUCTION**

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 pertinent information for species identification. Detailed knowledge on the hair structure is required to identify the species, where the morpho-taxonomy cannot give the proper result. The tricho-taxonomy chiefly 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. There are many workers viz., Mayer [7]; Stains [13]; Brunner and Comman [2]; Moore *et al.* [8]; Koppiker and Sabins [6]; Teerink [14]; Wallis [15]; Chakraborty and De (2010) have well documented the different hair characters of mammals. In India, the tricho-taxonomic studies have been carried out by many workers on different orders of class Mammalia viz., Rajaram and Manon [9]; De [4]; Chakraborty and De [3]; Bahuguna *et al.* [1]; Sarkar (2011), etc. However, scanty information is available on the hair structure of *Boselaphus tragocamelus*. Therefore, the present study was undertaken to provide a complete combination of characters i.e. macro and microscopic characters of hairs of *Boselaphus tragocamelus* for species identification.

This species is listed under Schedule III of the Indian Wildlife (Protection) Act, 1972 and as per the IUCN Red List category (2016-3), *B. tragocamelus* is Least Concern. The present study was carried out to provide a complete combination of 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 identification of the species.

### **MATERIAL AND METHODS**

The guard hairs were collected from the mid-dorsal region of three dry skin of the species present in the National Zoological Collections, Mammal and Osteology Section, Zoological Survey of India, Kolkata, India. The samples were washed thoroughly with Acetone ( $(\text{CH}_3)_2\text{CO}$  = 58.08) and Carbon tetrachloride ( $\text{CCl}_4$  = 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 ( $\mu\text{m}$ ) 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 Comman [2], Moore *et al.* [8], Teerink [14]. The description of different terms of patterns used in the results and discussion have been given herewith were followed from the Brunner and Comman [2], Teerink [14].

**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:** *Unicellular* – The medulla is composed of a continuous single column of discrete cells formed by transversal position. The pattern may be regular or irregular. *Straight*– the form of the medulla margins have a smooth and straight line.

## RESULTS AND DISCUSSION

The dorsal guard hair of *B. tragocamelus* studied is bicoloured having earth yellow at base black at tip of the hair, having 2 bands and the profile of hair is slightly wavy. The coat colour of animal is iron blue to lighter grey (♂), sandy brown (♀). The mean length and diameter of hair was recorded as 14.3–51.6 (31.9±11.7) mm and 64.6–223.1 (198.2±18.3) µm, respectively (Table 1.0). The cuticular characteristics were as: scale position- 'transversal', scale patterns- 'regular wave', structure of scale margins- 'smooth' and distance between scale margins- 'near' (Fig. 1.0; 2.0). The medullary characteristics were as: composition of medulla- 'unicellular regular', structure of medulla- 'simple', and form of the medulla margins- 'straight' (Fig. 3.0). The cross-section was observed as 'oval' shape (Fig. 4.0).

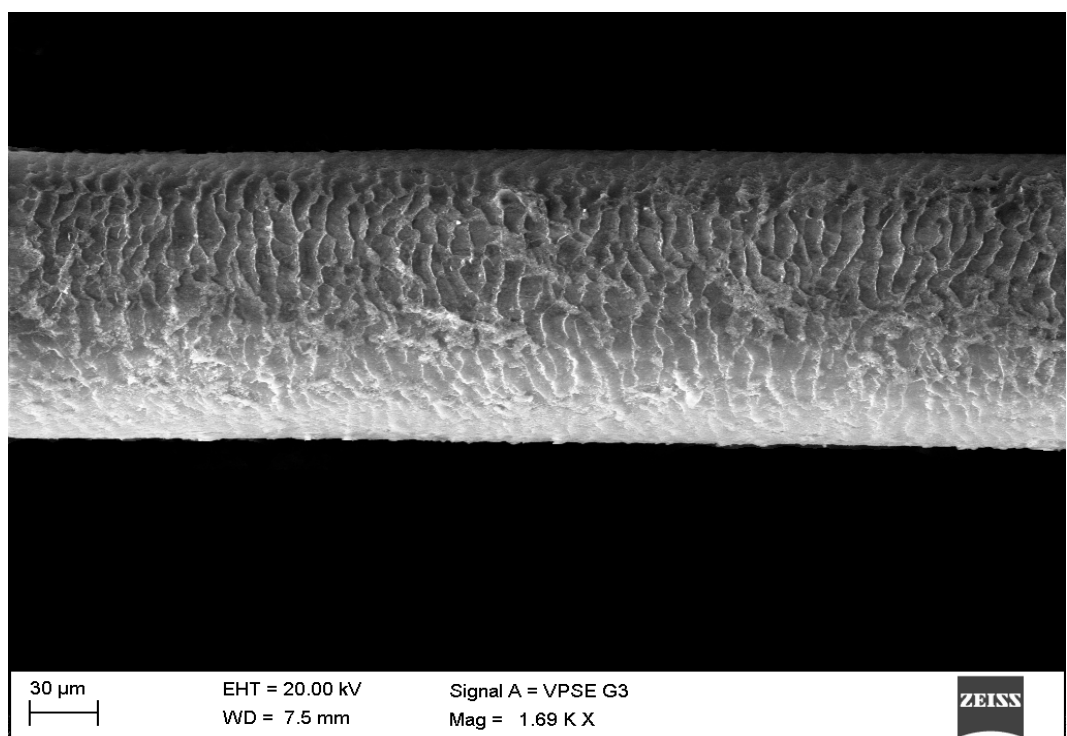
The hair of *B. tragocamelus* can easily be distinguished from all other Artiodactyls by its colour and profile, which is always slightly wavy, lengthier (31.9±11.7) and thicker in diameter (198.2±18.3), bicoloured having colour of earth yellow and black, and have distinct microscopic characters such as regular wave pattern and near margin of cuticular scales, unicellular regular and simple medulla, and the shape of cross-section is oval. So far, there is no specific hair studies have been conducted on this species except the histological study by Shambhulingappa *et al.* [12]. Therefore, this study provides a complete combination of characters of dorsal guard hair of *B. tragocamelus* for species identification.

Dharaiya and Soni [5] have documented the transverse sections of hairs of some antelopes. 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 [9, 5]. 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 [2, 14]. On the basis of morphological and microscopic characters dorsal guard hairs, the key characters of hair to identifying this species is presented in Table 1 along with microscopic photographs (Figs. 1).

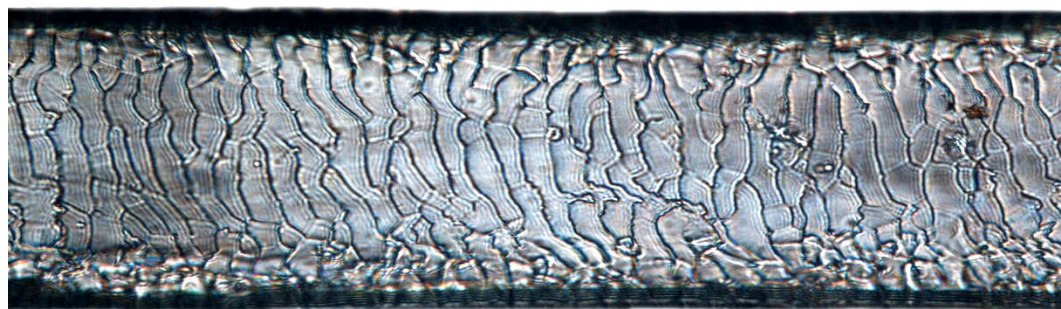
**TABLE 1.0** Physical and microscopic characters of dorsal guard hairs of *Boselaphus tragocamelus*

Macroscopic characteristics	
Coat colour	Iron blue to lighter grey (♂), Sandy brown (♀)
Colour of dorsal guard hair	Bicoloured, <i>Base</i> : Earth yellow; <i>Tip</i> : Black
No. of colour bands	2
Profile	Slightly Wavy
Length (mm)	14.3–51.6 (31.9±11.7)
Width (µm)	64.6–223.1 (198.2±18.3)
Cuticular characteristics	
Scale position	Transversal
Scale patterns	Regular wave
Structure of scale margins	Smooth
Distance between scale margins	Near

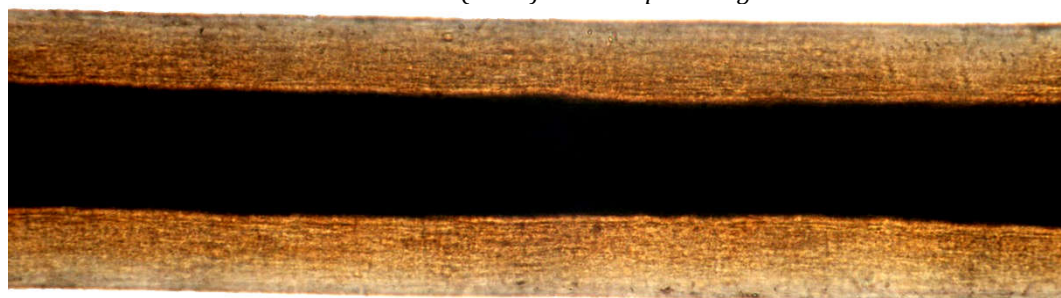
Scale count/mm length of hair	140–248 (186.6±39.8)
Length of scale (µm)	91.4–99.1 (94.7±2.2)
Width of scale (µm)	9.3–11.7 (10.1±1.1)
<b>Medullary characteristics</b>	
Composition of medulla	Unicellular regular
Structure of medulla	Simple
Margins of medulla	Straight
Width of medulla (µm)	86.5–98.5 (93.3±4.7)
<b>Shape of cross-section</b>	Oval



**FIGURE 1.0** Scanning electron micrographs of cuticula of *Boselaphus tragocamelus*



**FIGURE 2.0** Cuticula (200X) of *Boselaphus tragocamelus*



**FIGURE 3.0** Medulla (200X) of *Boselaphus tragocamelus*



**FIGURE 4.0** Medulla (200X) of *Boselaphus tragocamelus*

## CONCLUSION

The *B. tragocamelus* is 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.

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