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# REVIEW ON FORENSIC ANALYSIS OF HAIR BY SCANNING ELECTRON MICROSCOPE IN DOMESTIC AND WILD ANIMALS

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## ABSTRACT

Analysis and Identification of hair is the most complex and distinct aspect in the field of forensics.The examination of animal hair is a ubiquitous discipline in wildlife forensics. Examination is largely based on microscopy, which enables the hair analyst in identification of hair as animal in origin, to distinguish the hair to a particular species, and to conduct comparative examinations. Analysis of animal remains, e.g. hair at a crime scene helps to provide evidence for contact of a suspected assailant and diagnosing drug expose. The cuticular pattern, cross section and medullary index provides information on the domestic and wild species of the animal. The present study was conducted to investigate some morphological features of hair samples of domesticated and wild animal species using scanning electron microscopy for their identification. Scanning Electron Microscope shows the optical means of identification regarding structural, surface morphology, coupled with scientific data and focuses on species identification.

## INTRODUCTION

Illegal poaching is a challenge to a wide variety of endangered species worldwide[1].It has en dangered wildlife, ecosystems, lives, and livelihoods, in equal measure, in both developing and developed world nations.It has changed dimensions and scale in a way that suits an incre asingly digitized world that has seen personal and materialistic boundaries blur.Wildlife crim es frequently occur in remote areas without witnesses, leaving wardens with very little eviden ce to investigate.A seemingly perfect crime disguises a series of clues that are invisible to the average eye that need to be strategically placed together to solve the crime.WildlifeForensics use the same standards as human forensics, with a few variations. The difference is that wildli fe forensics need to be able to identify and differentiate between a variety of species, whereas human forensics includes only one species homo sapiens.Modern crime detection has becom e a scientific endeavor that involves testing, evaluating and recognizing biological evidence, f ingerprints, blood and skin traces, tissue samples, teeth pulp, hair to establish the nature of th

e crime and the method of execution and, most importantly, the perpetrator of the crime..Acc ording to wildlife protection act, 1972 'wildlife'includes any animal, aquatic or land vegetation which forms part of any habitat.
The killing of wild animals which are beingprotected from hunting by legislation, also know as poaching, is one of the most serious crimes investigated by forensic wildlife scientists. Oth er wildlife crimes include the purchase and sale of endangered animals, and the possession an d sale of protected animals. [2,3]Wildlife forensic is one of the fields of forensic science that involve the use of scientific procedures to examine, identify and compare the evidences from crime scene .The purpose of this is to link the suspect with the victim (which is specifically ananimal)[4].Forensic wildlife scientists must be prepared to recognise samples from any spec ies in the world that are illegally hunted, stolen, poached or traded in an illicit market.Althoug h wildlife forensic scientists may seem to be facing a daunting challenge in developing new a nd accurate identification techniques, they have one advantage over human forensics-
sample size is rarely a problem.The mammalian hair fibres depict a compelling biological material which can be sampled, collected, transported and resist putrefaction which remains for very long periodof time, therefore which makes it feasible for providing long-term information. In some cases, hair samples can be the only evidence recovered from a crime scene. The hair morphology is useful for the study of evolution and domestication of various mammals in zoology, morphology, archeological studies and forensic sciences.The macro and microscopical structural features are widely used for identification of hair and for proceeding the investigation. Microscopic analysis remains principally qualitative technique including visual assessments and signifies on developing more objective metrics and even less on quantitation of hair damage extremity. Thespecific features of the hair shaft (ratio of development of three layers, cuticle, cortex and medulla) and their structures which is discussed in figure 1 pigmentation of cortex, cuticular pattern, shape of cuticular scalesand the shape, size, pigmentation and position of medullar cells. Scanning Electron Microscope (SEM) is considered to be the most preferred method for identification and analyzation of internal features of hair samples.

## METHOD

### Search Action

A coordinated and methodized search was conducted for articles related to particular topic includes collection of hair from crime scene, structure of hair, analyzation of hair using scanning electron microscope and forensic significance of hair. Preliminary investigation in Google Scholar gave up auxiliary unique results with respect to particular topic therefore, the investigation of journal was restricted to PubMed, Web of science and Research Gate.

### Study Selection

The search results from the database gave back 67 articles from PubMed. A supplementary 55 journal reports and articles were received from Web of Science and 112 from Research Gate, pertinent to the study criteria. These contents were analyzed independently.234 articles were included for the study and 67 were removed due to their insignificance to the pertained topic. The complete texts of 73 articles were scrutinized for inclusion and 83 were rejected in final scrutiny, by reason of reiteration of information. 11 journal report from the initial search action were used in the study selection.

**Collection of hair**

The hair samples from various regions of animal body, poaching surroundings and from regions surrounding the dead animal body is taken using forceps. Gloves should be used during collection process in order to avoid contamination of evidences. The collected hair and other evidences are packed in zip lock bags and then transferred to a paper envelope. The hair samples are preserved by washing them with absolute alcohol at room temperature for about 24 hours and are packed in fresh zip lock bags. The preserved hair sample is kept in 4°Ctill further analysis. The sample should be properly cleansed to remove excess dirt or dust particles for obtaining accurate result during analysis.

## SCANNING ELECTRON MICROSCOPE [10]

The Scanning Electron Microscope (SEM) scans a focused electron beam over a surface to create an image.The hair samples can be dissected in pieces of 5mm sizeleaving 3 mm from root side with the help of stereomicroscope. The sample holder with mounted samples are coated with gold using auto fine coater and are observed under a Scanning Electron Microscope for the aspect of better and prominent result.

Analyzation using SEM provides accurate details of hair sample such as scale count, scale structure, scale height, hair shape, hair diameter and surface damage, whether physical or chemical at variable magnifications. Elemental analysis of hairscan be done by using Energy Dispersive Spectrum (EDS) coupled with SEM for analysis of different elements of periodic table.The animal hair variability in each race is greater than the variability of hairs on a single individual's head. Supporting the statement of(J.Curr.Microbiol.App.Sci(2019) 8(2): 1028-1034) the hair of the cat is nearly circular in cross-sections ,coarser and straighter hair (which is discussed in figure 3) and antelope hair is the roost flattened being quite curly in nature, as tends to be the case with flattened ovaloid cross-sectioned hair(discussed in figure 2).

In SEM, stereo photographs can be taken which provides better magnification of the sample. Stereo photographs are taken by placing the sample at a particular angle,then tilting it an additional 2° to 10° to another angle for taking another picture. It is the angle at which the sample can be normally observed and depth is interpreted by analysing the images formed at the different angles. The stereo image can be observed by holding the picture about 10 inches from the eyes, and views the stereo pair. Stereo glasses can also be used to view the image. Stereo photographs show the depth of field which cannot be observed under normal light optical instruments as the depth of field would not be the same and shows poor resolution with the optical instruments in general use.

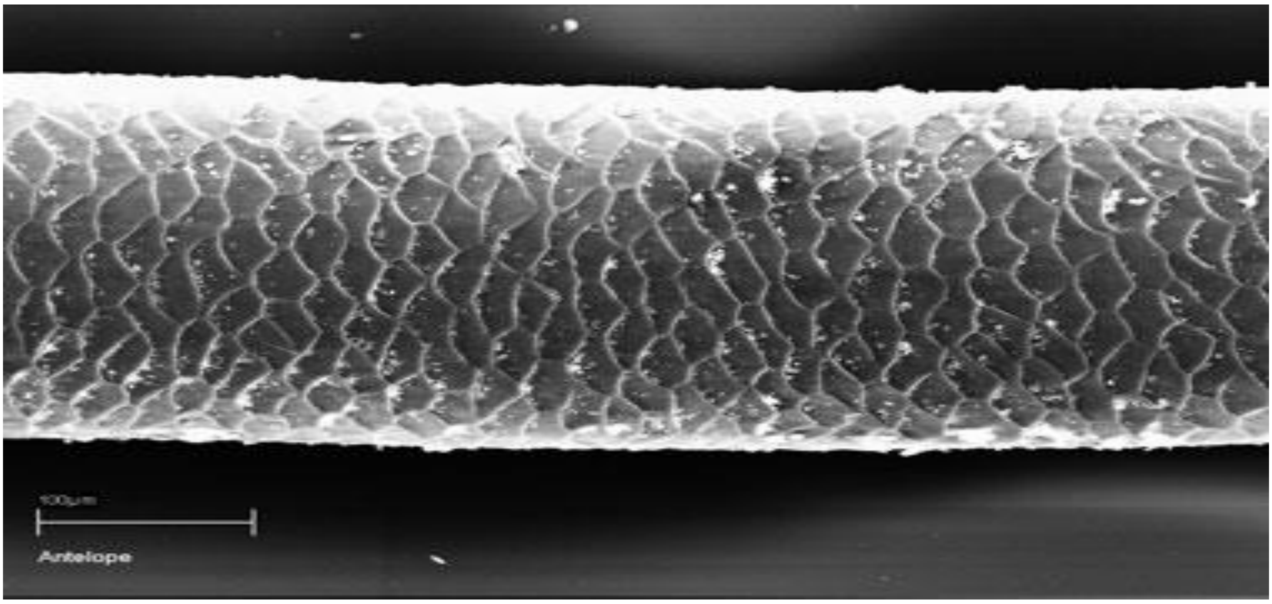


Figure 2 showing wild Antelope hair under scanning electron microscope

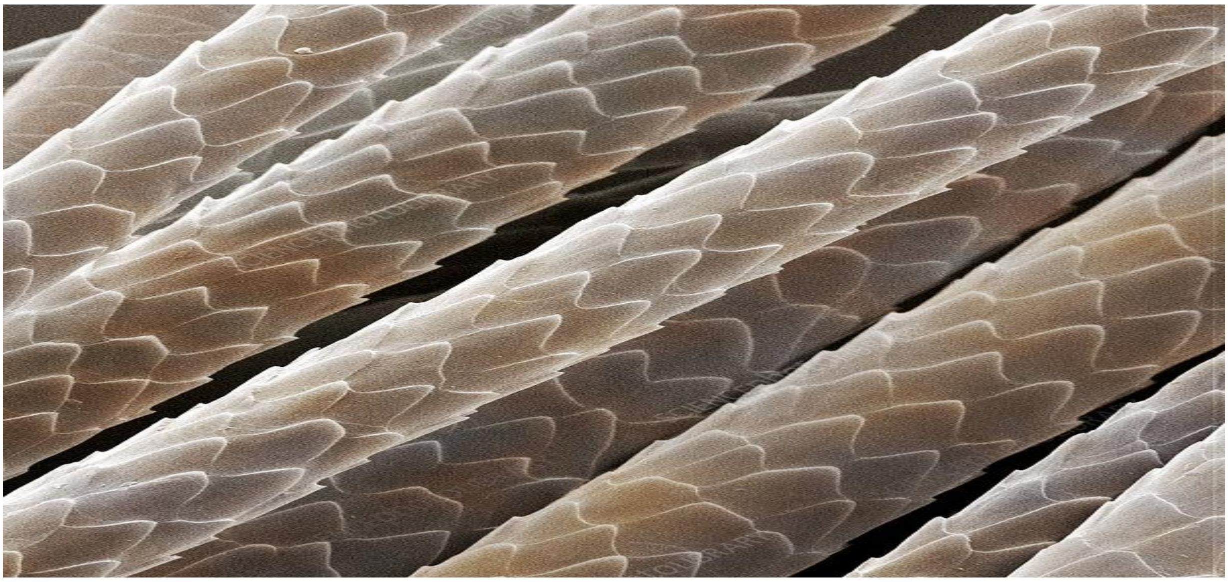

Figure 3 showing domestic cat hair under SEM

**FORENSIC SIGNIFICANCE**

Hair is an eclectic integrant in forensic science and an indispensable feature in the process of investigations. Animal hair is one of the most ubiquitous aspect in the field of wildlife forensic. In forensic, morphological examination of hair is the pre-eminent process during hair examination. The major medico legal concerns associated with hair examination includes species identification,origin of the particular species, determination of the hair's origin from the body and the comparison of the hair sample from the victim to the crime scene. It is an illustrious information that from morphological features of hairs, animal species can be discriminated without further unpleasant concerns which provides the pathway for

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morphological examination of hairs as an important method used in forensic science. The major features that make hair a good subject for establishing identity of an individual are its resistance to chemical decomposition and its ability to retain structural features over long period of time. Cuticle has a major role in providing resistance to the hair.The peculiar differencesin the hair including pathological, chemical and other abnormal conditions which affects the structural and surface characteristics of hair helps in identifying the animal individuals.

## DISCUSSION

The purpose of present study was to establish a detailed knowledge on the aspects of peculiarity of hair samples in the field of wildlife forensic.Significance of hair in forensic, its collection and preservation methods, structural characteristics of hair and its analyzation using scanning electron microscope. Scanning electron microscope is an advanced technique for sample analysis and provides a clear-cut view on the sample placed. Species identification and determining the origin of species was a challenging factor once but with the advanced technologies it seems elementary nowadays. Scanning Electron Microscope is one of the major equipment used in hair analysis due to its high resolution and magnification power. It is mainly used for species identification by examining the cuticular pattern, cross section and medullary index of the hair. Species determination provides details on the origin and characteristic of a particular animal individual.

## CONCLUSION

Wildlife forensic is a combined version of various field of science in accordance with wildlife protection and conservation act. Hair identification is an involuted and distinct aspect in view of forensic investigation.It entails several tests and uncertainties still exist in determining conclusions to establish whether a single hair is identifiable from an individual. The Scanning Electron Microscope alone may not provide final conclusions, as however, with farther tests and comparative studies, this type of study eventually leads toa more constructive identification of the hairs, since it definitely shows improvement over the optical means of identification regarding structural, surface morphology, coupled with other scientific data.

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