Determination of Somatic Origin of Human Body Hair and Its Comparision with Animal Hair

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Abstract: *Hair is the most frequently found trace evidence in the crime scene. It assists in establishing a relation between crime scene, a victim and a criminal. This study was carried out at Sam Higginbottom University of Agriculture Technology and Sciences. The present study is carried out to find the most reliable quantitative parameter for differentiation of the human hair from the animal hair. Hair samples from various species of animal and various sites of human hair were considered. In present study the diameter, medullary index, Color of the human and different animal hair was measured. Compound microscope, measuring scale, Micrometer was used for the purpose of observation. The purpose of study was to develop a data base by analyzing the medullary index of animal hair, Diameter of human and animal hair and color of human and animal hair in different part of human and animal body to narrow down forensic analysis in crime scene investigation.*
Keywords: *Medullary index, Micrometer, Compound microscope, Hair.*

I.   Introduction

Hair is a protein filament that buildups from follicles begin in the dermis, or skin. Hair is one of the describing characteristics of mammals. The human body, apart from location of glabrous skin, is bound in follicles which crop thick bounding and better vellus hair. Utmost current affection in hair is adjust on hair buildup, hair blazon and hair care, but hair is also an precious biomaterial primarily be composed of protein, notably keratin. Attitudes towards changeable hair, such as hairstyles and hair ejection alter deeply side to side changeable cultivation and historical periods, but it is a number of times hand me down to add up to a person's personal beliefs or social area, such as their age, sex, or religion. In criminal analysis the precious tool that are being hand me down as clue and at once encounter are hairs. All along the course of poaching by trapping, deskinning, removing of flesh, break of bones, hairs are readily lost from the innocent at the crime scene. Hair might also be injected to the criminal. This circumstance is matching to the situation in human investigation. According to **Montagan** (1963) states that hair is "as dead as rope". The hair root embedded in the skin is a living tissue and grows to produce the hair we see, which is a dead tissue. The living part, the hair follicle, is an appendage of the skin and develops as an invagination of the epidermis. The natural growth process of the follicle causes hairs to be shed on a periodic basis, but they are changed and this cycle is again and again all among and over again, although the replacement hair may well be different from its predecessor. It is this periodic shedding that causes hair from a person's body to be currently begin on clothing and at scenes of crime, and which build them as useful as associative clue in forensic science.

II.   Methodology

The hair samples were collected from the human hair of different sites and hair of different animals for the identification of medullary index, color, and diameter of hair. Human hair including scalp, moustache, and pubic hair while animal hair including different species of animal including cow, pig, buffalo, dog, rabbit, goat, sheep, deer, cat. In the present work 50 sample of hair were collected for the identification of medullary index, color, and diameter of hair analyzed by the compound microscope and micrometer. Hair strand from different animals were collected. The tip and the root of the hair of each sample were cut so that only shaft region was selected for the examination. Out of 50 samples, 25 of human hair and 25 of animal hair were collected the human hair of different sites and hair of different species of animals.

Preparation for human hair slide

Human hairs were washed with acetone. Each strand of hair sample were dried, the hair sample were placed on a microscopic slide with a drop of glycerin and cover by the using of cover slip and was subjected to microscopic examination. Hair strands were observed under 40x resolutions.

Preparation for animal hair slide

Firstly each animal hair samples were washed with soup solution followed by distilled water for 2-3 times to remove the dust and debris. Later the each sample was again washed in ether/alcohol (50:50) for 2-3 minutes to remove fatty materials and blot dried if any. Each dried hair were treated with hydrogen peroxide for two hours to bleach the hair, it helps to make the line of differentiation between cortex and medulla. After each dried hair strand were cleaned in xylene and mounted a microscopic slide by placing hair strand on slide in a drop of xylene covering the whole hair strand under cover slip. Each slide has been named appropriately and allowed it to dry for 48 hours. Animal hair strand were observed 40x and the mounted hair slide were examined for morphological characteristics and different and sites were calculated under microscope by using the micrometer scale.

Calculation of Medullary Index:-

* The distance of medulla was measured transverse section and cortex was measured cross section.

$$MI = \frac{\text{Width of medulla}}{\text{Width of cortex}}$$

III. Result And Discussion

In the present work, the given hair samples from various species of animal hair and various sites of human hair were observed under compound microscope and micrometer. The total numbers of observation were made on 50 hair samples in which medullary index, color, and diameter were observed. Out of 50 samples, 25 of animal hair and 25 of human hair samples were collected from various species of animal hair and various sites of human hair. After its examination following result were obtained which are given in the below:-

A: ANIMAL HAIR

As the table no. 3.1 shows that the mean diameter of cortex of animal hair varies between 0.3mm to 0.7mm, the mean diameter of the medulla of animal hair varies between 0.2mm to 0.6mm.

Table No 3.1 Medullary Index of Animal Hair

Name of Animal Hair	Mean Medulla Diameter(mm)	Mean Cortex Diameter (mm)	Medullary Index (mm)
Goat	0.4	0.7	0.57
Cow	0.2	0.7	0.28
Deer	-	-	-
Dog	0.3	0.4	0.75
Pig	0.6	0.66	0.63
Cat	0.2	0.3	0.66
Sheep	0.25	0.5	0.50
Buffalo	0.5	0.54	0.52
Rabbit	0.5	0.52	0.51
Donkey	0.25	0.5	0.50

As the table no. 3.2 shows that the maximum colors of Goat, Deer, Dog, Cat, Sheep, Rabbit hair was white and minimum colors of Cow, Pig, Buffalo, and Donkey was brown and black.

Table No 3.2 Color of Animal Hair

No. of Sample	Name of Animal Hair	Color Observation
1.	Goat	White
2.	Cow	Brown
3.	Deer	White
4.	Dog	White
5.	Pig	Black and White
6.	Cat	White
7.	Sheep	White
8.	Buffalo	Black
9.	Rabbit	White
10.	Donkey	Brown

B: HUMAN HAIR
As the table no.3.3 shows that the mean diameter of scalp of human hair varies between 0.5 mm to 0.62 mm. Diameter of shown is above 0.54 mm instead of in sample no. G, H, E, B, and C.

Table No 3.3 Diameter 0f Human Scalp Hairs

Sample No.	Diameter (mm)					Mean Diameter (mm)
A	S1	S2	S3	S4	S5	
	0.5	0.6	0.5	0.5	0.6	0.54
B	0.7	0.6	0.6	0.5	0.6	
						0.6
C	0.7	0.6	0.6	0.6	0.6	
						0.62
D	0.6	0.5	0.5	0.5	0.6	
						0.54
E	0.5	0.4	0.5	0.6	0.6	
						0.58
F	0.6	0.5	0.5	0.5	0.5	
						0.52
G	0.6	0.6	0.5	0.5	0.6	
						0.56
H	0.6	0.6	0.6	0.5	0.6	
						0.58
I	0.6	0.5	0.6	0.5	0.5	
						0.54
J	0.5	0.5	0.5	0.5	0.5	0.5

As shown the table no. 3.4 the moustache hair having mean diameter of 0.64 mm to 0.68 mm and table no. 3.5 shows that the pubic hair having mean diameter of the 0.58 mm to 0.66.

Table No 3.4 Diameter of Moustache Hair

Sample No.	Diameter (mm)					Mean Diameter (mm)
A	S1	S2	S3	S4	S5	
	0.7	0.7	0.7	0.7	0.6	0.68
B	0.7	0.8	0.6	0.5	0.6	0.64

Table No 3.5 Diameter of Pubic Hair

Sample No.	Diameter (mm)					Mean Diameter (mm)
A	S1	S2	S3	S4	S5	
	0.7	0.7	0.7	0.6	0.6	0.66
B	0.6	0.6	0.6	0.5	0.6	0.58

As shown the table no. 3.6 the maximum colors of sample name A, B, C, E, F, H, I, J human hair was black and minimum colors of sample name D and G was brown.

Table No 3.6 Color of Human Hair

No. of Sample	Name of Human Hair Sample	Color Observation
1.	A	Black
2.	B	Black
3.	C	Black
4.	D	Light Brown
5.	E	Black
6.	F	Black
7.	G	Brown
8.	H	Black
9.	I	Black
10.	J	Black

As the table no.3.7 shows that the Diameter of scalp human hair was 0.55 mm, Moustache hair was 0.66 mm and Pubic hair was 0.62 mm. Medulla was present in scalp hair of human and absent in moustache and pubic hair. Color of scalp hair of human was black and brown, moustache hair was light black, and in pubic hair was black. Medullary Index of scalp hair was 0.2 mm, in moustache and pubic hair medullary index was absent. Shape of scalp hair was

Table No. 3.7 Somatic origin of human hair

Parameters	Scalp Hair	Moustache Hair	Pubic Hair
Diameter	0.55 (mm)	0.66 (mm)	0.62 (mm)
Length	6- 7 (cm)	1-2 (cm)	1-3 (cm)
Medulla	Present	Absent	Absent
Color	Black & Brown	Light Black	Black
Medullary Index	0.2 (mm)	Absent	Absent
Shape	Straight, Curly, wavy	Straight, curly	Curly

IV.   Discussion

In animals the medulla is always more than ½ of the total diameter of the hair while in humans the ratio is usually less than 1/3. **(Saferstein 2004)**.The result of hair examination on the basis of the diameter of the shaft may not be reliable as the diameter of the shaft of hair is not proved to be the significance parameter to differentiate between human and animal hair. The diameter of the medulla is a useful parameter to differentiate between the human and animal hair. It is observed in the present study that the diameter of medulla of human hair was 0.1 mm and the diameter of medulla of animal hair was between 0.2 mm to 0.6 mm. In the present study, it was observed that medullary index of animal hairs was from 0.28 mm to 0.75mm. The findings are similar to **Kshrisagar S. V. et al**. Our value differs with value of medullary index of buffalo was 0.51mm, which is greater than 0.50 but it is similar to findings by **Kshrisagar S. V. et al**. In the present study, it was observed that medullary index of human hair was 0.2 mm, where as the medullary index of human hairs from different somatic origin were Pubic Hair (Absent), Moustache hair (Absent), and Shaft hair (0.2mm). Similar value is stated by **Krishnan Vij** and **Kshrisagar S. V. et al.**, that the medullary index of human hair was less than 0.25.

V.   Conclusion

After the complete examination of both animal hair and human hair, it was observed that the medullary index of human hair was 0.2 mm and medullary index of animal hair >0.28 mm. Thus, the medullary index is the most significant parameter in differentiation of human from animal hair as there is difference in values of medullary index between human and animal hair, It is also helpful to know the part of body from which it is derived. The hair samples can be examined by using the compound microscope. They observed that the arrangement of the cortical cells of human hairs was to be fairly irregular with conspicuous inter digitations of cell boundaries as compared to animal hair. The medulla of human and animal hair hairs was filed with cellular remnants of destroyed medullary cells showing fibrous structures. The lamellar structures of cuticular cells became very clearly visible. The number and the overall thickness of cuticular cell layer is human and animal hairs investigated varied considerably between scalp and pubic hairs from animal to animal. Hence, Hair samples available in any form are important criterion for differentiation between animal and human hair. It may be prove very good physical evidence in investigation of crime.

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