

## Role of Hair Keratin Phenotypes in the Establishment of Individuality & Determination of Inheritance; A Comparative Study Among the Distinct Indian Stratum

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### ABSTRACT

At the site of crime scene, distinct types of evidences such as biological, chemical or physical are collected in several conditions. Such facts play a dynamic role in the identification of an individual involved in a particular crime. Over the years of advancement in the field of investigation, DNA has been used a source to fortitude of species and to determine the personal identification from various sources i.e. hairs, nails, sweat etc. Hairs are the physical evidences repeatedly confronted in different conditions. The Two of the features i.e. resistance and chemical decomposition and its ability to retain structural features over an extended period makes hair a good subject for establishing individual identity. Hairs, which are composed primarily of the protein keratin, can be defined as slender outgrowths of the skin of mammals. This study was focused on the significance of the role of hair keratin phenotypes in the establishment of individuality and determination of inheritance from the hairs samples of hairs among the several Indian stratum. The results of this study present the slight variation among genders and conclude that gender discrimination is not possible from keratin phenotypes. While the occurrence of keratin K1, K2, K3, have higher percentage of inherited pattern from parents.

### KEYWORDS

Hairs; Keratin Phenotypes; Individuality; Genetic Inheritance; Evidences; DNA etc.

### INTRODUCTION

The epoch of methodological investigation has arisen the feasibility of distinct evidences in the conclusion of any crime and plays a vital role by linking a perpetrator and scene of occurrence [1, 2]. The evidences carry utmost information and help to determine the identity of an suspect/perpetrator during the investigation. Prevailing expansion of scientific technologies has proven its utility to reveal out the identity of perpetrator from various types of evidences [3, 4, 5]. Over the years, DNA analysis has been remain a prime milestone for personal identification in several cases i.e. disputed paternity/maternity, identity from unknown biological fluids or tissues, hairs, fingerprints etc<sup>6</sup>. Out of many trace evidences which are secured from the crime scene, hair samples got an utmost

importance in identification of perpetrator. Topical development in the identification of predators have concluded that hair samples plays a key role in identification procedure other than just extracting the DNA for fingerprinting [7,8]. However a few factors i.e. environmental and chemical processes can degrade DNA, limiting its usefulness over time. Hairs consist three layers that are concentric in nature namely medulla, cortex and cuticle [9, 10, 11]. Medulla is the inner most, soft layer made up of the rounded cells. The middle layer is termed as cortex which carries the hair pigments. Cuticle is the outermost layer which consists scale, hard, transparent and protects the inner layers of hair [12]. These thread like strands are commonly composed of fibrous protein which is the main

constituent of human organs. According to the lexicon hairs are any of the fine thread-like strands which grow from the skin of humans (different part of the human body), mammals, and some other animals hoof known as Keratin [13, 14]. Mammals have approximately 30  $\alpha$ -keratin variants that are the primary constituents of hair. Proteins are more robust than the DNA and can be found in any tissue of hair sample [15].

Keratin provides the information of all proteins which are extracted from skin modifications. Subsequently, it was appreciated that keratin is a mixture of proteins, keratin filament-associated proteins and other proteins mainly enzymes [16, 17]. Later Keratins were defined as certain filament-forming proteins with specific physicochemical properties and extracted from the cornified layer of the epidermis, whereas those filament-forming proteins that were extracted from the living layers of the epidermis were grouped as prekeratins/cytokeratins [18, 19]. Keratin as a structural protein can be classified i.e.  $\alpha$ -helices &  $\beta$ -pleated sheets. Polypeptide changes are responsible for the formation of keratin protein [20, 21]. These chains can either curl into helices ( $\alpha$ -conformation) or bond side-by-side into pleated sheets ( $\beta$ -conformation) [22].

This comparative study was based on the role of hair keratin phenotypes in the establishment of individuality and determination of inheritance among the various Indian stratum [23]. The observation of the study provides the available variation among stratum and their families that provides the individualistic features. According to the results of this study, it is insignificant to discriminate among the genders, but as per the law of inheritance, it can be utilized to establish relation between disputed paternity/maternity cases or missing person.

## METHODOLOGY

This present study consists 400 hair samples including 200 males and 200 females that were collected from the local Jaat residents of age group of 15-55 years from the population of district- Baghpat, Shamli, Meerut of Western Uttar Pradesh (Northern part) of India. All the subjects were selected randomly, and consent was taken earlier. The comparison among the various Indian stratum were comprised with the help of available studies conducted by several researchers/ Scientists.

## MATERIAL

At least, 8 samples per subject were collected from distinct locations of head. All the collected samples were preserved in marked paper envelope separately. For the examination of samples, Perfit vertical slab gel Electrophoresis (advance version) was used.

## METHOD

For the examination of hair samples, all the glass wares were cleaned in 5% of chromic acid to remove any kind of foreign elements or ingredients. To remove the remnants of acid, carriers were cleaned from distilled water and put throughout the night. During this study, the steps of extraction methods were followed according to the methods of Deepti Jindal's study.

### Extraction of Proteins

All the samples to be analyzed were cleaned by using solvent (Ethanol, Petroleum ether) and then were cut into small shred. To extract the hair protein; DTT-100mg, SDS-2% of wt./vol., tris-0.10 gm, urea -8 gm, were dissolved in 10 ml of distilled water (9.3 pH) [24, 25].

### Preparation of hair protein Extracts

The shred hair samples were suspended in extraction solution for next 24 hours at room temperature. The samples were centrifuged to dispose of undissolved materials and the supernatants were used for electrophoresis [26].

### Solution for Electrophoresis of hair samples

Electrophoresis method was based on the sodium dodecyl sulphate polyacrylamide vertical with discontinuous buffer system. For gel preparation, Acrylamide, Bis-acrylamide urea were dissolved in 100 ml of distilled water [27]. A numerous type of chemicals i.e. ammonium per-sulphate (2 gm/5 ml.), Tris -SDS+ SDS+ glycerol+ B-mercaptoethanol+ B 15 bromophenol mixed with distilled water (25 ml+3gm+ 15 ml+ 10 ml+ 1 ml+100 ml.) are used for the electrophoresis of hair samples [28,29].

All the samples were photographed by Epic-Infocus cell phone with 16 mega-pixel camera, while the statistical analysis was conducted by use of chi-square formula and updated SPSS-software.

## RESULT & DISCUSSION

To extract out the information about an individual, scalp hairs are considered the preminent cradle. Therefore, 400 scalp hairs (including 200 males and 200 females) were collected from the Jaat who farmers by profession and residents of the western part of Uttar Pradesh and Northern population of India are. According to existing research carried out by numerous scientists/ researchers;  $K_1$ ,  $K_2$  and  $K_3$  are basic and very frequently occurring phenotypes pattern. Therefore, keratin phenotypes  $K_1$ ,  $K_2$ ,  $K_3$  were the key in this research.

Due to lower quantity of Sulphur in keratins, these can be distinguished easily by careful examination of their various bands

which ranges approximately to the molecular weight of 40-60 kילו Dalton. The obtained keratin phenotypes are given below in table no.1-

**Table No.1:** frequency of occurring the keratin pattern among the distinct Indian stratum.

Population No. of samples		Types of keratin and its frequency			Unpre- dictable
		K <sub>1</sub>	K <sub>2</sub>	K <sub>3</sub>	
Jaats (Farmers)	400	67.20%	21.45%	6%	5.35%
Jat Sikhs	100	78%	13%	4%	5%
Banias	96	78.12%	11.45%	6.25%	4.16%
Khatri	102	76.47%	12.75%	5.88%	4.90%
Brahmins	98	80.61%	13.26%	4.08%	2.04%

During the analysis of hair samples, it was observed that first two bands of keratins do not distinguish from each other. The k<sub>1</sub> phenotype had three bands and k<sub>2</sub> has two bands. The third keratin k<sub>3</sub> shows four bands. As a resultant of this study, it was observed that K<sub>1</sub> keratin has most frequency (67.20%) while keratin phenotype K<sub>1</sub> has only 21.45% of occurrence rate. K<sub>3</sub> Phenotype has lowest frequency only 6% in the total examined samples whereas 5.35% of samples couldn't represent their significance. The study of keratin shows that it can help to significantly identify an individual. To discriminate between the genders, the samples were further studied and analyzed. The obtained results are shown in the given table no.2-

**Table No. 4:** Presentation of parents and their children's keratin phenotypes distribution.

S. NO.	PARENTS	NUMBER OF FAMILIES	CHILDREN			KERATIN PHENOTYPES			UN-PREDICTABLE
			Boys	Girls	Total	K <sub>1</sub>	K <sub>2</sub>	K <sub>3</sub>	
1.	K <sub>1</sub> , K <sub>1</sub>	93	97	95	192	173	00	00	19
2.	K <sub>1</sub> , K <sub>2</sub>	57	61	58	119	80	35	00	04
3.	K <sub>1</sub> , K <sub>3</sub>	30	46	26	72	55	02	13	02
4.	K <sub>2</sub> , K <sub>2</sub>	03	03	07	10	00	05	02	03
5.	K <sub>2</sub> , K <sub>3</sub>	00	05	02	07	00	03	02	02
6.	K <sub>3</sub> , K <sub>3</sub>	1	02	01	03	00	02	00	01

**Table No. 2:** Distribution of gender according to the occurrence of keratin phenotypes in local Jaat residents.

GENDER OF SUBJECTS	PHENOTYPES			TOTAL
	K <sub>1</sub>	K <sub>2</sub>	K <sub>3</sub>	
Females	141	24	19	184
Males	132	31	21	184
<b>Total</b>	273	55	40	<b>368</b>

The results have slight variations among both of the genders which doesn't distinguish between them significantly. Therefore, it can be stated that gender discrimination is not possible from the keratin phenotypes. Similar like of this study, the distribution of gender as per the observation of keratins among another Punjabi stratum are given below in table no-3;

**Table No.-3:** Distribution of gender according to the occurrence of keratin phenotypes in a Punjabi stratum.

GENDER OF SUBJECTS	PHENOTYPES			TOTAL
	K <sub>1</sub>	K <sub>2</sub>	K <sub>3</sub>	
Males	116	28	17	161
Females	122	26	13	161
<b>Total</b>	238	54	30	<b>322</b>

Similar like of the consequences of local jaat resident's findings, the stratum of Punjab also gives slight variations among both genders which doesn't distinguish between them significantly. Now, to determine the correlation of the keratin phenotypes between the parents and their children of jaat's

stratum of western Uttar Pradesh, these hair samples were further analyzed. After getting processed, it was observed that keratin phenotype  $K_1$  has higher number of frequency in comparison of another remaining keratins  $K_2$  and  $K_3$ . The results are shown in table no.4.

The results of this study show that  $K_1 \cdot K_1$ ,  $K_1 \cdot K_2$  and  $K_1 \cdot K_3$  have

higher percentage of their occurrence and between the parents and their children. During this examination process of the samples, a few of samples couldn't identify because of the samples were either destroyed or diffused. Therefore, the prediction of such samples was columned in the un-predictable category.

**Table No. 5:** Presentation of parents and their children's keratin phenotypes distribution among the Punjabi stratum.

S. NO.	PARENTS	NUMBER OF FAMILIES	CHILDREN			KERATIN PHENOTYPES			UN-PREDICTABLE
			Boys	Girls	Total	$K_1$	$K_2$	$K_3$	
1.	$K_1 \cdot K_1$	82	89	83	172	158	NIL	NIL	14
2.	$K_1 \cdot K_2$	48	53	50	103	71	29	NIL	3
3.	$K_1 \cdot K_3$	26	35	23	58	43	NIL	11	4
4.	$K_2 \cdot K_2$	2	1	2	3	NIL	2	NIL	1
5.	$K_2 \cdot K_3$	2	2	1	3	NIL	2	1	NIL
6.	$K_3 \cdot K_3$	1	1	1	2	NIL	NIL	1	1

As per the available data in table no-5, the keratin phenotypes of Punjabi stratum were also carrying the variation. This variation is the indication of variance in genetic heritage in the hairs. The percentage of keratin phenotypes  $K_1$ ,  $K_2$ ,  $K_3$  along with the un-predictable from the selected families are given below in table no.6-

**Table No. 6:** Percentage of the keratin phenotypes among the children and to the parents.

S. NO.	PARENTS	KERATIN PHENOTYPES PERCENTAGE AMONG TWO INDIAN STRATUMS						UN-PREDICTABLE	
		$K_1$		$K_2$		$K_3$			
1.	$K_1 \cdot K_1$	90.10	91.86	NO	NO	NO	NO	09.89	08.14
2.	$K_1 \cdot K_2$	67.22	68.93	29.41	28.15	NO	NO	03.36	02.92
3.	$K_1 \cdot K_3$	76.38	74.14	02.77	NO	18.05	18.97	02.77	06.89
4.	$K_2 \cdot K_2$	NO	NO	50	66.67	20	NO	30	33.33
5.	$K_2 \cdot K_3$	NO	NO	42.85	66.67	28.57	33.33	28.57	NO
6.	$K_3 \cdot K_3$	NO	NO	66.66	NO	NO	50	33.33	33.34

According to the existance of the frequencies of three foremost keratin phenotypes ( $K_1$ ,  $K_2$ ,  $K_3$ ), it was observed that these can be influenced by the inheritance and controlled by the autosomal multiple alleles. Rendering to the study of Schimkat and his colleagues, it was found that four autosomal dominant recessive way that might be controlled by 2 independent loci k and m which are dominant while  $k_1$  & non-mare recessive [30, 31].

Due to the electrophoretic mobility, keratins have significantly proved the principal structural proteins. These keratins can be extracted from the hair samples/evidences by use of electrophoretic technique [32]. As per the research findings of several scientists and researchers, the species determination and variation between individuals can be studied. By the observation of this study, the identity of an individual couldn't be possible. Whereas, it was examined that the higher per-

centage of keratin among the parents represents its effect in the observation of children. In a family of  $K_1$ ,  $K_2$ ,  $K_1$  reflects its strength while  $K_2$ ,  $K_3$ ,  $K_2$  the percentage is significantly higher. This study significantly proved that the presence of keratin among the parents influences the phenotypes in the children. This research proposes that keratin phenotypes are inherited autosomal features due to multiple alleles. This research can be helpful to identify to identify an individual (subjective empathy) and even can be helpful to determine the relationship between children and their parents/ disputed paternity and maternity cases.

## CONCLUSION

Numerous morphological topographies of the hair samples i.e. colour of hair, presence of medulla, cuticle, medullary index, determination of species etc. play a dynamic starring role in forensic exploration. These topographies can meticulously overlay between the species and even the individuality among the same species. Therefore, hairs from various parts are not totally homogenous. Hence, variation is observed among the hair of same individual or same species. The observation of the study makes available to the variation among the families and provides the individualistic features. Keratin also designates the significant values of an individual specially in those cases where the paternity/maternity are under clash. The types of Keratin phenotypes are not pretentious of any gender. These are inherited genetically and look as if to be due the autosomal genes with multiple alleles. Whereas, the phenotypes  $K_1$  is the most frequent among the selected subjects/family from the nominated population. Whereas in  $K_2$  dominant family, it shows its higher frequency, similar like of these  $k_3$  signifies its values. According to the results of this study, it is insignificant to discriminate among the gender, but as per the law of inheritance, it can be utilized to establish relation between disputed paternity/maternity cases or missing person.

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