



QUANTITATIVE KERATIN EXTRACTION FROM HUMAN FEMALE HAIRS OF DIFFERENT AGE GROUPS

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ABSTRACT Hair is one of the main sources of keratin protein. Keratin has gained popularity due to its exceptional biodegradable nature and is useful in various industries like poultry, textile, agriculture and cosmetics. In the present study, hair samples were collected from females of different age groups. The keratin extraction process involved a combination of chemical and enzymatic treatments, followed by purification steps. The conformation of keratin was done using ninhydrin test. The study was undertaken to analyse the quantitative keratin extraction from human female hairs of different age groups and also for optimal isolation of keratin from human hair with a potential source of application in the environment.

KEYWORDS : Keratin, Hair, Protein, Extraction.

INTRODUCTION:

Mammals are special because of their hair. The follicles that cover the human body produce both thin and dense hair terminals. The protein keratin makes up human hair. Keratin, a member of the intermediate filament protein class, is one of the most significant structural proteins present in some vertebrate epithelial cells. Keratin proteins are fibrous, with lengthy polypeptide chains and crosslinking fibres. (Murray *et al.*, 2017) Keratin proteins are long polypeptide chains of amino acids arranged in a fibrous shape. A protein's fundamental macromolecular structure is a polypeptide chain, which is composed of amino acids. Certain amino acids, such as glycine, alanine, serine, and valine, are abundant in keratin proteins. Some trace amounts of tryptophan, lysine, and methionine are also present. (Strnad *et al.*, 2011)

Keratin is a member of the scleroproteins, a family of fibrous structural proteins. It is the most prevalent structural protein present in animal horns, claws, feathers, nails, and hair. (Chilakamarry Reddy C *et al.*, 2021). There are two types of keratins: 1) α -keratin and 2) β -keratin. Compared to alpha keratin, beta keratin is more resilient. Mammals contain alpha keratin, which is the main component of wool, hair, claws, hooves, horns, and stratum. However, the beta form is mostly present in birds beaks and claws; reptile's scales and claws. Highly stable and insoluble in the majority of organic solvents is keratin.

Agrawal V *et al.*, (2019) state that over time, several techniques for extracting keratin from human hair have been developed, with the main focus being on cleaving disulfide bonds on the keratin protein backbone to increase its aqueous solubility. In recent times, keratin has been extracted by a variety of methods, including oxidation and reduction. Additionally, keratin can be extracted via superheated hydrolysis and sulfitolysis from a variety of materials. The majority of the studies show how keratin may be used in a variety of industries, including agriculture, textiles, poultry, and cosmetics. The goal of the study was to learn more about and extract high-quality keratin protein from hairs, which may have environmental applications.

MATERIALS AND METHODS:

Hair sample: Three distinct age groups of human females provided hair samples for collection. Each sample of hair weighed 0.7 grams. The following age groupings are listed: 1) Aged 13 to 18 2) Aged 20 to 25 years 3) More than 40 years

METHODOLOGY:

This present study used Sen P *et al.*, (2021) method for the keratin extraction procedure. Human female hair samples from three different age groups were collected and each sample weighed 0.7 gm. Each 0.7 gm of hair sample was soaked in 20 ml of 2% sodium dodecyl sulphate (SDS) solution for 20 minutes. Then the sample was suspended in 1.5 N of Na₂S solution and placed in dry region at room temperature for 5-6 hours. Further, the sample was mixed with mechanical stirrer (magnetic stirrer can also be used) to finely mix the hair and produce a hydrolysate. The aliquot was then centrifuged at 5000 rpm for 5 minutes at room temperature. The supernatant was collected and the pH of the solution was brought to 2-3.5 using 1 N HCl so as to precipitate out keratin from the hydrolysate. Then the solution was kept undisturbed for 2-3 hours to obtain keratin in white precipitate. Later, the precipitate was dried to obtain keratin flakes. Further, keratin

was recovered and pulverized. Ninhydrin test was done for conformation.

OBSERVATION AND RESULT:

The acquired keratin's color serves as a reliable gauge of its purity, a faint milky white hue during the recuperation phase, which turned milky yellow upon final dehydration. These findings were contrasted with the body of research that has already been done, which confirms that keratin is milky yellow in color.

The keratin when added to ninhydrin reagent, the solution turned into deep blue to violet color indicating the presence of keratin protein. This result corresponds to standard coloration of protein extracted.

This study analyses the quantitative keratin extraction from human female hairs of different age groups. According to different age groups, age group I (13 to 18 years) contains 0.51 gm; age group II (20 to 25 years) contains 0.48 gm and age group III (above 40 years) contains 0.42 gm of keratin protein. Table 1 shows keratin obtained from different samples from human female hairs of different age groups.

Table 1: Keratin obtained from different samples from human female hairs of different age groups

Sr. no	Age group	Sample no.	Quantity of sample	Protein obtained	Mean
1)	Age group I (13 to 18 years)	Sample 1	0.7 gm	0.51 gm	0.51
		Sample 2	0.7 gm	0.49 gm	
		Sample 3	0.7 gm	0.53 gm	
2)	Age group II (20 to 25 years)	Sample 1	0.7 gm	0.44 gm	0.48
		Sample 2	0.7 gm	0.48 gm	
		Sample 3	0.7 gm	0.52 gm	
3)	Age group III (above 40 years)	Sample 1	0.7 gm	0.38 gm	0.42
		Sample 2	0.7 gm	0.42 gm	
		Sample 3	0.7 gm	0.47 gm	

DISCUSSION:

The purpose of the study was to quantitatively extract keratin from human female hairs of various age groups, shedding light on age related variations in hair keratin content. Keratin is a multipurpose biopolymer which is used in the production of fibrous composites, and with necessary modifications, it can be developed into gels, films, nanoparticles, and microparticles. (Chilakamarry Reddy C *et al.*, 2021). The study was contrasted with the pig hair test conducted by Cassoni A *et al.*, (2018). Pig hair is far thicker and denser than human hair, and it contains a higher percentage of fat. The outcomes of this investigation were also compared with the keratin extraction technique developed by Sen P *et al.* (2021) for human hair. This strategy yielded nearly identical results to the one conducted in this experiment. In this study, we employed a quantitative approach to extract keratin from hair to access its yield and purity. The present study when compared with Kuzuhara A *et al.*, (2007) and Giesen M *et al.*, (2011) revealed a compelling trend indicating a decrease in keratin quantity in human hair with advancing age. Quantitative analysis across different age groups consistently demonstrated a decline in the level of this structural protein, keratin with aging.

CONCLUSION:

The remarkable yield, purity and exploration of optimization avenues position this research as a significant contribution to the broader understanding of keratinous material, paving the way for continued advancements in the field of keratin research.



Soaked hair sample in Na₂S solution



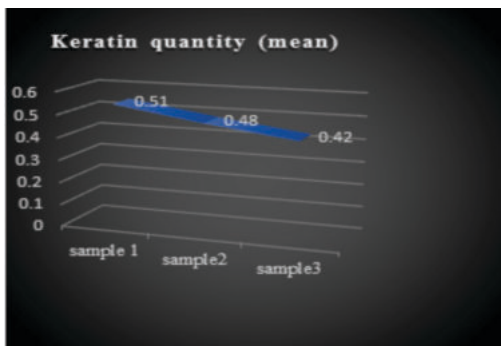
Centrifugation at 5000 RPM



Sample after resting showing precipitate



Sample after recovery showing keratin



Sample 1: indicates age group 13 to 19
 Sample 2: indicates age group 20 to 25
 Sample 3: indicates age group above 40

Graph 1: Graph representing keratin quantity obtained from different age groups.

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