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Physicochemical Properties of Human Hair using Fourier Transform Infra-Red (FTIR) and Scanning Electron Microscope (SEM)

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ABSTRACTS

This research work is to investigate the physicochemical properties of human hair. Data was obtained by analyzing human hair using Fourier Transform Infra-Red and Scanning Electron Microscope. Several results were obtained, including data on the chemical properties of human hair.

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1. INTRODUCTION

Hair is a protein filament that grows from the dermis' follicles. Hair is one of the distinguishing features of mammals (Erdoğan, 2017). Aside from patches of glabrous skin, the human body is covered in follicles that generate thick terminal and fine vellus hair. Hair is most commonly associated with hair development, hair types, and hair maintenance, but it is also an important biomaterial consisting mostly of protein, particularly alpha-keratin. Hair is often used to indicate a person's personal beliefs or social position, such as age, sex, or religion (Park *et al*., 2018). Attitudes toward different types of hair, such as hairstyles and hair removal, vary widely across cultures and historical periods, but it is frequently used to indicate a person's personal beliefs or social position, such as age, sex, or religion (MacFarlane *et al*., 2017).

Here, the purpose of this study was to investigate the physicochemical properties of human hair. Data was obtained by analyzing human hair using a Fourier Transform Infra-Red (FTIR) and a Scanning Electron Microscope (SEM). Several results were obtained, including data on the chemical properties of human hair.

2. METHODS

Human hair substrates were obtained from wastes, which are from different male individuals were collected from local barbers' shops. The human hair samples were mixed, washed with liquid detergent, rinsed several times with distilled/deionized water, and then left to dry at room temperature (25 ^{o}C). The hair was cut to an approximate length of 1–3 mm using scissors. This study analyzed human hair using FTIR and SEM analysis. In brief, the FTIR was used spectrometer (Germany) for analyzing human hair, and the spectra were recorded in the range of 600–4000 cm-1 with 16 scans and a resolution of 4 cm-1. For the SEM analysis, the human hair test sample was over-dried at 40^{o}C and scanned with SEM for observation of hair morphology. Hair samples were put on stubs and gold-sputtered. Images were collected on a JEOL JSM 5310 scanning electron microscope operating at 15 kV.

3. RESULTS AND DISCUSSION

Figure 1 shows the FTIR spectrum of human hair. The results showed several peaks, including peat at about 3200 cm-1, informing the OH component. Some peaks were found, informing some chemical bonding structures. The main peaks were obtained at 1650, 1400, 1250, 1100, 1030, and 950 cm-1. Based on Nandiyanto *et al.* (2019), the peaks possibly corresponded to:

(i) 1650 cm-1 is for Alkenyl C=C stretch, Primary amine, NH bend, Amide, Quinone or conjugated ketone, Open-chain imino (-C=N-), and Open-chain azo (-N=N-).
(ii) 1400 cm-1 is for Vinyl C-H in-plane bend and Phenol or tertiary alcohol, OH bend, Carboxylate (carboxylic acid salt), Organic sulfates, and Carbonate ion.
(iii) 1250 cm-1 is for skeletal C-C vibrations, Aromatic combination bands, Phenol, C-O stretch, Epoxy, and oxirane rings, Aromatic ethers, aryl -O stretch, Tertiary amine, CN stretch.
(iv) 1100 cm-1 is for Aliphatic fluoro compounds, C-F stretch, Secondary alcohol, C-O stretch, Alkyl-substituted ether, Cyclic ethers, large rings, Alkyl-substituted ether, Cyclic ethers, large rings, Aromatic phosphates (P-O-C stretch), Organic siloxane or silicone (Si-O-C), and Sulfate ion.
(v) 1030 cm-1 is for Alkyl-substituted ether, C-O stretch, Aliphatic phosphates (P-O-C stretch), and Phosphate ion.

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(vi) 950 cm-1 is for Vinyl C-H out-of-plane bend.

Figure 2 shows the SEM image of the human hair. The analysis of human hair using microscopes has been well-documented, such as reported by Putranto *et al*. (2014). The present results showed the hair has some fibers.

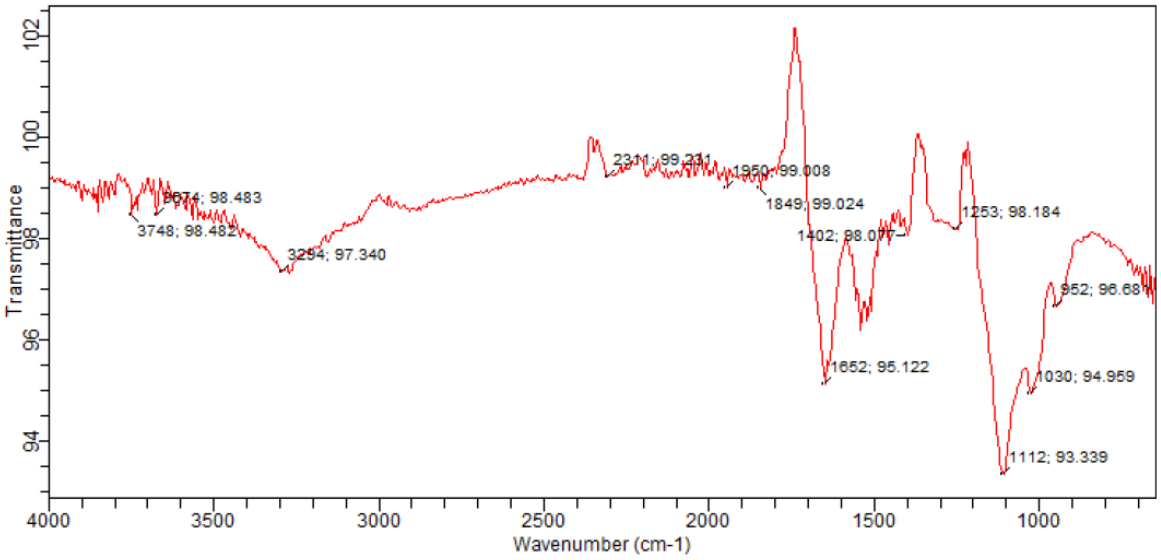

Figure 1. FTIR spectrum obtained for Human hair fiber samples alone**.**

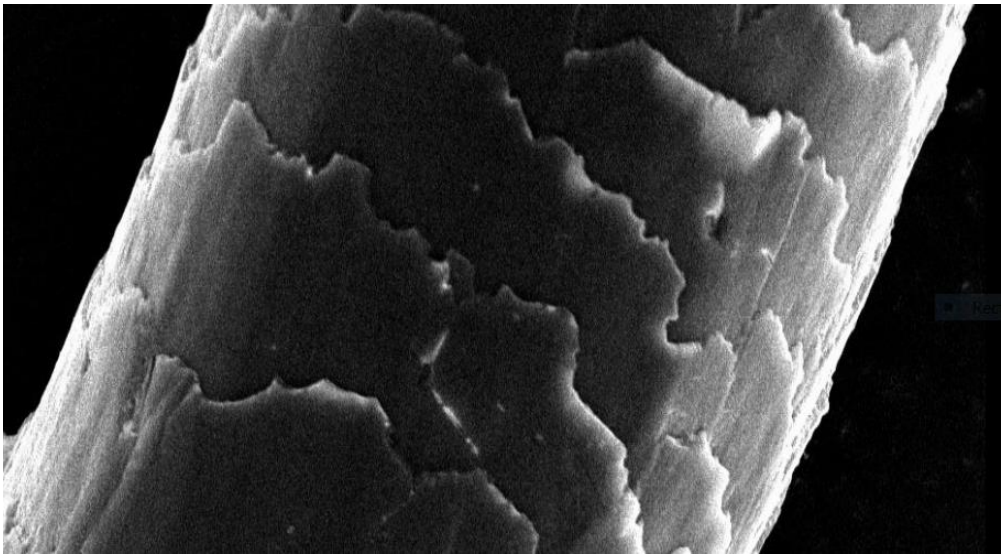

Figure 2. Scanning Electron Microscopy of Untreated Human hair fiber sample**.**

4. CONCLUSION

This study reported the physicochemical properties of human hair. Data was obtained by analyzing human hair using FTIR and SEM.

5. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

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