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〈Regular Article〉

Effects of Reductive and/or Oxidative Treatment during Permanent Wave Procedure on Human Hair Keratin Films

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Abstract

Human hair keratin films were used in order to examine the effects of reducing and oxidizing agents. Thioglycolic acid and sodium bromate were employed as reducing and oxidizing agents, respectively. The white and opaque appearance of the keratin films turned transparent as the concentration of thioglycolic acid increased. However, when followed by the oxidizing treatment, the keratin films returned to their original white and opaque appearance. According to SEM observation, the keratin films consist of fine granular and reticular structures. The SEM observation of the keratin films after the reductive treatment showed dissolution and disappearance of such structures. Furthermore, when the films received sodium bromate treatment after the reductive treatment, reticular and granular structures within the films were found apparently reconstructed. By the reductive treatment of thioglycolic acid, the weight of the keratin films decreased. Electrophoretically, proteins with molecular mass of 10–30 kDa and approximately 90–120 kDa (about 94 kDa) were contained in the eluate after the reductive treatment. When comparing the time course of protein elution between human hair samples and keratin films by thioglycolic acid, the keratin films within a short period of time had the higher concentration of proteins eluting from them than hair samples. According to the calculation, proteins had eluted from the films by 2000–3000 times faster than from human hair samples, proving the high sensitivity of the films. Moreover, the FT-IR measurement of the keratin film was effective for detecting the formation of cysteic acid as an indicator of hair damage by permanent wave process. The keratin films exhibited reactivity as human hair to the reducing agent and oxidizing agent used in permanent wave treatment. Furthermore, keratin films indicate uniformity in structure, whereas human hair has complex and multilayered structure, consisting of cuticle, cortex, and medulla. We expect that the use of the keratin films can make the measurement of hair damage caused by permanent wave treatment easier and more convenient.

Key words: human hair keratin film, reduction and oxidation, permanent wave, keratin associated protein, keratin.