PHOTO-DAMAGE OF HUMAN HAIR

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Abstract

The paper presents understanding of photo damage to human hair and the processes suggested in the literature for photodegradation. It can be seen that in this problem there are still a number of unanswered issues. For instance, there is still a lack of a clearer knowledge of the hair structural modifications induced by various wavelengths of radiation. Reasons to these concerns are often supported on the quantity and type of melanin in each hair, but variables such as the lack of understanding of melanin structure and proven methodologies for human hair research make it hard to achieve a general agreement on these problems.

Key words: human hair, photo damage, hair structure, melanin.

Introduction

Ultraviolet and visible radiation is well known to harm hair[1]. Sun radiation creates dryness, decreased strength, rough surface texture, color loss, decreased luster, stiffness, fragility, and a dull, unhealthy general hair appearance[2]–[4]. Although, there is little knowledge of biochemical and photochemical changes due to radiation exposure in hair compared to other research fields. The scientific studies usually deal with observations of physical changes due to exposure to radiation[5], [6], but do not demonstrate the hair photo-degradation mechanism.

Structure of Human Hair

The human hair fiber consists primarily of keratins, a class of helicoidal protein complexes containing insoluble cystine that account for 65–95 percent of the hair by weight. Water, lipids, pigment, and trace elements are the remaining constituents. The hair shaft's largest mass is in the cortex, where crystallized a-keratin fibrils are accountable for the notable mechanical characteristics of hair. Another hair fiber component is the medulla, the function of which is not well defined and generally only a small percentage of the fiber mass. The medulla may be totally absent, or along the fiber axis it may be constant or discontinuous. Human hair can be regarded as

a structure of two parts in terms of its interaction with visible and UV radiation. In the visible area of the light spectrum, keratins are transparent, but some amino acids, tryptophan, cystine, tyrosine, and histidine communicate with UV. Melanin, which is in the cortex only, communicate with visible and UV radiation. Approximately 97% of the hair mass, primarily absorbs UVB radiation and 3% absorbs UVA, UVB, and visible radiation.

Effects of Photo degradation

The human hair, if exposed to sunlight over a prolonged period of time, can be harmed in various ways. In most scenarios, the amino acids of the cuticula are altered to a greater extent than those of the cortex because the outer layers of the fiber receive higher radiation intensities. This exposure can cause rupture and detachment of the outer layers, leading to the splitting of the outer layers. With respect to physical measurements associated with hair fiber strength and integrity, UV radiation reduces stress-to-break, Young's module and dynamic contact angle and improves wet-combing force, copper absorption and hair fiber transverse swelling.

From the hair spectrum, acquired through diffuse reflectance spectrophotometry (DRS)[7], we noted that each hair sort displays a specified reflectance pattern, i.e. Fig. 1, which significantly changes after hair irradiation. Both loss of protein and modifications in color depend on the type of hair.

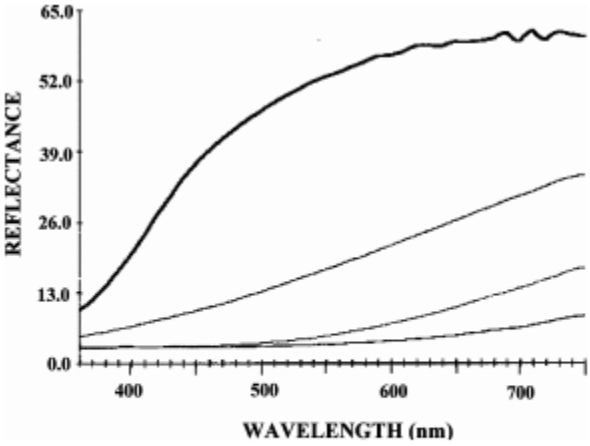

Fig. 1 Human hair diffuse reflectance spectra. From top: white, blond, brown and red hairs. Spectra change substantially when hair is exposed to sun radiation. Modifications are not attributable to melanin photodegradation only.

Conclusion

The absence of satisfactory knowledge of hair structure and most of all, hair variability, makes its study a difficult subject. This is aggravated by the lack of conventional methodologies for human hair studies. Color modifications, protein loss, and changes in mechanical properties are the primary parameters analyzed in hair UV damage evaluation.

References

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