UV Damage of the Hair

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ABSTRACT

Hair is a very important for our self-confidence as well as a very important part of appearance and self-concept. It reflects our personality and hair loss or hair damages are considered aesthetic imperfections and social handicap. Outward part of the hair is a »hair shaft« keratin fiber structure sensible to external effects whether they are mechanical, physical or chemical. Excessive sun exposition is the most frequent cause of hair shaft’s structural impairment. Photochemical impairment of the hair includes degradation and loss of hair proteins as well as degradation of hair pigment. Hair protein degradation is induced by wavelengths of 254–400 nm. UVB radiation is responsible for hair protein loss and UVA radiation is responsible for color changes. Absorption of radiation in photosensitive amino acids of the hair and their photochemical degradation is producing free radicals. They have adverse impact on hair proteins, especially keratin. Melanin can partially immobilize free radicals and block their entrance in keratin matrix. It also absorbs and filters adverse UV radiations. Therefore melanin is important for direct and indirect protection of hair proteins. Protecting the cuticle is very important for keeping hair shaft’s integrity. One can achieve that by avoiding noxious impacts or by implementation of hair care products with UV filters. Nowadays major studies and researches are conducted in order to create hair care products that prevent hair damage.

Key words: hair, UV radiations, free radicals, hair care products

Introduction

Hair has a great social significance for human beings. It is a very important for our self-confidence as well as a very important part of appearance and self-concept. It reflects our personality and hair loss or hair damages are considered aesthetic imperfections and social handicap. Outward part of the hair is a »hair shaft« keratin fiber structure sensible to external effects whether they are mechanical, physical or chemical. Photo ageing of the skin is nowadays very explored and researched domain by scientists and large pharmaceutical companies who are producing more and more advance-technology anti-age cosmetics. In recent times attention is directed also on photo ageing of the hair and major studies and researches are conducted in order to create hair care products that prevent hair damage.

Hair Structure

Hair is composed of heavily melanized keratin fibers. Keratin is insoluble protein complex that forms 65% to 95% of hair fiber volume. It is consisted of amino acids bounded with all sorts of bounds (amid, disulfide, hydrogen, ionic and hydrophobic)1. Amid bounds are strongest and they can be broken only by impact of very strong acids and alkalis or by cutting. Once broken, they can never be restored. Central part of the hair (medulla) is surrounded with cortex – the greatest mass of the hair shaft. The melanin granules are located inside the cortex and constitute 3% of hair fiber volume. There are two types of melanin: eumelanin (dark-brown pigment) and pheomelanin (red pigment)1. Type, size, amount and distribution of melanin granules inside the cortex as well as thickness of hair shaft and content of air in hair shaft, es-
tablish hair color. Cortex is surrounded with cuticle, protective layer of overlapping keratinized scales that constitute 10% of hair fiber volume. Cells of cortex and cuticle are bonded with structural lipids. Hair shaft is also consisted of other proteins (17%) and minerals (0.5%)\(^2\).

**Hair Damage Caused by Ultraviolet Radiation**

All adverse external impacts that are causing degeneration of hair are called «weathering» by Rook and his associates. Excessive sun exposition is the most frequent cause of hair shaft’s structural impairment. Dryness, reduced strength, rough surface texture, loss of color, decreased lustre, stiffness and brittleness of hair are caused by sun exposure\(^3\). UVB radiation maintains in cuticle area, while UVA radiation passes through cuticle and penetrates to cortex. Photochemical impairment of the hair includes degradation and loss of hair proteins as well as degradation of hair pigment. Hair protein degradation is induced by wavelengths of 254–400 nm\(^2\). UVB radiation is responsible for hair protein loss and UVA radiation is responsible for color changes\(^2,3\). Amino acids cystine, methionine, tryptophan, tyrosine and histidine are the most submissible to photochemical degradation. Ultraviolet radiation is causing oxidation of afore-mentioned amino acids as well as oxidation of the amid carbon of polypeptide chains\(^2\). These reactions are giving yellowish tone to the hair; which is called «photeyellowing»\(^5\). The amino acids of the cuticle are altered to a greater extent than those of the cortex because the outer layers of the fiber receive higher intensities of radiation\(^5\). This exposure can cause rupture and detachment of the external layers resulting in splitting of the ends. Portion of certain amino acids depends on the type of hair. Dark and black hair has more photosensitive amino acids (for example cystine) than fair hair\(^2,5\). Therefore dark and black hair has more photosensitive amino acids as well as oxidation of the amid carbox of polypeptide chains\(^2\). These reactions are giving yellowish tone to the hair, which is called «photeyellowing».\(^5\) The amino acids of the cuticle are altered to a greater extent than those of the cortex because the outer layers of the fiber receive higher intensities of radiation\(^5\).

Increased exposition to sunlight also causes disappearance of very enhanced or decreased humidity. Melanin associated. Excessive sun exposition is the most frequent cause of hair shaft’s structural impairment. Dryness, reduced strength, rough surface texture, loss of color, decreased lustre, stiffness and brittleness of hair are caused by sun exposure\(^3\). UVB radiation maintains in cuticle area, while UVA radiation passes through cuticle and penetrates to cortex. Photochemical impairment of the hair includes degradation and loss of hair proteins as well as degradation of hair pigment. Hair protein degradation is induced by wavelengths of 254–400 nm\(^2\). UVB radiation is responsible for hair protein loss and UVA radiation is responsible for color changes\(^2,3\). Amino acids cystine, methionine, tryptophan, tyrosine and histidine are the most submissible to photochemical degradation. Ultraviolet radiation is causing oxidation of afore-mentioned amino acids as well as oxidation of the amid carbon of polypeptide chains\(^2\). These reactions are giving yellowish tone to the hair; which is called «photeyellowing».\(^5\) The amino acids of the cuticle are altered to a greater extent than those of the cortex because the outer layers of the fiber receive higher intensities of radiation\(^5\). This exposure can cause rupture and detachment of the external layers resulting in splitting of the ends. Portion of certain amino acids depends on the type of hair. Dark and black hair has more photosensitive amino acids (for example cystine) than fair hair\(^2,5\). Therefore dark and black hair has more photosensitive amino acids as well as oxidation of the amid carbox of polypeptide chains\(^2\). These reactions are giving yellowish tone to the hair, which is called «photeyellowing».\(^5\) The amino acids of the cuticle are altered to a greater extent than those of the cortex because the outer layers of the fiber receive higher intensities of radiation\(^5\).

**Hair Care**

Protecting the cuticle is very important for keeping hair shaft’s integrity. One can achieve that by avoiding noxious impacts or by implementation of hair care products with UV filters\(^8\). Physical and chemical filters achieve protection from UVA and UVB radiation\(^10\). Physical filters are surface protectors that are reflecting ultraviolet rays of all wavelengths\(^10,11\). Most common physical protectors are titanium dioxide and zinc oxide. Chemical filters are preventing penetration by absorbing UV rays\(^12\). The best filter with wide spectrum is benzophene\(^13\). UVB photo filters, such as octyl methoxy cinnamate, absorb less than 25% of the total UV irradiation at concentrations as high as 30 mg/g hair\(^14\). UVA absorbers were found to be more effective, with benzophenone-3 and benzophenone-4 absorbing about 40% of UV at the same concentration\(^13,14\). The UV filters represent a first defense line aimed to reduce the amount of UV radiation that reaches the hair structure\(^14,15\). Antioxidants constitute a second defense line by reducing the amount of free radicals generated inside the hair\(^16\). UVB filters are more efficient than UVA filters to avoid the free radical production in hair\(^16\). Antioxidants have to penetrate into the hair structure and must interact with the melanin polymer to be efficient\(^16\). The encapsulation in suitable carrier systems (for example liposomes) enhances the penetration capacity of actives into the hair and protects the antioxidants against oxidation\(^16\).

### REFERENCES

OŠTEĆENJE KOSE UV ZRAKAMA

S A Z E T A K