

Chemical Danger in Hair Keratin Care

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Abstract – Hair, whose main function is to protect the head from cold, heat and impacts, has been a measure of beauty and elegance in people, especially women, for centuries. When we look at the structure of hair, it is an integrated system with its own chemical and physical behavior. It can wear out and fall out over time and various environmental effects. There are many different formulations and types of products available for hair care. One of these is hair keratin care applied to damaged, thin, dull or curly hair. This treatment, also known as Brazilian blow-dry, is a treatment that ensures that wavy and curly hair remains straight for months and has a lively, smooth, shiny and silky appearance. Most of these products, which are widely used in practice, contain formaldehyde or its derivatives and are marketed as safe. In animal and human studies, short-term exposure to formaldehyde can cause erythema, itching and burning eyes, runny and stuffy nose, loss of appetite, nausea, vomiting and confusion, while long-term exposure can cause contact dermatitis, congenital defects such as low birth weight and isolated heart disease, cytotoxicity in the respiratory tract in the form of acute lung injury, nasal congestion, pulmonary edema and cancer. Everyone, especially members of the profession, should be more aware of this issue. Safety assessment of hairdressing products should take occupational exposure into account and should not focus solely on consumer safety. Inspection of such products and hairdressers in the market should be ensured.

Keywords – Hair Keratin Care, Brazilian Blow-Dry, Formaldehyde, Hairdresser, Health Risks

I. INTRODUCTION

Living things are naturally covered in order to be protected from external factors in natural life. The hair covering their bodies is dense in some species and less in others, depending on the species. In the human body, hair is an aesthetic element. Hair, whose main function is to protect the head from cold, heat and blows, has been used for centuries to beautify and change human beings, and has been cut, combed, gathered, braided, and dyed in colors other than its own color in various ways according to the unique fashion and understanding of beauty of each period. Hair has been a measure of beauty and elegance for centuries, especially for women.

II. HAIR STRUCTURE

When we look at the structure of the hair, it is an integrated system with its own unique chemical and physical behavior. There are no nerve endings in it,

but it is fed by blood vessels from the roots. The part of the hair under the skin is alive. Since nerve endings are connected to the root of the hair shaft, we feel through the nerves when our hair is pulled or straightened. Hair consists of three layers. Medulla, cortex and cuticle from the inside out. The medulla runs along the middle of the hair shaft like a wick. Towards the tip of the hair shaft, the marrow cells become sparse. The marrow layer contains soft spongy honeycomb-like cells and air spaces. The medulla is present in hard hair such as gray hair, thick hair and beards, but is absent in the fine hair of children. The cortex is the hardest and most important part of the fiber layer, where 80% of all cells in the hair are collected. It forms the basic internal structure and gives the hair its elasticity. The cuticle is the outer protective covering of the hair, it is a chemically resistant area and consists of overlapping scales (keratinocytes). It is colorless

and transparent. Although this layer is composed of very durable keratin, it can be worn and shed over time due to the effects of weather, combing, brushing and chemical treatments [1]–[3].

A. Keratins

Keratin is one of the most abundant proteins in the body of mammals, birds and reptiles. It is a structural component of wool, nails, horns and feathers and provides durability to the body [4]. It is mainly found in epithelial cells of higher vertebrates [5]. With the development of urbanization, food industries, especially the meat market, slaughterhouse and wool industry, produce millions of tons of keratin-containing biomass. Major producers include the USA, Brazil and China, which produce over 40 million tons per year [6], [7].

Keratins are cysteine-rich proteins associated with intermediate filaments, which are cytoskeletal elements with a diameter of 8-10 nm [8]. They are mainly found in two forms, α - and β -keratins. α -keratins are abundant in soft tissues such as sheep wool, skin and hair. They are rich in cysteine and contain smaller amounts of the amino acids hydroxyproline and proline. However, β -keratins are found in hard tissue proteins of bird feathers, fish scales, nails and others. They are rich in alanine and glycine and poor in cysteine, hydroxyproline and proline [9]. Chemically, keratins are highly stable and insoluble in most organic solvents. The abundance of cysteine makes keratin susceptible to hydrolytic and oxidation reactions [10]. The high cysteine content is a unique feature that distinguishes keratin from other structural proteins such as collagen and elastin. The main amino acids found in keratin are cysteine, glycine, glycine, proline, serine and low amounts of lysine, histidine and methionine are also present [11], [12].

III. HAIR KERATIN TREATMENT

Hair is one of the most important aesthetic and beauty elements for women. Similar to skin care, women are extremely sensitive about their hair. There are many different formulations and types of products available for hair care. One of them is hair keratin care applied to damaged, thin, dull or curly hair. Brazilian blow-drying is known by many names such as Brazilian Keratin Treatment-BKT, hair straightening with albumin, hair botox. Brazilian blow-drying is an application that allows wavy and curly hair to remain straight for months

and long periods of time and to have a vibrant, smooth, shiny and silky appearance [13]. Brazilian keratin treatments are widely available products used by women all over the world to straighten hair. Hydrolyzed liquid keratin rapidly penetrates the cortex of the hair and reacts with the keratin of human hair. The formaldehyde released during heating helps to fix the hydrolyzed keratin to the hair's natural keratin [14]. This creates a waterproof film around the hair and seals the cuticles, enhancing the shine and smoothness of virgin and bleached hair. It is formaldehyde that allows hair to retain keratin for a long time [15], [16]. Many of these widely used products contain formaldehyde or its derivatives and are marketed as safe. The use of formaldehyde formulations in hair care products has become very popular since 2003 and the first country to start this practice was Brazil in Rio de Janeiro. Brazil has been the place where this hair treatment has spread around the world. The practice soon became so popular that it attracted the attention of Brazilian health inspection agencies [ANVISA], which banned the use of any product containing formaldehyde in concentrations above 0.2% in cosmetics and 5% in nail polish. Formaldehyde was subsequently replaced by glutaraldehyde, a potentially 10 times more mutagenic and neurotoxic product belonging to the same aldehyde group. Easily available on the market, glutaraldehyde was often used as a sterilizer. Soon it was no longer a homemade product but a semi-industrialized, illegal substance commercialized in every salon in Brazil [17]- [19].

IV. DANGER IN HAIR KERATIN TREATMENT: FORMALDEHYDE

Formaldehyde (CH_2O) is a chemical produced in large quantities catalytically by the vapor-phase oxidation of methanol and is a highly toxic, flammable gas, slightly heavier than air and detectable at low concentrations [20]. Currently, formaldehyde is commercially available as formalin containing 37% by weight or 40% by volume of formaldehyde gas in water [21]. Formaldehyde is an important chemical for the global economy, widely used in construction, woodworking, furniture, textiles, carpeting and chemical industries. Although formaldehyde is a natural metabolic product of the human body, high-dose exposure increases the risk of acute poisoning, while long-term exposure can lead to chronic toxicity and even

cancer (IARC, 2006) [22]. Before 1990, occupational exposures in the chemical and timber industries and in anatomy and pathology laboratories were the major sources of formaldehyde exposure. Recently, however, exposure from newly remodeled homes, offices, public places, food, fabrics, carpets and even ambient air in large cities has increased dramatically. Formaldehyde levels between 0.1 and 0.5 parts per million (ppm, approximately 0.12-0.6 mg/m³) can be detected by human senses, 0.5 to 1.0 ppm (0.6-1.2 mg/m³) can cause eye irritation, and over 1.0 ppm (1.23 mg/m³) can irritate the nose and throat (NICNAS, 2006). Possible routes of exposure to formaldehyde are inhalation, ingestion and dermal absorption [23].

Formaldehyde is a known irritant and carcinogenic lining tissue that can cause a direct systemic threat to humans and other animals. Animal and human studies have suggested that short-term exposure to formaldehyde causes erythema, itching and burning eyes, runny and stuffy nose, loss of appetite, nausea, vomiting and confusion. The occupational health hazards of formaldehyde are primarily due to its toxic effects after inhalation, after direct contact of formaldehyde in liquid or vapor form with the skin or eyes, and after ingestion. Prolonged exposure to formaldehyde can cause contact dermatitis, congenital defects such as low birth weight and isolated heart disease, respiratory cytotoxicity in the form of acute lung injury, nasal congestion, pulmonary edema and cancer. However, the effects of formaldehyde on asthmatics may be due to previous repeated exposure to formaldehyde [24]-[26].

While studies on rats and mice show that formaldehyde exposure between 3 ppm and 400 ppm has effects on reduced food and water intake, decreased body weight, gastrointestinal effects, liver and kidney, In human and animal models, concentrations above 6 ppm have been shown to cause nasal and eye irritation, throat irritation, decreased respiratory function body weight, increased allergic responses, neurological effects [affecting neuronal morphology, behavior, disturbances in biochemical parameters and cerebral oxidative damage [27].

Formaldehyde inhalation causes various damages to many organs of the living body, including the testes, brain and liver [28]- [30]. Several studies

have shown that long-term occupational exposure to airborne formaldehyde leads to more cases of nasal and throat cancer, while research on laboratory rats exposed to airborne formaldehyde for a lifetime revealed that some rats only developed nasal cancer. Formaldehyde has been found to have a species-specific effect, and humans are more prone to developing cancer due to formaldehyde exposure [20]. Studies have shown that humans are more sensitive to indoor and outdoor air pollutants and respond to low doses of inhaled chemicals such as formaldehyde. Nasal biopsies of workers with more than five years of occupational exposure to formaldehyde showed a higher degree of metaplastic changes, epithelial dysplasia, recurrent nosebleeds and nasal stenosis [31]. This is a long-term effect and indicates that formaldehyde may be potentially carcinogenic to humans.

In BKT applications, the presence of formaldehyde in solutions containing keratin above certain ratios may pose a health risk. Formaldehyde is a chemical that is restricted for use in cosmetic products and can be found in products for preservative purposes at a maximum of 0.2%. Formaldehyde is recognized as a carcinogen by major cancer agencies. In addition to its long-term carcinogenic effects, formaldehyde entering the body through inhalation can cause throat and eye burns and respiratory complaints. In some states in the US, Canada and the European Union, the practice known as Brazilian Blow-drying, which contains high levels of formaldehyde, is banned, but studies by Galli et al. [32] focus on EU countries and show that a large proportion of the materials used in the market contain formaldehyde either above or very close to threshold values. The study by Pierce et al. [33] shows that the formaldehyde concentration is 11.5% in Brazilian Blowout products, 8.3% in Global Keratin products, 3% in Coppola products, while BKT and similar products sold in the USA and various other countries with the label "formaldehyde free" contain unacceptably high levels of formaldehyde (up to %11) In a report prepared by the Center of Disease Control in the USA [34], the results of a field study conducted in a hair salon in Ohio are reported, and it is shown that almost 11% of the products sold as formaldehyde free contain this substance, posing very serious risks. Maneli et al. [35], in a study conducted in South Africa, another country where this technique is widely used, revealed the health hazards of the

materials used in Brazilian Blow Drying, while Lorenzini [36], in a study conducted in Porto Alegre, examined the perceptions of hairdressers on the hazards of formaldehyde and found that negligence and ignorance of the dangers were generally noted. The study by Hammam et al. [37] focused on the city of Zagagig in Egypt, mentioned the genotoxic (a substance that can cause mutation or cancer by affecting DNA) factors of the materials used in hairdressers and beauty salon workers, and stated that the risk of occupational diseases in hairdressers due to the chemicals they use is higher than in many other sectors and that occupational health and safety measures are inadequate.

V. CONCLUSION

Safety assessments of hair products are mainly aimed at consumers, but the exposure of professional hairdressers who perform these procedures on a regular basis may be significantly higher. These data suggest that regulations for these chemicals in hair salons need to be improved. Awareness needs to be raised by everyone, especially members of the profession. Safety assessments of hairdressing products should take occupational exposure into account and not focus solely on consumer safety. Inspection of such products and hairdressers in the market should be ensured.

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