MILBON

News Release

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Milbon Finds Curly Hair Has Weak Cuticle Adhesion and Low Hair Strength

-Microscopic Observation of Hair Structure for Hair Types Around the World by Inborn Curl Shape-

Milbon Co., Ltd. (head office: Chuo-ku, Tokyo; President and CEO: Hidenori Sakashita), a manufacturer of salon-exclusive haircare products and cosmetics, observed at the microscopic level the hair microstructure of different hair types around the world, classified according to their inborn curl shape. As a result, we found that curly hair has weaker cuticle adhesion and lower hair strength than straight hair. We also confirmed that the amount of glycoprotein[*1], which is believed to contribute to cuticle adhesion, was low. The results of this study were presented at the following academic conference.

[Presentation]

Academic conference: 21st IUPAB Congress

Title of presentation: Differences in microstructural changes during tensile deformation between hair shapes

Date of presentation: June 27, 2024

[Research Background]

There are many different hair shapes in the world, including straight and strongly curled hair. Hair types can be classified according to their inborn curl shape and are referred to as straight hair, wavy hair, curly hair, and coily hair, in order from weakly curled to strongly curled hair (Figure 1).

Straight and wavy hair is common in Japan and other Asian regions, while many people in North America and Africa have curly and coily hair. It is known empirically that these strongly curled hairs are more susceptible to physical stresses such as tangling and pulling due to their shape, and are more prone to damage phenomena such as hair breakage and split ends.

In this study, we investigated the differences in hair microstructure between straight and curly hair in order to grasp the causes of damage in curly hair, with the aim of establishing effective damage care methods for a wider range of hair types around the world.

Figure 1. Hair types

[Study Findings]

1. Curly hair found to have weak cuticle adhesion and low resistance to physical stress

We investigated the resistance of curly hair to stretching, noting that curly hair is susceptible to physical stresses such as tangling and pulling. The investigation revealed that curly hair is less resistant than straight hair (Figure 2). To determine what features of the hair microstructure are responsible for this low resistance, we observed both the surface and interior of stretched hair using laser scanning microscopy[*2] and X-ray CT measurements[*3] at SPring-8[*4]. This revealed that curly hair tends to have gaps between cuticles on the outermost surface and between the cuticle and the hair interior as it is stretched (Figure 3). This indicates that cuticle adhesion is weaker in curly hair than in straight hair, leading to the low resistance to stretching.

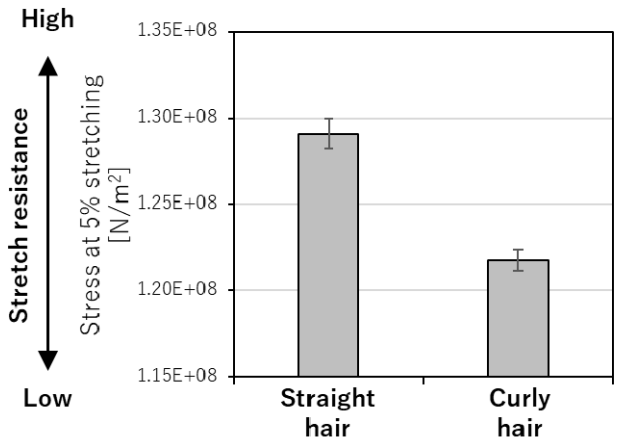

Figure 2. Resistance to stretching
Curly hair was less resistant than straight hair in the resistance evaluation based on the force required to stretch the hair lengthwise.

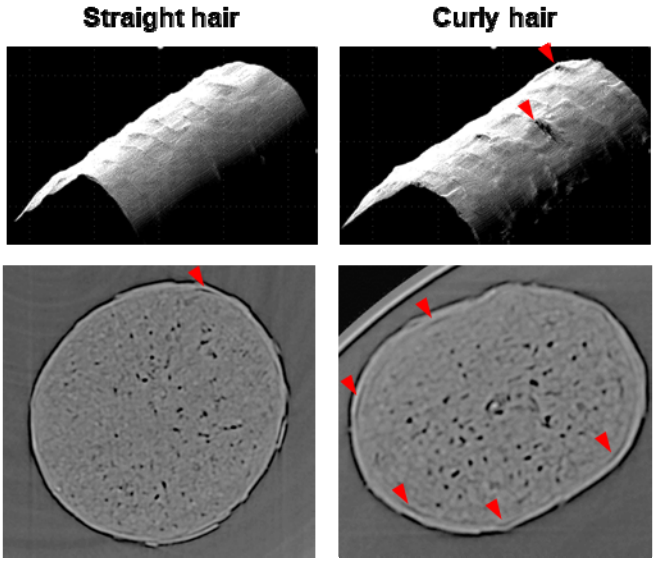

Figure 3. Microstructure of stretched hair (upper row: hair surface, lower row: hair interior)
Red marks indicate areas of cuticle lifting.

2. Curly hair found to have less glycoprotein that contributes to cuticle adhesion

A structure called cell membrane complex (CMC) exists between cuticles and between the cuticle and the hair interior, and glycoprotein contained in CMC is thought to contribute to the adhesion of cuticles and other structures (Figure 4). We measured the amount of glycoprotein in hair and found that curly hair contains less glycoprotein than straight hair (Figure 5).

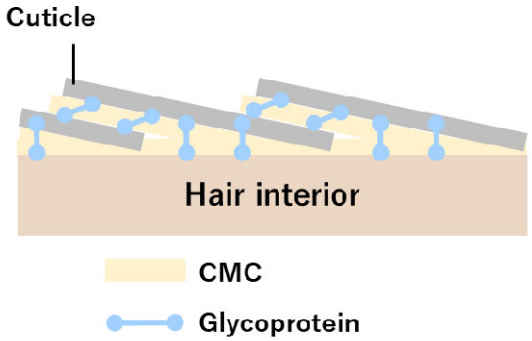

Figure 4. Image of adhesion between hair microstructures

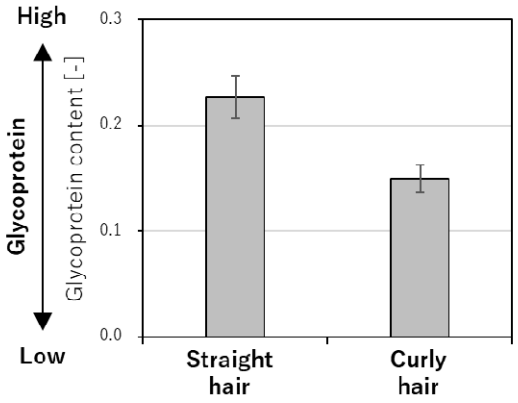

Figure 5. Difference in glycoprotein content between hair types

[Future vision]

We will use this study toward the development of hair care products that effectively repair curly and coily hair that is prone to damage and allow people to continue to enjoy their ideal hair in their own way. Milbon will continue to research various hair types and beauty behaviors around the world to develop products for the global market.

«Terminology»

*1 Glycoprotein

Proteins with glycans attached to some amino acid residues.

*2 Laser scanning microscopy

Technology that can capture the surface structure of an object in a non-destructive manner. Microscopic observation using a single-wavelength laser beam and confocal optics enables detailed three-dimensional observation of an object's surface profile.

*3 X-ray CT measurement

Technology that can capture the internal state of an object in a non-destructive manner. In this study, X-ray CT measurement using the world's most powerful synchrotron radiation at the

BL24XU beamline of SPring-8 have enabled us to precisely capture the internal microstructure of hairs. Part of this study was conducted as part of the General Proposal for Industrial Applications 2023B3264 at the Japan Synchrotron Radiation Research Institute (JASRI).

Milbon has captured the internal microstructure of hair with this measurement technique in the past.

*4 SPring-8

SPring-8 is a large synchrotron radiation facility which delivers the most powerful synchrotron radiation currently available. Consisting of narrow, powerful beams of electromagnetic radiation, synchrotron radiation is produced when electron beams, accelerated to nearly the speed of light, are forced to travel in a curved path by a magnetic field. The research conducted at SPring-8, located in Harima Science Park City, Hyogo Prefecture, Japan, includes nanotechnology, biotechnology and industrial applications. The name "SPring-8" is derived from "Super Photon ring-8 GeV" (8 GeV, or 8 giga electron volts, being the energy of electron beam circulating in the storage ring).

Reference: SPring-8 website（http://www.spring8.or.jp/en/about_us/whats_sp8/）

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