News Release
Kao Corporation

Kao
Kirei–Making Life Beautiful

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FOR IMMEDIATE RELEASE

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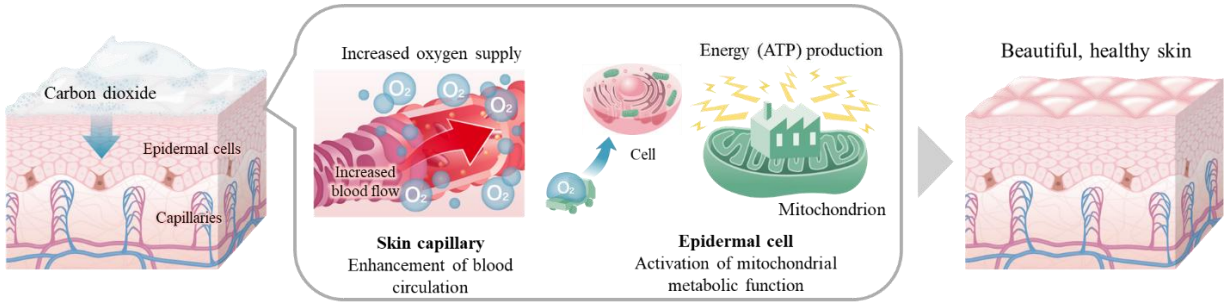
Mechanism by Which Enhanced Blood Circulation Activates Epidermal Cells Newly Confirmed in Human Skin

The Dilation of Capillaries and the Supply of Oxygen Stimulate Mitochondrial Metabolic Function

Kao Corporation's Skin Beauty 1 Products Research and Analytical Science Research have successfully demonstrated, in human skin, that application of a carbon dioxide-containing composition dilates capillaries to promote blood circulation, and thereby activates mitochondrial metabolic function in epidermal cells, which are responsible for producing energy. It is anticipated that increasing mitochondrial metabolic function in epidermal cells will prove to be an important step in achieving beautiful, healthy skin.



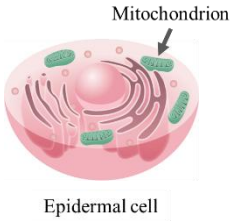
The effects of enhanced blood circulation on epidermal cells (diagram)

Some of the results of this research will be presented at the 103rd Annual Meeting of the Physiological Society of Japan (March 10–12, 2026, Tokyo).

Background

It has been said that promoting blood circulation improves skin condition, and Kao had already discovered, through research into the condition and function of capillaries, that there is indeed a relationship between blood circulation and epidermal skin condition. However, the mechanism by which enhanced blood circulation causes changes in the skin cells, or exactly what those changes are, had not been fully elucidated.

It is known that when carbon dioxide penetrates the skin, it dilates capillaries and promotes blood circulation. Kao therefore considered whether increasing the oxygen supply to epidermal cells by capillary dilation might change the metabolic state of the mitochondria and have a positive effect on actual cell function. Based on this hypothesis, Kao conducted the present study, in which a carbon dioxide-containing composition was used as a means of promoting blood circulation, and the composition was tested on human skin.



Establishment of a technology for highly accurate evaluation of the mitochondrial metabolic state of epidermal cells in human skin

To test this hypothesis, Kao needed measurement technology capable of assessing the metabolic state of the mitochondria in epidermal cells of living human skin. Kao therefore focused on autofluorescence spectral analysis, which utilizes the natural fluorescence present within cells. When cells use oxygen to produce energy (adenosine triphosphate, ATP), the activity of the mitochondria changes. These changes appear as oxidation-reduction reactions of substances involved in energy metabolism, and it is known that autofluorescence characteristics also change accordingly. Kao has utilized this property to develop a technology for evaluating the energy state of cells in human skin using autofluorescence as an indicator.

Specifically, by optimizing conditions when taking measurements with confocal fluorescence microscopy and building a deep learning model to automatically extract cells from the stratum spinosum, Kao was able to reliably acquire autofluorescence spectral data and establish a method for highly accurate evaluation of the mitochondrial metabolic state of epidermal cells in human skin.

Enhancement of mitochondrial metabolic function in epidermal cells through the application of a carbon dioxide-containing composition is confirmed in human skin

In October 2025, Kao conducted a test on seven Japanese men and women in their 30s and 40s, in which a carbon dioxide-containing composition capable of maintaining a high concentration of carbon dioxide gas was applied to the inside of their forearms for two minutes. Before application, and for up to ten minutes after the composition was removed, the autofluorescence spectra of the epidermal cells were acquired over time and analyzed. The results confirmed that application of the carbon dioxide-containing composition enhanced mitochondrial metabolic function*[1] compared with a carbon dioxide-free composition (Figure 1).

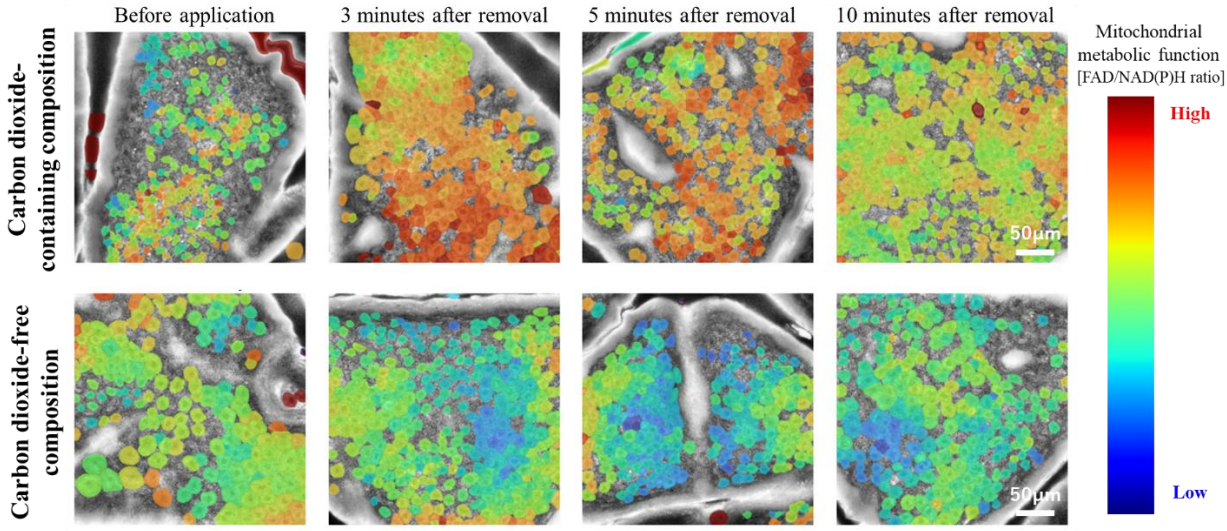


Figure 1. Changes in mitochondrial metabolic function in epidermal cells of living human skin

By using Kao's technology for automatic visual extraction of the capillary region*[2] to analyze the state of the

capillaries during these changes, Kao has confirmed that capillary dilation and mitochondrial metabolic function activity are linked, which suggests that enhanced blood circulation has a positive effect on cellular metabolism.

*1 A state in which the oxidative phosphorylation process, which produces more energy from the same amount of nutrients, becomes more active, resulting in increased energy production efficiency.

*2 Kao News Release, August 2, 2019

Kao: Confirming the links between skin condition and regulation of capillary blood flow: An image analysis technology to visualize capillaries in facial skin

In order to verify this mechanism, Kao cultured human epidermal keratinocytes in environments having different oxygen concentrations, and analyzed their autofluorescence spectra. The results confirmed that mitochondrial metabolic function improves with increasing oxygen concentration (Figure 2). This suggests that the enhancement of mitochondrial metabolic function in epidermal cells observed when a carbon dioxide-containing composition is applied to human skin is due to increased oxygen supply resulting from capillary dilation.

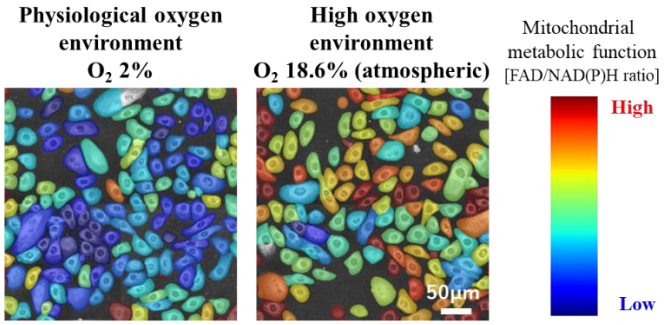


Figure 2. Changes in mitochondrial metabolic function in cultured human epidermal keratinocytes

Summary

Utilizing the knowledge it has amassed through its dermatological research, Kao has now established a new evaluation technology for visualizing the state of mitochondrial metabolism in epidermal cells in human skin, and has demonstrated that promoting blood circulation by applying a carbon dioxide-containing composition enhances mitochondrial metabolic function in epidermal cells. The results of this research support the idea that "good blood circulation improves skin condition" at the cellular level. Kao will continue to investigate the multifaceted effects of carbon dioxide on skin, and deepen its research into the relationship between capillary blood flow and beautiful, healthy skin.

About Kao

Kao, a Japan-based manufacturer of personal care and household products, cosmetics, and specialty chemicals creates high-value-added products and services that provide care and enrichment for the life of all people and the planet. Through its brands such as *Attack* laundry detergent, *Bioré* and *Jergens* skin care products, *Laurier* sanitary products, *Curél*, *SENSAI*, and *MOLTON BROWN* cosmetics, and *Oribe* hair care products, Kao is part

of the everyday lives of people across Asia, the Americas, Europe, the Middle East, and Africa. Combined with its chemical business, which contributes to a wide range of industries, Kao generates about 1,630 billion yen in annual sales. Kao employs about 32,600 people worldwide and has more than 130 years of history in innovation. As an enterprise that provides products people use on a daily basis, the Kao Group takes responsibility to actively reduce the environmental footprint of its products throughout the product lifecycle. This is laid out in Kao's ESG strategy, the Kirei Lifestyle Plan, which launched in 2019.
Please visit the Kao Group website for additional information.

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