

Shiseido develops innovative technology to convert ultraviolet light into light that brings about beneficial effects on the skin

A new idea for positive coexistence with the environment,
and creating beauty from the wealth it provides.

Shiseido developed an innovative technology to convert ultraviolet light, which has been considered to have deleterious effects on the skin, into visible light ('skin-beautifying light') that is capable of exerting a favorable influence on the skin –technology that leads to achievement of beauty while promoting harmonious coexistence with our natural environment. Inspired by photosynthesis, in which sunlight is considered a "gift from the sun," the present study led to a discovery of the effect of Spirulina extract obtained from algae and fluorescent zinc oxide derived from natural minerals to efficiently convert ultraviolet light into visible light, which could successfully restore skin damage caused by ultraviolet light and also enhance the production of collagen and hyaluronic acid. Through the application of this technology, we aim to not only protect our customers from sunlight but also make use of the gift of the sun, thereby creating a future in which our customers can enjoy their daily lives more actively and freely. The results of this study were partly presented at the 31st International Federation of Societies of Cosmetic Chemists (IFSCC^{*1}) Congress 2020 in Yokohama, Japan (2020/10/21-10/30).

With regard to the present study, Shiseido has been advancing its own research by employing the "Premium/Sustainability" approach under the company's unique R&D philosophy, "DYNAMIC HARMONY." The company will continue to pursue studies to achieve the goal of creating products and services which can provide new value to the customers through the realization of harmonious coexistence with the environment, with the innovative technology, which, unlike other existing cosmetic products, allows for converting ultraviolet light into 'skin beautifying light'.

*1: IFSCC: The International Federation of Societies of Cosmetic Chemists

An international federation dedicated to the development of more sophisticated and safer cosmetic science technologies through cooperation among cosmetic scientists around the world.



Figure 1: How ultraviolet light is converted to visible light ('skin-beautifying light')
by blending Spirulina extract and fluorescent zinc oxide

Research background

We have been researching the various effects of light on the skin for many years. So far, we have shown that oxidative stress induced by ultraviolet light is a cause of photoaging, that blue light of intensity equivalent to that of sunlight can damage the skin, and that heat produced by infrared light causes damage inside the skin; these findings underscore the importance of protecting the skin from various [sources of] photo-damaging, such as ultraviolet light, in order to keep our skin healthy and beautiful. However, sunlight is the source of life that has continuously nurtured our lives. Instead of just avoiding it, we should take advantage of the gift of the sun so that we can all live better in harmony: To this end, Shiseido took on a challenge of developing a new technology to convert ultraviolet light - which are harmful to the skin - to something beneficial, which was the complete reversal of the idea.

Effects of 'skin-beautifying light' converted from ultraviolet light

In this study, we focused on "photosynthesis," which supports life on Earth, in order to turn skin-damaging ultraviolet light into something beneficial. Photosynthesis uses sunlight to produce energy, and in that process, it converts sunlight into visible light. Therefore, we thought that it might be possible to derive effects that are beneficial for the skin by converting ultraviolet light into another light and pursued further research in this direction. We searched for substances having the property of absorbing ultraviolet light and converting it at different light energy levels. We identified Spirulina extract and fluorescent zinc oxide from among more than 400 raw materials. These substances had sufficient light intensity and stability and were found to be highly safe.

(1) Dermal cell activation effect of Spirulina extract

It is known that dermal cells (fibroblasts) that produce collagen and hyaluronic acid, which are important for skin (e.g., resilience), are damaged when exposed to ultraviolet light, and their production declines. In this study, we confirmed that converting ultraviolet light to visible light ('skin-beautifying light') with Spirulina extract can help recover the activity of dermal cells that have been damaged by ultraviolet light and that the production of collagen and hyaluronic acid is increased compared to levels before ultraviolet light irradiation.

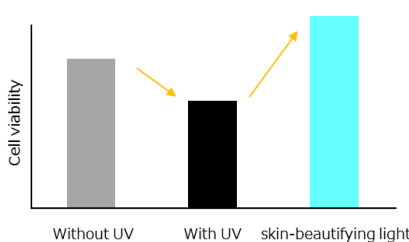


Figure 2: Fibroblast activation effect from Spirulina extract

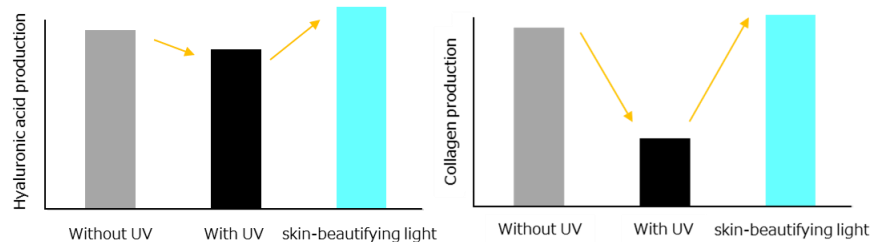


Figure 3: Stimulation of collagen and hyaluronic acid production

by Spirulina extract

(2) Epidermal cell activation effect of fluorescent zinc oxide

Since the light emitted by fluorescent zinc oxide has a shorter wavelength than the light emitted by Spirulina extract, we thought that it might have some effect on the skin surface. In this study, we confirmed that the activity of epidermal cells damaged by ultraviolet light can be recovered by converting ultraviolet light into visible light ('skin-beautifying light') using fluorescent zinc oxide. This finding suggests the possibility that the barrier function of the skin might be restored by 'skin-beautifying light'.

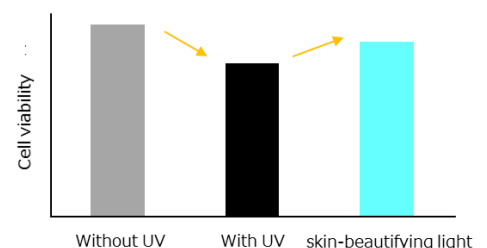


Figure 4: Epidermis activation effect

from fluorescent zinc oxide

(3) Anti-inflammatory effect of Spirulina extract combined with fluorescent zinc oxide

We also verified the effects of Spirulina extract and fluorescent zinc oxide when used in combination with each other. The cells of the skin exposed to ultraviolet light release inflammatory factors, which appear as redness on the skin. Repeated inflammation leads to photoaging of the skin in the long term. In this study, we succeeded in suppressing inflammation and reducing skin redness by converting ultraviolet light into visible light ('skin-beautifying light') with a combination of the two ingredients. Our findings suggest that 'skin-beautifying light' can prevent photoaging caused by inflammatory factors and that it exerts a favorable influence on the skin which helps maintain a healthy and beautiful appearance.

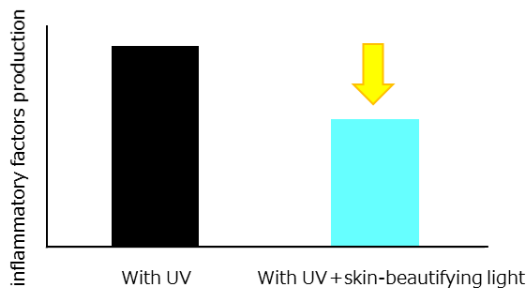


Figure 5: Anti-inflammatory effect of combination of Spirulina extract and fluorescent zinc oxide

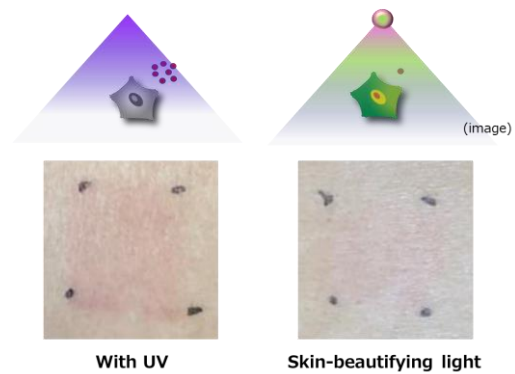


Figure 6: 'Skin-beautifying light' prevents inflammation and suppresses redness of the skin caused by ultraviolet light

Future perspectives

In the future, we will further advance this technology based on the new idea of "accepting the environment and living in harmony," and continue to take on new challenges to develop technologies that not only draw sunlight to our side, but also make use of other various environmental factors that surround our customers.

Leveraging our globally acclaimed R&D capabilities as our strength, we will continue to create innovative value toward the realization of the company mission, "BEAUTY INNOVATIONS FOR A BETTER WORLD," delivering beauty innovations to our customers worldwide.

Shiseido's new R&D philosophy "DYNAMIC HARMONY"

- Shiseido Formulates its Unique R&D philosophy "DYNAMIC HARMONY" (2021)

<https://corp.shiseido.com/en/news/detail.html?n=0000000003252>

- The DYNAMIC HARMONY special website:

<https://corp.shiseido.com/en/rd/dynamicharmony/>

<Reference Information>

Researchers' Challenge

■ Innovation through the fusion of diverse knowledge and people

The present study was conducted based on an entirely new and unprecedented idea that, rather than just preventing ultraviolet light as something harmful to the skin, it might also be possible to convert it into something good, thereby bringing about positive effects on the skin. To develop the technology, researchers from various fields of specialization, such as dermatology, inorganic chemistry, organic chemistry, photochemistry, and pharmaceutical technology, joined forces to conduct research. Researchers came from many different countries and regions, including Japan, Australia, France, and China. This high degree of diversity in the team helped create new ideas.



Figure 7 : Senior Chief Researcher, Kazuyuki Miyazawa (left),
Yurika Watanabe (right)

■ Numerous trial and error attempts

Since this technology conveys an entirely new idea, we needed to tackle new challenges from various perspectives, such as screening effective raw materials and establishing methods to evaluate the effects of converted light. For example, lights emitted by plants and minerals all differ by material, so we started by investigating roughly 400 types of raw materials. We verified differences in effect as well as the pattern and intensity of light among them, and through trial and error, we finally came to identify these two substances.

■ Thoughts for research

Through the use of this newly developed technology, Shiseido aims to create a future where customers can live in harmony with nature, enjoy the environment that surrounds them, and enjoy the benefits bestowed upon them in a form of "beauty." In addition to ultraviolet light, we will advance our research from a unique, Shiseido perspective looking into various aspects of the global environment—such as humidity and temperature—in our future studies.