

Research and Development

Shiseido Discovers Stretching along the Anti-Gravity System "Dynamic Belt" Activates Arrector Pili Muscles—Key to Improving "Sagging"

~Latest findings focused on the direction of the arrector pili muscles inside the skin, winning the top award at the IFSCC Congress four consecutive times~

Shiseido discovered that "Dynamic Belt," the anti-gravity system inside the skin that resists "sagging" caused by gravitational force, is oriented in a certain direction through joint research with Dr. Kyoichi Matsuzaki, Chief of External Plastic Surgery, Faculty of Medicine at the International University of Health and Welfare, together with researchers at Jichi Medical University and the National Institute for Physiological Sciences. Moreover, it was confirmed that stretching the skin along the direction of Dynamic Belt activates the arrector pili muscles^{*1}, with potential to improve facial sagging. Furthermore, our company found the licorice extract and the raspberry-derived extract were useful as ingredients that activate smooth muscle cells constituting the arrector pili muscles.

Shiseido has been conducting this research with the aim of elucidating the causes of "eternal skin concerns" that our customers have been expressing for many years, including dark spots/dullness, wrinkles, sagging, and pores, and developing solutions under "Skin Beauty INNOVATION," one of the three pillars of Shiseido's R&D strategy. The results of this research have been partly presented at "The 31st International Federation of Societies of Cosmetic Chemists (IFSCC)^{*2} Congress in Yokohama (October 21–30, 2020)" and won the top award, making Shiseido the winner of IFSCC Congress top award four consecutive times together with other "Anti-Gravity Science V" findings.

^{*1} The arrector pili muscles are involuntary muscles (muscles that cannot be moved at will) attached to the hair. They contract in response to stimuli such as coldness and emotions and exert a large force to make the hair stand on end. Our research team has demonstrated that these muscles, which connect the hairs to the superficial layer of the skin, resist skin deformation by restricting the movement of the skin during deformation.

^{*2} IFSCC: The International Federation of Societies of Cosmetic Chemists



Figure 1 Direction of Dynamic Belt

Because of the orientation of the arrector pili muscles (red structures), Dynamic Belt in the skin of the face runs in a certain direction (blue arrows) (Conceptual diagram. The actual size, number, color, etc. of the arrector pili muscles may differ from the diagram. Also, the direction of Dynamic Belt in the forehead tends to exhibit individual variation, and a typical example is shown in the diagram.)

Shiseido's efforts to tackle "sagging" and approaches to the anti-gravity system "Dynamic Belt"

With the aim to prevent and improve "sagging," Shiseido has been working toward the elucidation of the underlying mechanisms. Using "4D Digital Skin," the 4D skin analysis technology developed by our company to capture not only the structure of the skin but also its movements, we discovered a system in which the skin resists gravity that causes skin sagging. The mechanism involves the physical resistance of the skin against deformation, which is facilitated by the arrector pili muscles*1 densely distributed on the inside of the skin, and is referred to as "Dynamic Belt." Further, we have also elucidated that weakening of Dynamic Belt due to aging leads to sagging. This time, our research team worked on the development of approaches targeting this weakened Dynamic Belt.

New Discovery 1: The direction of gravity-resisting "Dynamic Belt" in the skin of the face

In order to approach Dynamic Belt (i.e., arrector pili muscle groups) that has become weakened with age, it is important to understand what the conditions of the arrector pili muscles are in the skin of the face. There is no adequate way to observe the arrector pili muscles from the outside of the skin. Therefore, we performed a three-dimensional analysis of the structure of the arrector pili muscles, and found that the arrector pili muscles are oriented in the direction that almost corresponds to the direction of the vellus hair (Figure 1). It was then possible to confirm the direction of the arrector pili muscles by observing the direction of the vellus hair. The observation of the facial vellus hair revealed that the direction of the arrector pili muscles, or in other words, the direction of the physical force produced by the arrector pili muscles (Dynamic Belt), is as shown in Figure 2. Using this knowledge, we advanced our study to explore an effective approach to tackle the weakened arrector pili muscles.

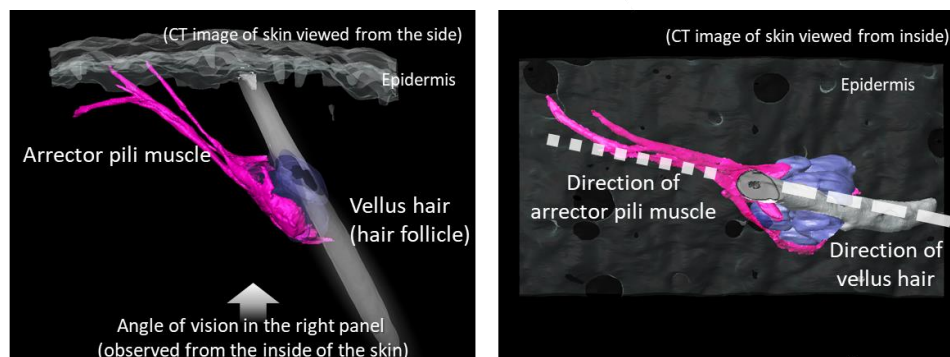


Figure 2 The arrector pili muscles are oriented in the direction of the vellus hair

Left) CT image of the skin from the side. The arrector pili muscle is shown in pink, and the hair follicle of the vellus hair is shown as the gray rod-shaped structure. The right panel shows an image taken from the bottom side, i.e., a view from the inside of the skin (arrow). Right) CT image of the skin viewed from inside. The inside of the epidermis is shown in the farthest back. The dotted lines show the orientation of the arrector pili muscles and that of the vellus hair. They appear to be oriented almost in the same direction.

New Discovery 2: Stretching along the direction of Dynamic Belt is key to improving facial sagging

We thought that weakened Dynamic Belt due to aging might recover if the arrector pili muscles could be activated. Accordingly, we cultured skin and applied various stimuli, and found that stretching the skin along the direction of the arrector pili muscles activated the arrector pili muscles (Figure 3). This finding led us to consider the possibility that improvement in Dynamic Belt and sagging might be achieved by performing stretching along the direction of the muscles, i.e., Dynamic Belt.

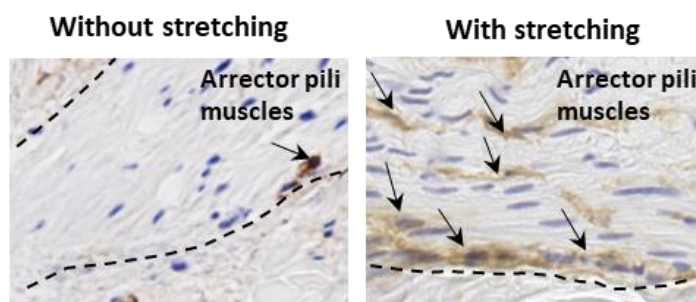


Figure 3 Stretching along the direction of the arrector pili muscles activates the muscles

Cross-sectional image of the skin. The area between the dotted lines (the area above the dotted line in the right panel) corresponds to the arrector pili muscles. By stretching the skin in the direction of the arrector pili muscles, a condition of activated muscles was induced (right panel; shown by the increase in the number of arrows). Blue dots indicate cells (nuclei).

New Discovery 3: Ingredients that activate the arrector pili muscles

Applying these results, Shiseido searched for ingredients that activate smooth muscle cells constituting the arrector pili muscles. This led to the identification of the licorice extract and the raspberry-derived extract, which were found to have the cell activating effect^{*3} (Figure 4).

^{*3} Patent pending (PCT/JP2021/006473)

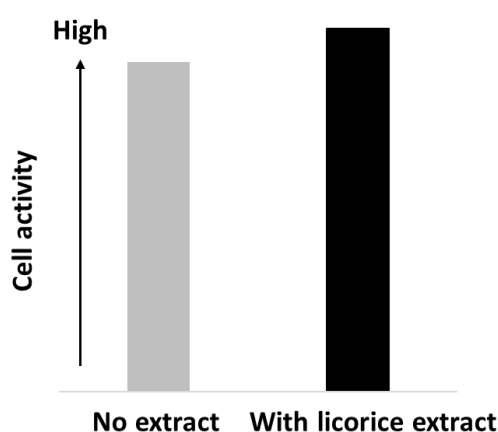


Figure 4: Licorice extract activates smooth muscle cells

Summary and Future Prospects

Now that the face mask rules have been relaxed, many customers are interested in "facial sagging." Shiseido, which has led the industry as a pioneer in the field of sagging research for a quarter of a century, discovered in the present study that the things including stretching along the direction of the arrector pili muscles, which are found in the face and serve as a system to resist sagging-causing gravity, has the potential to improve facial sagging by activating the arrector pili muscles that are prone to age-related weakening. We will apply these findings to our skincare products in the future to provide a beauty experience that exceeds the expectations of our customers. The results of this study will be presented at the European Biophysical Societies' Association (EBSA) Congress, which will be held in Stockholm starting July 31, 2023.

About Our R&D Strategy:

This study was conducted with the aim of elucidating the causes of "eternal skin concerns" that our customers have been expressing for many years, including dark spots/dullness, wrinkles, sagging, and pores, and developing solutions under "Skin Beauty INNOVATION," one of the three pillars of Shiseido's R&D strategy.

- Integrated Report 2022 (Beauty Innovation Part)
 - https://corp.shiseido.com/report/en/2022/value_creation/innovation/
 - Keywords
- Skin Beauty INNOVATION, external skin concern, sagging

Reference: Shiseido's "Sagging" Research and Results

For nearly a quarter of a century, Shiseido, led by Fellow Researcher Tomonobu Ezure, has developed and utilized the state-of-the-art analytical techniques to elucidate the phenomena and causes of "sagging," the age-related changes in the shape of the face including smile lines, marionette lines, and loosening of the face line. Results of our research include the discoveries of the "Anchor" structure, which supports the shape of the face, age-related "Dermal Cavitation" phenomenon, "Dermal Cell Network" of interwoven dermal cells, and the direction of the arrector pili muscles, "Dynamic Belt," which is a system that fights off gravity force. These research results have been highly evaluated internationally and academically, and have won the top prize in four consecutive academic congresses held by the International Federation of Societies of Cosmetic Chemists (IFSCC). Shiseido refers to these four findings as "Anti-Gravity Science V" and approaches "sagging" that many customers are concerned about by applying them to skincare.

<About the Anchor structure>

Shiseido Clarifies Skin Structure of Supporting Face Shape for the First Time in the World (2015)

https://corp.shiseido.com/jp/newsimg/archive/00000000001927/1927_w4y67_jp.pdf

<About the Dermal Cavitation phenomenon>

Shiseido Discovers That Age-Related Dermal Cavitation Leads to Sagging Skin (2015)

https://corp.shiseido.com/jp/releimg/2512-j.pdf?rt_pr=tr437

Shiseido Elucidates Mechanism of Age-Related Dermal Cavitation (2016)

<https://corp.shiseido.com/jp/news/detail.html?n=00000000001958>

<About Dermal Cell Network>

Shiseido Elucidates the "Fibroblast Network" of Cells in Dermis (2020)

<https://corp.shiseido.com/jp/news/detail.html?n=00000000002898>

<About Dynamic Belt>

Shiseido Discovers Skin's Anti-gravity System "Dynamic Belt" (2022)

<https://corp.shiseido.com/en/news/detail.html?n=00000000003506>

<About the development of techniques to analyze the inside of the skin>

Shiseido Develops "Digital 3D Skin", a New Skin Analysis Technology Using AI (2020)

<https://corp.shiseido.com/jp/news/detail.html?n=00000000002897>

Shiseido Develops "4D Digital Skin" (Electronic Skin), Finally Reconstructing Skin Movement on Computer (2021)

<https://corp.shiseido.com/en/news/detail.html?n=00000000003257>

Reference: Introduction of the researcher

■ A leading figure in global cosmetics research and development:
Tomonobu Ezure, Ph.D., Shiseido Fellow

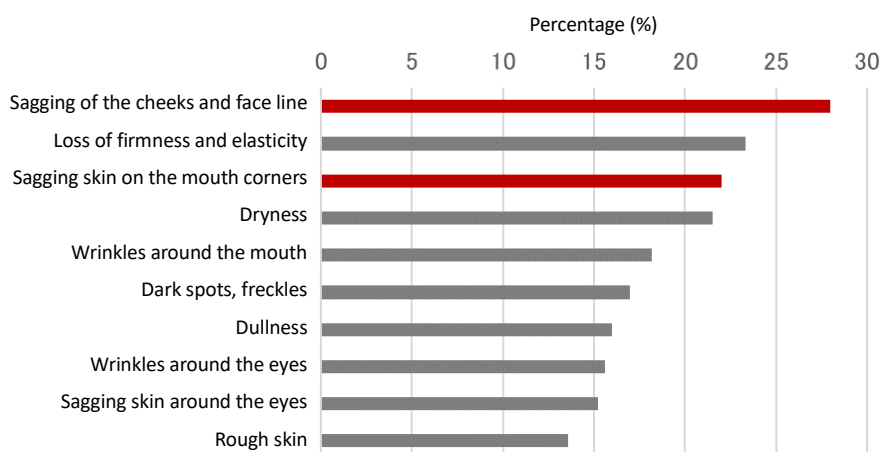
Dr. Ezure is the only researcher with the title of Fellow in the history of Shiseido since its foundation. He has won four consecutive awards at International Federation of Societies of Cosmetic Chemists (IFSCC) Congresses, and has received awards at various academic meetings in Japan and abroad, including the European Society for Dermatological Research and the Japanese Society of Aesthetic Dermatology. He gave a keynote speech on skin aging research at the IFSCC 2022 Congress in London. He continues to lead the research field of "sagging," the change of facial morphology due to aging, as a pioneer. His books include "*Kao no roka mekanizumu* (Mechanisms of facial aging)" (Nikkan Kogyo Shimbun), "*Atarashii sukin kea* (New skin care)" (Nikkan Kogyo Shimbun), and "*Tanin mesen de tarumi kea* (Sagging care from the view of others)" (Kodansha).



Shiseido Fellow
Tomonobu Ezure, Ph.D.

Reference: Skin troubles that our customers are conscious about when they remove their face masks (from consumer survey results)

The infectious disease classification for COVID-19 has been changed since May 2023, and face mask rules mainly concerning outdoor life have been loosened in Japan. Shiseido conducted a survey of 1000 women aged 45–69 years regarding "skin concerns that seem to have gotten worse or more frequent compared to before the COVID-19 pandemic." As a result, "sagging of the cheeks and face line" (28%) emerged as the number one concern, with "sagging skin on the mouth corners" (22%) being the third. These results suggest that a considerable number of consumers are concerned about "sagging" of the lower half of the face resulting from face mask wearing in daily life.



"Skin concerns that seem to have gotten worse or more frequent compared to before the COVID-19 pandemic."

(Responses were obtained from 1000 women aged 45–69 years, February 2022, a survey by Shiseido)

R&D Philosophy "DYNAMIC HARMONY" Approach

The present study has been conducted under the Inside/Outside approach of "DYNAMIC HARMONY," Shiseido's unique R&D philosophy. Using the state-of-the-art skin analysis technology, we will continue to tackle "sagging," the aging of the facial appearance (Outside), from the inside of the skin (Inside) to clarify the underlying causes and develop solutions.

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

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

<https://corp.shiseido.com/en/news/detail.html?n=00000000003252>

The DYNAMIC HARMONY special website:

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