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大阪大学 OSAKA UNIVERSITY
国立大学法人 大阪大学
〒565-0871 大阪府吹田市山田丘 1-1
TEL: 06-6877-5111 (代)
www.osaka-u.ac.jp

Press Release

研究成果

October 25, 2023

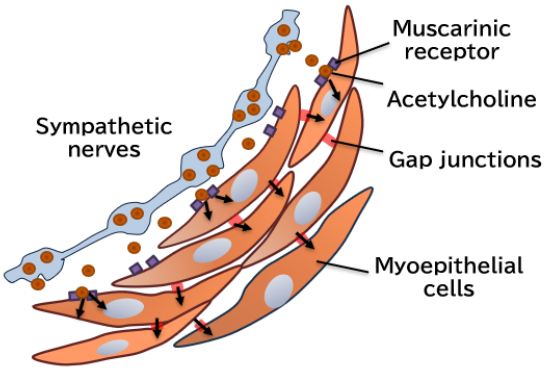
Research field: Life science and medicine
Keywords: Sweat glands, Gap junctions, hyperhidrosis, antiperspirant

Uncovering the Mechanism of Sweat Gland Contractions During Sweating and Discovering a New Antiperspirant Agent

– Awarded the Best Poster Presentation at IFSCC 2023 –
Potential Applications in the Development of Next-Generation Antiperspirants and Research on Sweating Dysfunction

【Key Research Findings】

- The mechanism by which sweat glands contract during sweating has been elucidated.
- Connexins*1 that form gap junctions*2 are abundant in myoepithelial cells, which are responsible for sweat gland contractions, and these gap junctions are significantly involved in sweat gland contractions during sweating.
- A gap junction blocker and its analogue monoammonium glycyrrhizate (GMA)*3 inhibit thermogenic (heat-induced) and psychogenic (mental stress-induced) sweating in humans.



Reference : Sweat gland tissue responsible for sweat secretion

- The findings of this study will be utilized in the development of next-generation antiperspirant technologies directly targeting sweat gland contractions during sweating to control perspiration beyond current methods. They are also expected to be applied to research on sweating disorders such as hyperhidrosis.

• Overview

Our research group led by Fumitaka Fujita, Guest Professor of the Laboratory of Advanced Cosmetic Science (Joint Research Program with Mandom), Graduate School of Pharmaceutical Sciences, Osaka University; Kiyotoshi Sekiguchi, Professor of the Division for Matrixome Research and Application (endowed by Mandom), Institute for Protein Research, Osaka University; Atsushi Tanemura, Associate Professor of the Department of Dermatology, Graduate

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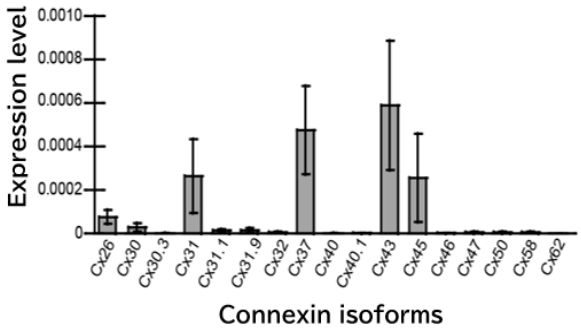
School of Medicine, Osaka University; Hiroyuki Murota, Professor of the Department of Dermatology, Nagasaki University Graduate School of Biomedical Sciences; and Ichiro Katayama, Specially Appointed Professor of the Department of Dermatology, Osaka Metropolitan University Graduate School of Medicine, has elucidated how sweat gland contractions occur during sweating in humans.

In this study, the researchers revealed that connexins (CXs), which form gap junctions, are abundantly expressed on myoepithelial cells that play a critical role in sweat gland contractions and that these gap junctions are significantly involved in sweat gland contractions during sweating (Fig.1). They also showed that carbenoxolone (CBX), a gap junction blocker, inhibited sweat gland activity. Furthermore, they found that GMA, an analogue of CBX, inhibited both thermogenic (heat-induced) and psychogenic (emotion-induced) sweating in humans (Figs.2 and 3).



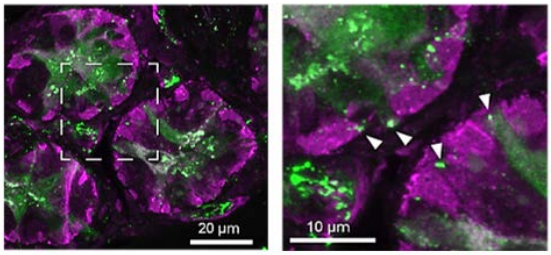


Fig.1. Connexins(CXs)are present in myoepithelial cells responsible for sweat gland contractions(upper panel), and CX43(arrows in right lower panel)is abundantly distributed on myoepithelial cells(purple in lower panel).

These findings are expected to contribute to the development of next-generation antiperspirant technologies that go beyond current approaches and to better understanding and treatment of hyperhidrosis, a sweat gland disorder.

Part of this study was presented at the international conference described below, held from September 4 to 7, 2023, in Barcelona, Spain, and received the Best Poster Presentation Award.

• Background of the research

Recent global rises in average temperatures have induced excessive sweating not only in individuals with hyperhidrosis but also in those without this sweating disorder, causing discomfort and affecting their quality of life (QOL). Antiperspirants are commonly used as a convenient way to control sweating. They suppress sweating as the active ingredients, aluminum salts, physically cap the sweat glands. However, according to a survey of antiperspirant users conducted by Mandom,*4 one in three users is not satisfied with the effectiveness of antiperspirants, indicating a need for further improvement in antiperspirant functionality. Toward developing a new antiperspirant technology different from conventional ones, this research group has previously used human sweat glands and demonstrated that sweat is expelled onto the skin surface by contractions of sweat glands during sweating. However, the detailed mechanism remained unclear, and no substances had yet been identified that effectively inhibited sweating.

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- Research content

The group collected eccrine sweat glands from human skin tissue, which were then stained and observed by microscopy. CXs, which form gap junctions, were expressed on myoepithelial cells, and were involved in sweat gland contractions during sweating. Among the CXs, CX43 was most abundantly distributed on the myoepithelial cells (Fig.1). CBX, a gap junction blocker, suppressed both myoepithelial cell movements and sweat gland activity. These results indicate that gap junctions in myoepithelial cells are a critical factor in sweat gland contraction during sweating.

Next, they investigated the antiperspirant effect of GMA, an analogue of CBX, on sweating induced by exercise and mental stress, using a perspiration meter that allows real-time observation of sweating behavior. The results showed that GMA applied to the human armpit delayed the onset of exercise-induced sweating and reduced the total sweat produced by a 15-minute exercise (Fig.2). In addition, GMA suppressed the behavior (amplitude) of sweating, suggesting that GMA inhibits sweat gland movements in the human armpit. Furthermore, the local application of GMA also inhibited palmar sweating induced by the mental stress of a 5-minute mental arithmetic task (Fig.3).

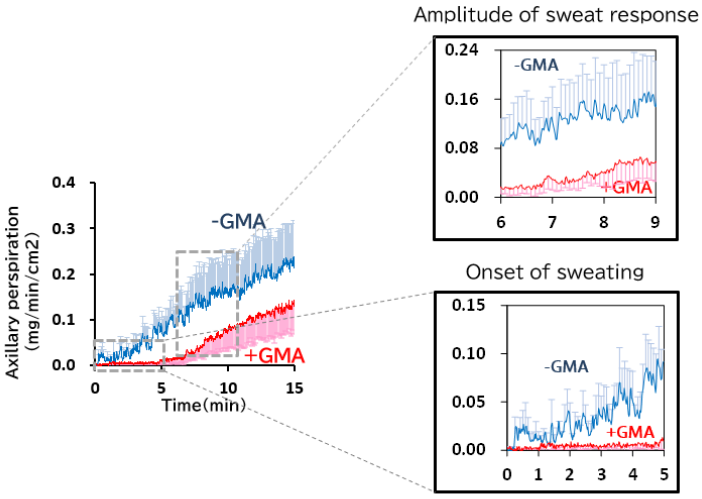

Fig.2. Dynamics of armpit sweating during exercise

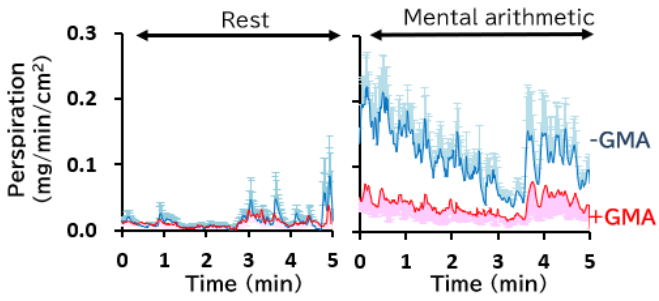

Fig. 3. Dynamics of palmar sweating during mental arithmetic

- Impact of this research achievement on society

The new antiperspirant technology found in this research directly targets sweat glands, and thus it could be useful in enhancing the effectiveness of antiperspirants through the development of antiperspirant products with new functions and products combined with conventional methods. In addition, further elucidation of the dynamic sweating mechanism in sweat glands is expected to contribute to a better understanding and treatment of sweating-related disease (hyperhidrosis).

- Special notes

This work was presented at the international conference described below, held on September 4 to 7, 2023, in Barcelona, Spain, and won the Best Poster Presentation Award out of 449 presentations (including 76 oral and 373 poster sessions).
The International Federation of Societies of Cosmetic Chemists (IFSCC) 2023
Title:Next-generation antiperspirant technique
: Controlling the contraction of human eccrine gland
Presenters:Takeshi Hara, Kie Nakashima, Ayumi Kyuka, Hiroko Kato, Fumitaka Fujita, Atsushi Tanemura, Yukinobu Nakagawa, Hiroyuki Murota, Ichiro Katayama, and Kiyotoshi Sekiguchi

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- Notes and Glossary

*1 Connexins
A family of proteins that form gap junctions
*2 Gap junctions
Intercellular connections between neighboring cells that allow ions with low water solubility and electrical signals to pass between cells
*3 Monoammonium glycyrrhizate (GMA)
A compound extracted from the herbal medicine licorice root
*4 Survey of antiperspirant users conducted by Mandom.
September 2023/men and women aged 20-59/n=449/Internet survey/survey by Mandom

【Message from Takeshi Hara (Manager of Life Science Research Group, Advanced Technology Institute, Mandom Corporation and Guest Associate Professor of the Graduate School of Pharmaceutical Sciences, Osaka University)】

Humans can efficiently regulate their body temperature by sweating. It is well-recognized that this sweating function enables humans to perform exercise for long periods. However, rising average temperatures due to global warming and psychosocial stress have increased the opportunities for excessive sweating and the number of people suffering from excessive sweating and its associated unpleasant odor. People living with hyperhidrosis, a physical disorder with the primary symptom of excessive sweating, experience difficulties in their daily lives due to this symptom, resulting in a reduced quality of life (QOL). To address these concerns about excessive sweating in customers, we have been dedicated to uncovering the sweating mechanism in human sweat glands and developing novel, effective antiperspirant ingredients. In the future, we intend to implement the findings of our research in real life to improve the QOL of individuals with sweating problems.