



How can we reduce the discomfort of malodors in the nursing care scene? Development of novel fragrances using the olfactory receptor technology.



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Introduction:

Background

- The world's population has been aging rapidly, and because of improved hygiene and nutrition, as well as the developments of medical technology people live longer.
- Thus, the number of elderly who needs nursing care has increased accordingly and they are required to be cared for at home or assisted living facilities.

Problem

- There is a characteristic malodor in the nursing care scene, which is very stressful for both caregivers and care-receivers and is causing reduced their QOL. In this study, this peculiar odor arising from care-receivers and drifting in the care space was defined as "the nursing care odor".
- Although many odor control strategies have been developed in the past, but in general, malodors are composed of various malodorous components, so it has not been easy to reduce sufficiently the unpleasantness of malodors even if only the major components are eliminated.

Solution

- Olfactory Receptor (OR) technology with Harmonizing technology was combined to effectively reduce the discomfort to complex nursing care odor.
 - OR technology: a selective deodorization technology using OR antagonism.
 - Harmonizing technology: a masking technology that harmonizes malodor components and changes them into pleasant fragrances [1].

Our Aim

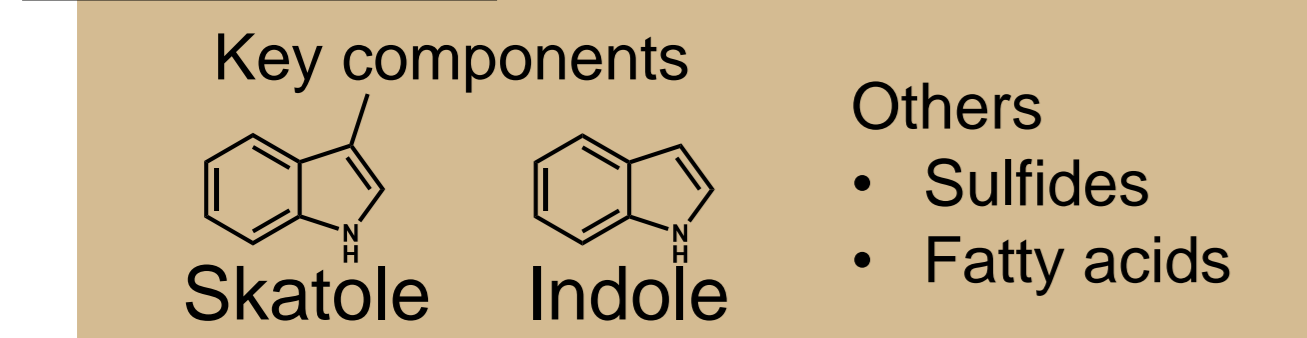
- Development of novel deodorant fragrances that effectively reduce the nursing care odor by combining OR and harmonizing technologies.

Materials & Methods:

Target Malodor: Nursing Care Odor

The nursing care odor consists of several strong malodors such as excrement and body odor [2,3]. Especially fecal odor is a major contributor.

Fecal Odor

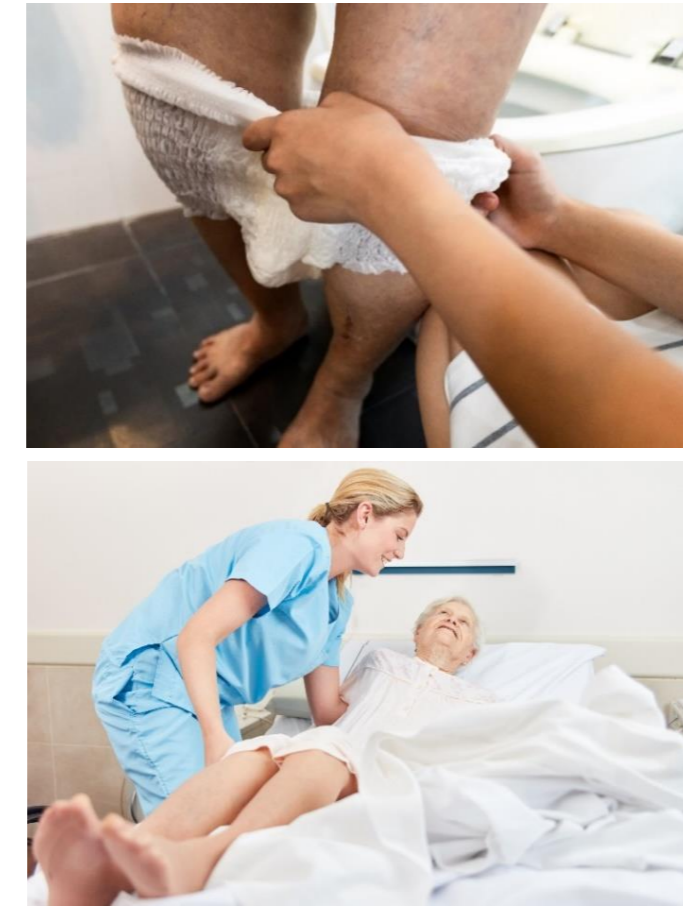


Body Odor

- Aging Odor
- Sweat Odor

Urine Odor

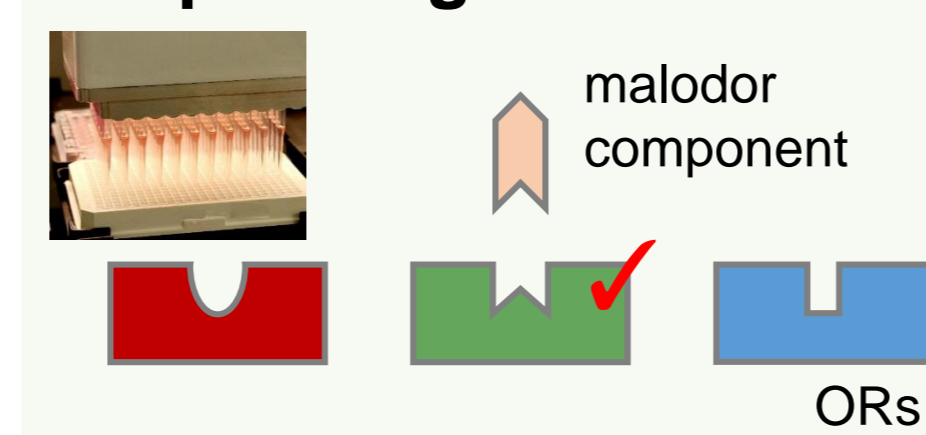
Sick Odor



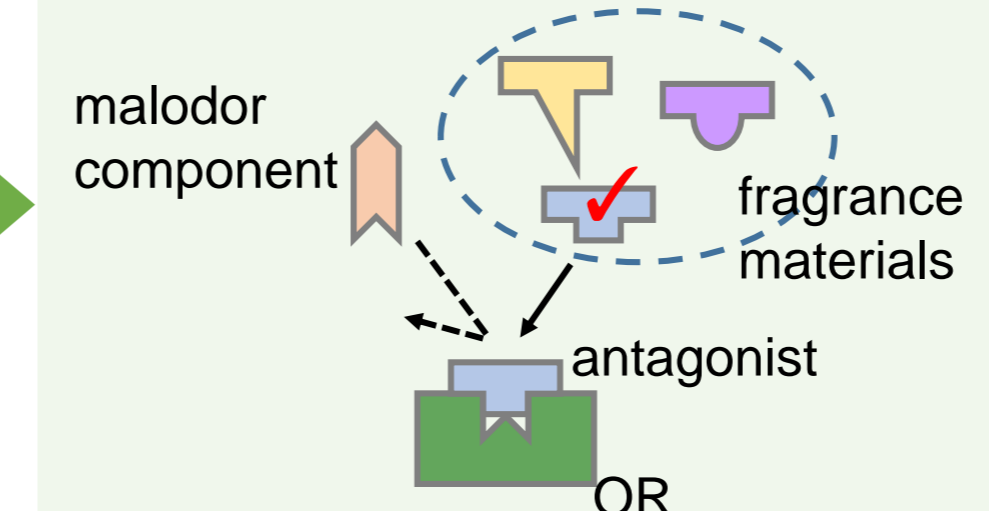
Development Strategy

OR and Harmonizing technology were complementarily combined in order to develop more effective deodorant fragrances efficient for complex malodors such as nursing care odor.

Search for ORs Responding to Malodor



Antagonist Screening



Fragrance Creation with OR & Harmonizing Technology

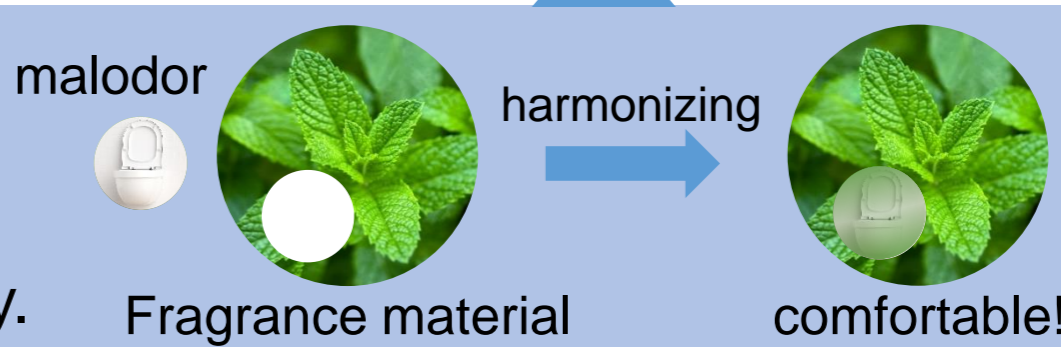


Deodorant Fragrance for Nursing Care Odor



Harmonizing Technology

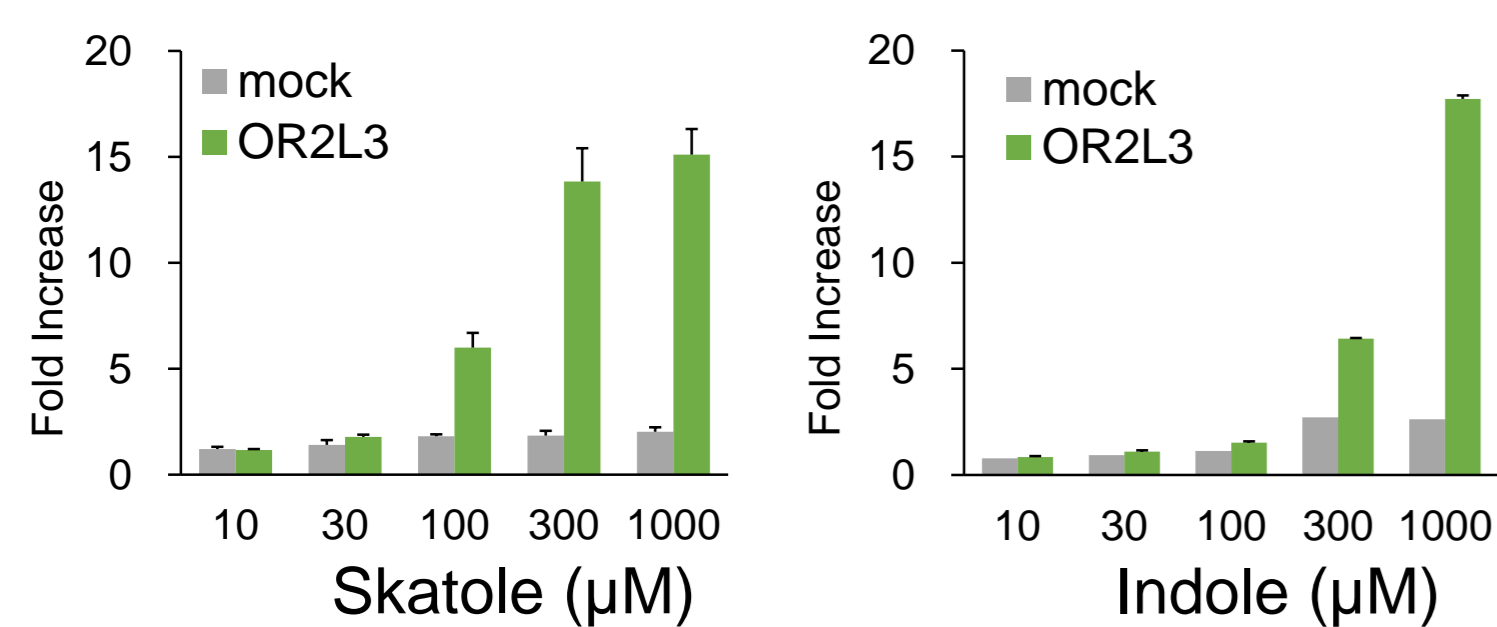
The technology is to change malodors into pleasant fragrances by harmonizing a fragrance with the malodor. It is expected to effectively reduce discomfort against malodors in combination with OR technology.



Results & Discussion:

Luciferase Reporter Gene Assay

Identification of Human ORs for Fecal Malodor Key Components



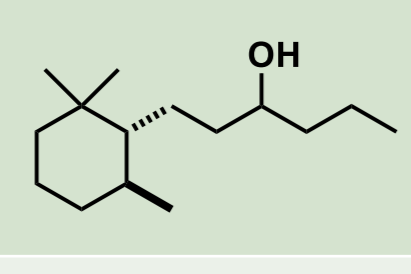
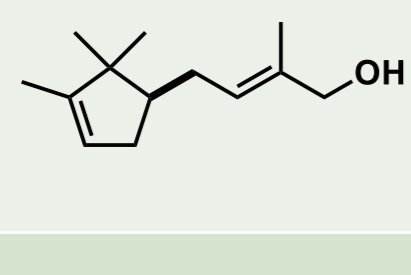
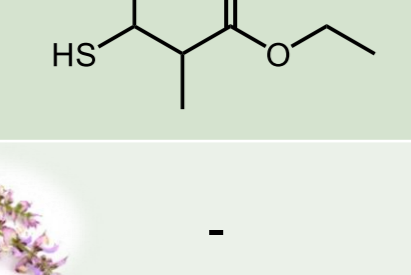

OR2L3 was found as the receptor to the fecal odor key components for the first time.

Search for Potential Antagonists of OR2L3

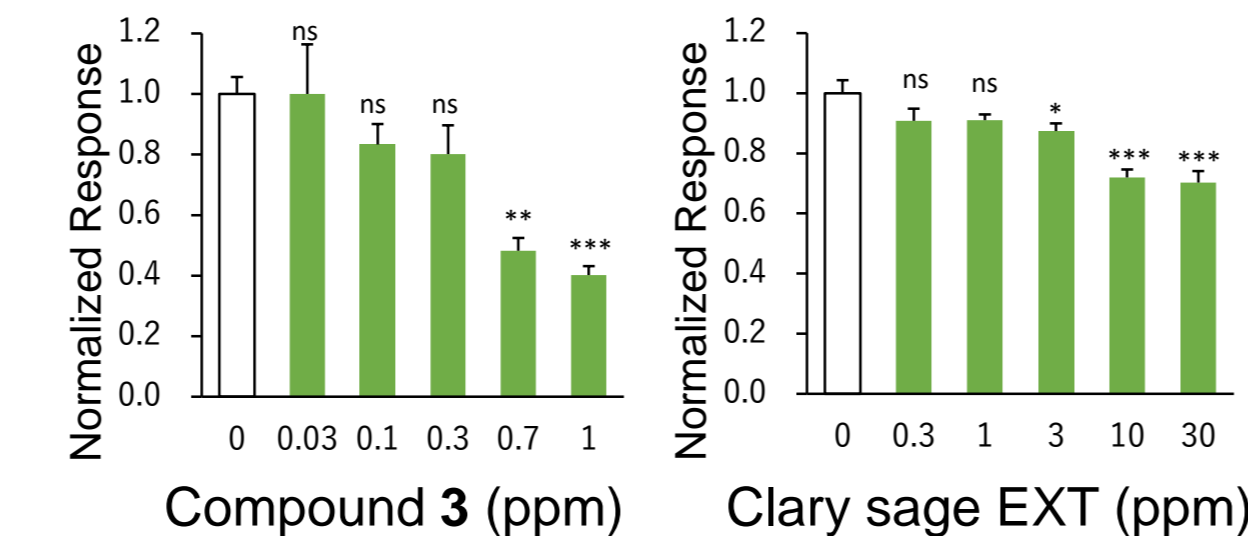
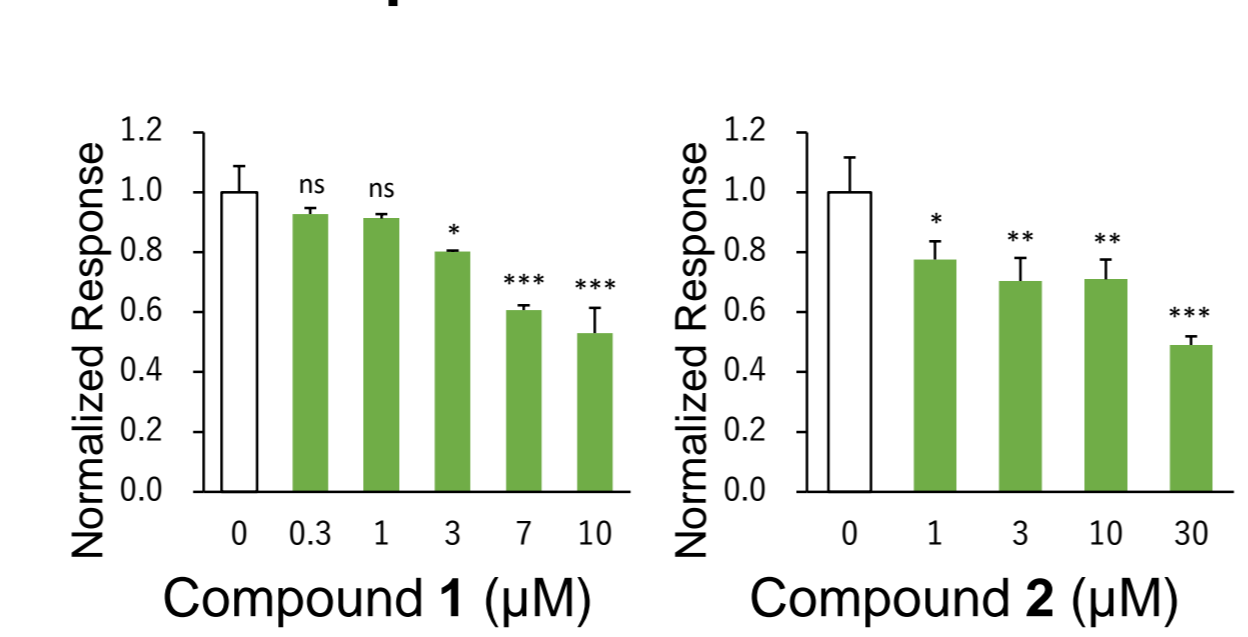
Antagonists Screening with Fragrance Materials

Normalized Response of OR2L3 to Skatole (300 μM)

800 fragrance materials were screened using skatole. Dozens of materials suppressed the cellular responses. Among these potential antagonists, we chose 4 materials.

Antagonist	Chemical Name	Chemical Structure	Odor Description
Compound 1	Cyclohexanepropanol, 2,2,6-Trimethyl- α -propyl		Woody, Amber
Compound 2	2-Methyl-4-[(1R)-2,2,3-trimethylcyclopent-3-en-1-yl]but-2-en-1-ol		Woody, Sandalwood
Compound 3	Ethyl 3-mercapto-2-methylbutanoate		Fruity, Tropical Fruit
Clary sage extract (EXT)	-		Herbaceous, Clary sage

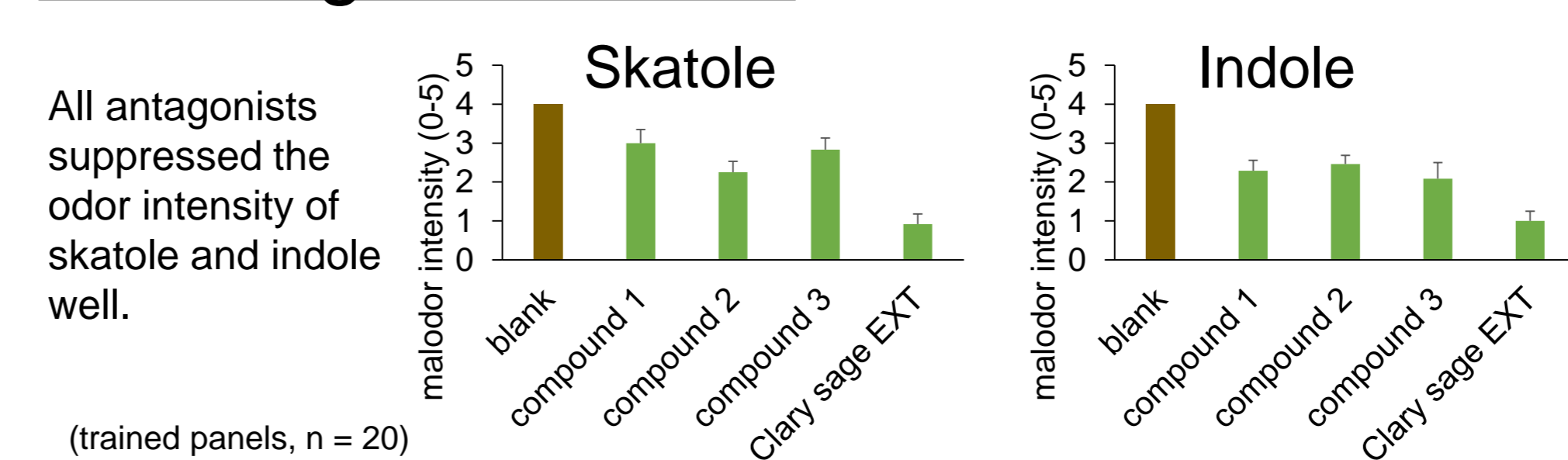
Inhibitory Activity of The Antagonists on the Response of OR2L3 to Skatole



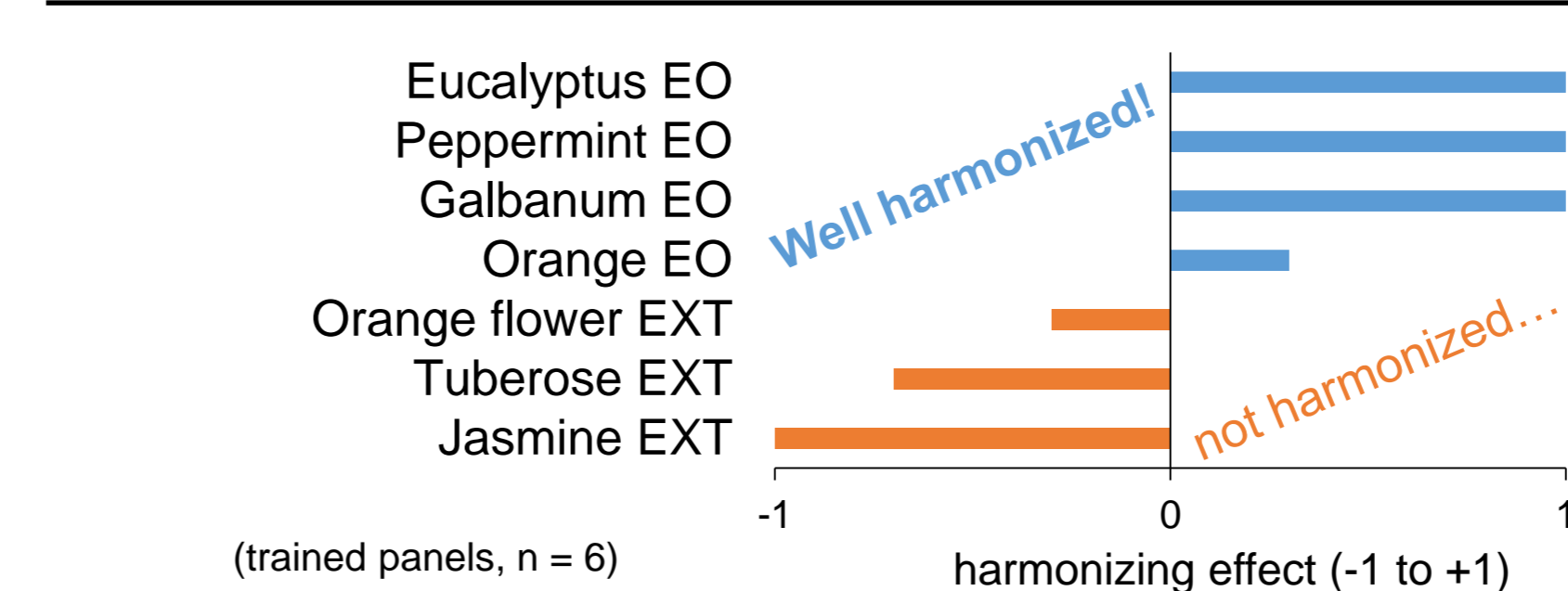
The materials significantly suppressed the OR2L3 response to skatole. When the target malodor was changed to indole, all antagonists similarly inhibited the OR response.

Sensory Evaluation

Masking Effect of The Antagonists on The Target Malodors

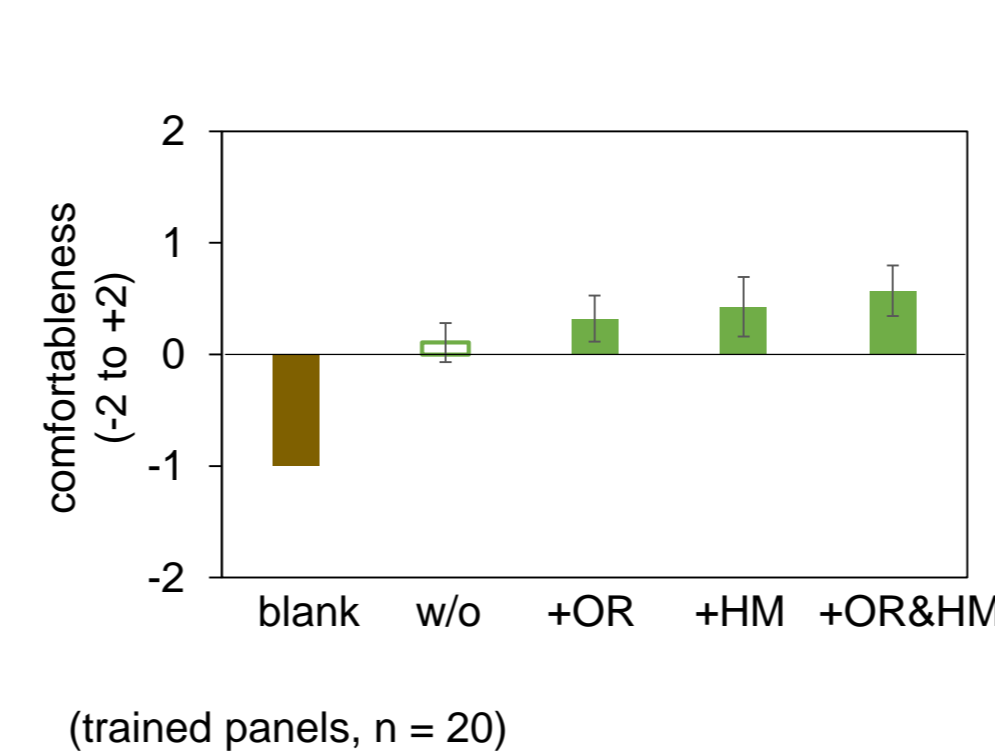


Harmonizing Effect between Fecal Odor and Essential Oils and Extracts



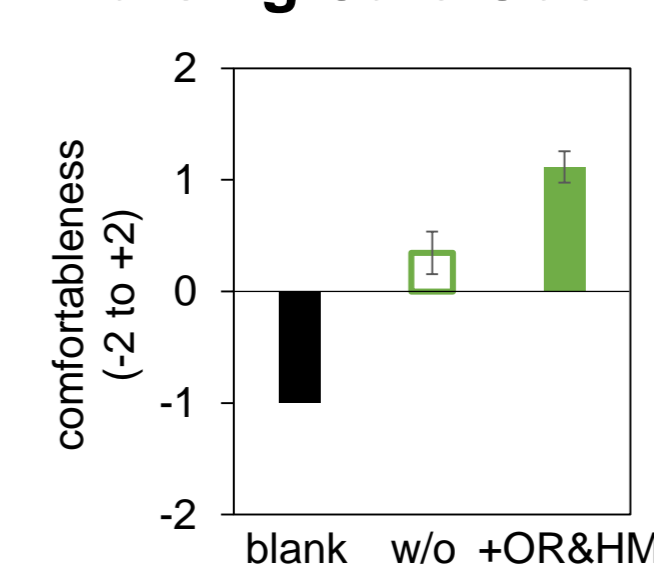
Discomfort Reduction Effect of Fecal Odor & Nursing Care Odor

Model Fecal Odor



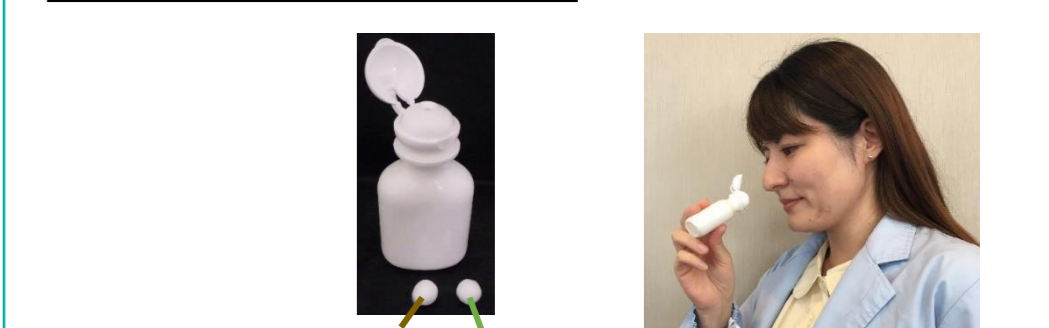
"+OR" reduced the discomfort of the model fecal odor more than "w/o". This was considered due to skatole and indole were suppressed effectively. "+HM" also reduced the discomfort of the model fecal odor sufficiently because it harmonized with the fecal odor and reduced the perception level of the fecal odor. "+OR&HM" resulted the highest reduction effect among them.

Model Nursing Care Odor



The model fragrance (+OR&HM) reduced the strong discomfort of the model nursing care odor effectively. OR2L3 antagonists, compound 1 and compound 2, and the harmonizing fragrance material, Eucalyptus EO, have been reported as antagonists of OR2C1, which responds to key components of aging and sweat odors [4, 5]. Thus, it was considered that these materials worked synergistically to the reduction of discomfort of the nursing care odor.

Evaluation Method



Two cotton balls were placed in a plastic bottle

Preparation of Malodors & Fragrances

- Model fecal odor: Skatole, indole, sulfides, and low fatty acids.
- Model nursing care odor: The model fecal odor and the model aging odor including (E)-2-nonenal
- Practical deodorant test fragrances: They were made as shown in the table below.

	w/o	+OR	+HM	+OR&HM
Model Fragrance a)	✓	✓	✓	✓
OR (antagonist)		✓		✓
Harmonizing EO			✓	✓

a) A floral fragrance which did not contain both any antagonist nor any harmonizing fragrance material

Conclusions:

- We have succeeded in developing novel deodorant fragrances for the nursing care odor that can significantly reduce discomfort.
- OR2L3 was found as the receptor to the fecal odor key components for the first time and then potential antagonists of it were discovered with fragrance materials.
- It was demonstrated in the sensory evaluation that the antagonist fragrance materials significantly suppressed odor strength of skatole and indole.
- To utilize the harmonizing technology, essential oils that have a high harmonizing effect with fecal odors were discovered and then verified their effectiveness.
- It was demonstrated that the fragrance incorporated both OR technology and harmonizing technology could greatly reduce the discomfort of nursing care.
- Thus, it was clearly suggested that this combination was valid in order to develop more effective deodorant fragrances for complex malodors.
- It can be expected that the novel deodorant fragrances developed by this new methodology will relieve stress from both caregivers and care-receivers by reducing the discomfort of nursing care odor and make them healthier physically and mentally, leading to improvements in QOL.



References:

- Sawano, K. (2000) Body Odors. The Japanese J. Taste and Smell Res. 7:3-10
- Murata, J. et al (2016) The Home Care Situation for the Elderly and an Evaluation of Their Environment. J. Environ. Eng., 81:599-606
- Itakura, T. et al (2008) Research on The Level of Odor in a Patient Room of The Hospital. J. Environ. Eng., 73:327-334
- Mihara, H. et al (2020) How Can We Control Unpleasant Body Malodor Effectively? Development of Novel Fragrances Using the Olfactory Receptor Technology. IFSCC Magazine, 23:173-178
- Mihara, H. et al (2021) Novel Deodorant Fragrances -Scents utilizing olfactory receptor technology offer efficacy in the control of body malodor-. Perfumer & Flavorist, 46:22-31