News Release

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mandom

Mandom strengthens antifungal effect with alkanediol technology

—A new approach that expands the possibilities of preservative-free formula—

Mandom Corporation (Head office: Osaka, President Executive Officer & Director: Ken Nishimura, hereinafter "Mandom") pursues "creation of new value" as a human-oriented company to delight, excite, and bring joy to consumers, and it conducts research and development with the aim of achieving maximum safety, functionality, and comfort during use.

At Mandom, we focused on the antimicrobial properties of the non-irritating moisturizing ingredient "alkanediol" and in 2005 succeeded in developing our own "preservative-free formula" that does not use conventional preservatives.

We now have further evolved this technology, establishing a technology that exhibits high antifungal action such as *Aspergillus brasiliensis* (mold) and *Candida albicans* (imperfect yeast: hereafter referred to as "yeast") through the synergistic effect of decylene glycol (C10) and 1,2-heptanediol (C7), two types of alkanediols.

The results of this research won 7th place in the poster presentation category at the 17th ASCS (Asian Societies of Cosmetic Scientists) Conference, held in the Philippines in June 2025.

Research background

Preservatives (such as parabens and phenoxyethanol) used in cosmetics are essential ingredients for maintaining the quality of the product, but due to concerns about skin irritation and allergies, there has been a demand for the development of formulations that are less irritating and can be used safely. Mandom focused on the antimicrobial properties of the non-irritating moisturizing ingredient "alkanediol" and in 2005 succeeded in developing our own "preservative-free formula" that does not use conventional preservatives. Alkanediol is a general term for moisturizers such as pentylene glycol, hexanediol, and caprylyl glycol and is a type of polyol.

However, previous preservative-free formulas did not have sufficient antifungal effect against mold and yeast. It was already known that decylene glycol (C10), a type of alkanediol known to have antifungal properties, is difficult to incorporate into formulations that contain a lot of water and that its antifungal properties are weakened depending on the combination of cosmetic ingredients.

Therefore, we hypothesized that if we could improve the dispersibility of C10 in water, we could maximize its antifungal properties and establish a highly versatile preservative technology that could be applied to a wide range of dosage forms, and we began working on developing the technology.

Research contents

As a solution to achieve effective antifungal action of decylene glycol (C10), we predicted that 1,2-heptanediol (C7), which has the property of being compatible with both water and oil, would improve the solubility of C10, and we attempted to evaluate the degree and elucidate the mechanism of antifungal effects.

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1. Combination of C10 and C7 improves antifungal effect.

Using a model lotion formulation, the antifungal effects of C7 or C10 alone and when both ingredients were used together were checked with a preservative efficacy test* (Figure 1). When C7 or C10 was added alone, neither showed sufficient antifungal effect against yeast or mold, which are types of fungi. C10 is known to have antifungal effects, but because it is highly lipophilic and was solubilized with a surfactant in order to be incorporated into the lotion, we believe that its efficacy was not fully demonstrated. On the other hand, when C10 and C7 were used together, the number of fungi was significantly reduced, demonstrating a high antifungal effect. Furthermore, it was confirmed that the effect became apparent in a shorter time than when the conventional preservatives methylparaben (MP) and phenoxyethanol (PhE) were combined.

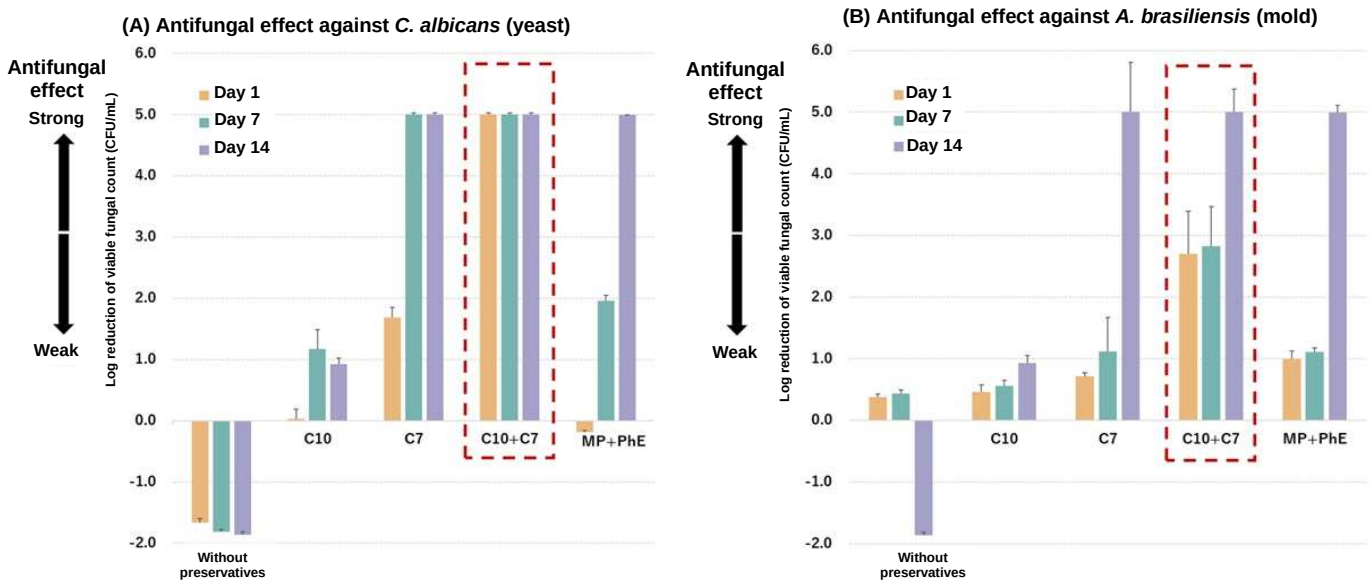
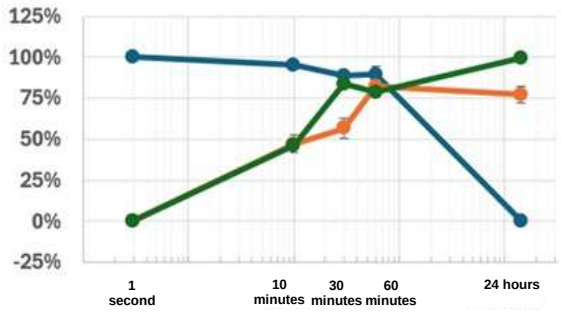


Figure 1. Antifungal effect against fungi (yeast, mold)

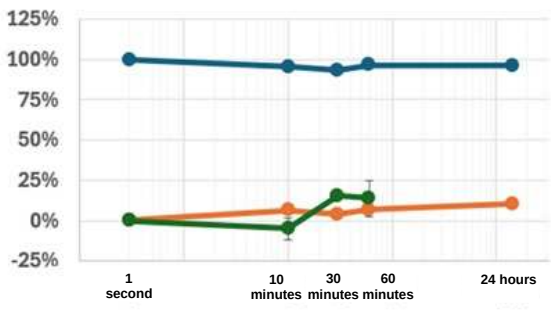
2. It was confirmed that the combination of C7 and C10 damages fungal membranes and inhibits the metabolic activity of fungi.

To elucidate the antifungal mechanism of the combined use of C7 and C10, we evaluated the degree of cell membrane damage and the rate of inhibition of metabolic activity (respiratory activity) during the preservative efficacy test on *Candida albicans*, a representative yeast fungus (Figure 2).

During the first 24 hours in the formulations that did not contain preservatives or that contained the conventional preservatives methylparaben and phenoxyethanol, there was almost no increase in membrane damage or decrease in metabolic activity, and no reduction in the viable fungal rate was observed compared to the initial fungal count (100%). On the other hand, when C7 and C10 were used in combination, membrane damage and metabolic inhibition progressed over time from the start of the test, and the viable fungal rate decreased significantly following 60 minutes until 24 hours later. Although the causal relationship with membrane damage and metabolic inhibition cannot be determined with certainty, it is thought that the combined effect of C7 and C10 led to the fungal death.

<table>
<tr><td>Result</td><td>(A) C10+C7
 

Viable fungal rate (%)
Membrane damage rate (%)
Metabolic activity inhibition rate (%)

* The horizontal axis is elapsed time (logarithmic scale).</td><td>(B) MP+PhE
 

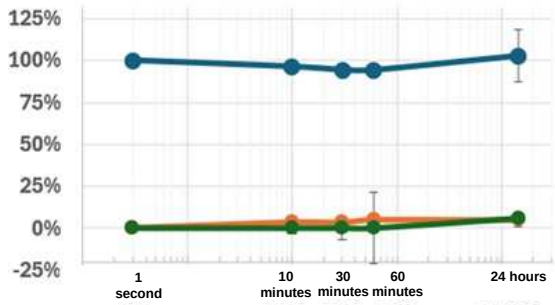
(C) Without preservatives
 
</td></tr>
<tr><td>Viable fungal rate</td><td>Significant decrease following 60 minutes</td><td>No change</td></tr>
<tr><td>Membrane damage rate</td><td>Increased over time</td><td>No change</td></tr>
<tr><td>Metabolic activity inhibition rate</td><td>Increased over time</td><td>No change</td></tr>
</table>

Figure 2. Changes in membrane damage rate, respiratory activity inhibition rate, and viable fungal rate of yeast over time

Considerations and future prospects

This study revealed that the combined use of C10 and C7 provides a high antifungal effect. It is thought that C7 increases the dispersibility of C10 in water, making it easier for it to act on the fungal cell membrane, resulting in membrane damage and inhibition of metabolic activity, leading to fungal deaths.

Furthermore, in a model lotion formulation, it was confirmed that the combination of C10 and C7 was also effective against bacteria. Additionally, antimicrobial effects have been recognized not only in lotions but also in formulations such as gels and sheet masks, which is expected to further expand the possibilities for preservative-free formulas.

This technology responds to the demand for products that are less irritating and safe to use and will contribute to the development of products that can be used safely even by people who are sensitive to preservatives. Mandom will continue to explore further possibilities in preservative technology and develop products that meet the safety, comfort during use, and diverse needs of consumers. We will continue to contribute to technological innovation across the industry and aim to create better products.

Notes and Glossary

* A test to evaluate antimicrobial effects by inoculating a certain number of fungi or bacteria into a product such as a lotion, then measuring the change in the microbial count after storing it for a certain period of time (usually 14 days).