News Release

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Mandom Successfully Develops Cream Formulation that can be Blended with up to 70% Alcohol
~ A very rich-texture cream that both moisturizes & sterilizes ~

Mandom Corporation (Head Office: Osaka City; President Executive Officer & Director: Ken Nishimura; hereinafter referred to as “Mandom”) is promoting the development of hygiene-related technology as part of its efforts to contribute more to the increasing awareness consumers have towards cleanliness.

Demand for disinfectants has been growing in recent years, and we understand that many alcohol[*1]-based disinfectants, although exceptional at sterilization, deprive the skin of water and cause skin to become dry. Therefore, we set out to develop an emulsification (cream) formulation that both moisturizes and sterilizes the skin, something that has conventionally been difficult to achieve. As a result, we have successfully developed a cream formulation that can be blended with up to 70% alcohol, which is a concentration that demonstrates sufficient sterilization capability. In the future, we will use this technology as a basis for adjusting alcohol concentrations and texture, and apply it to the development of products that meet the wants of consumers.

Background Information on this Research

Up until now, moisturizing formulations with high alcohol content were generally gel formulations. These gels gave consumers a refreshing sensation thanks to their alcohol content, but they did not give any rich or full-bodied sensations to help achieve a moisturizing feeling. By switching to a cream formulation, we strived to develop a moisturizing formulation with high alcohol content in order to achieve a rich, moisturizing feeling when applied.

Normal cream formulations combine surfactants in order to evenly emulsify (blend) aqueous and oily ingredients. Since many surfactants dissolve easily in alcohol, emulsification tends to become difficult when the combined alcohol amount increases. In addition, many thickeners, which are required for adjusting cream-formulation-like properties such as appropriate hardness and texture, have a tough time thickening alcohol, which makes it difficult to achieve required levels of hardness and texture. Furthermore, cream formulations generally undergo a warming process during production, so alcohol volatility by heating was another issue that had to be addressed if a high concentration of alcohol is blended into the mix.

To address the issues listed above, we examined optimal combinations to achieve high alcohol content emulsification from over 100 types of surfactants, and endeavored to further the ingenuity of its manufacturing conditions after selecting thickeners that sufficiently demonstrate thickening effects.

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1. Combination of two types of surfactants & thickeners enables emulsification with high alcohol content

Generally, emulsification is a method of evenly mixing water and oil, two contents that do not usually mix. However, this developed product emulsifies water and alcohol content by atomizing (turning them into emulsified particles) and mixing them into the oil content. Normally, emulsified particles join (fuse) together and cause the constituent ingredients to separate, which makes it impossible to achieve a cream-like condition. However on this occasion, after repeated examinations conducted on over 100 types of surfactants, we have discovered a combination of two types of surfactants*2 of differing molecular size that prevents the joining of emulsified particles and forms a stable emulsified state (Figure 1-A). We have also discovered a thickener*3 that demonstrates effective thickening effects even during emulsification in mixtures with high alcohol content from among a specific group of ionic polymer thickeners (Figure 1-B). By combining these surfactants and thickeners, we were able to achieve stable emulsification that can blend alcohol with up to 70% concentration.

When the state of emulsification is bad, these minute emulsified particles separate in a high temperature environment over time (Figure 2-A), but we were able to confirm that the cream it developed on this occasion remained stable over time and did not separate even when left in 40°C conditions for two months (Figure 2-B).

Furthermore, the two types of surfactants mentioned above are both liquid surfactants that can easily be mixed without heating, which means that the use of these surfactants can save the warming process during emulsification and solve the issue of alcohol volatility during the heating process in production.

2. Evaluation results on functionality of cream containing alcohol

The two tests mentioned below conducted evaluation tests on the sterilizing and moisturizing capability of the formulation with an alcohol concentration of 50%, assuming used on the skin of hands.

♦ Evaluation of sterilizing capability

After mixing this formulation with various bacteria (Escherichia coli and staphylococcus aureus), the number of bacteria was measured at regular intervals (time-kill test). Sterilization effect was confirmed to show a 99.99% decrease in the number of bacteria one minute after the test began. Assuming a real-use scenario, a hand-shaped agar plate was used in a stamp test, and the formulation's effectiveness (bacteria reduction) on finger bacteria was also evaluated (Figure 3).

♦ Evaluation of moisturizing capability

This formulation and a solution with 50% alcohol concentration was applied to the skin of separate hands, and the stratum corneum water content of each hand was compared and measured before and up to 60 minutes after application. It was found that this formulation greatly improved water content after application, and high water content was displayed even after 60 minutes had passed (Figure 4).

In addition, we confirmed the effects of the continuous use of this formulation. In a winter environment where skin dries easily, we evaluated the condition of hand skin textures, where this formulation was applied for two weeks on one hand, and where no products were applied to the other hand for the same two-week period. The hand that did not have any products applied to it showed signs of chafing and redness, while the other hand to which this formulation was applied retained a healthy condition (Figure 5-A). Also, upon confirming the skin

texture condition after continued use of this formulation, we confirmed that the hand to which this formulation was continuously applied had many more texture points compared to the hand that did not, and that the skin textures were in good condition. (Figure 5-B)

In this manner, we have succeeded in developing emulsification technology with high alcohol content, a feat that has been difficult to achieve until now, and realized the difficult task of creating a product that both effectively moisturizes and sterilizes.

We will continue to develop new technologies that make consumers' hygiene habits more comfortable and pleasant.

*1 The term "alcohol" used in the text refers to ethanol (also known as "ethyl alcohol")

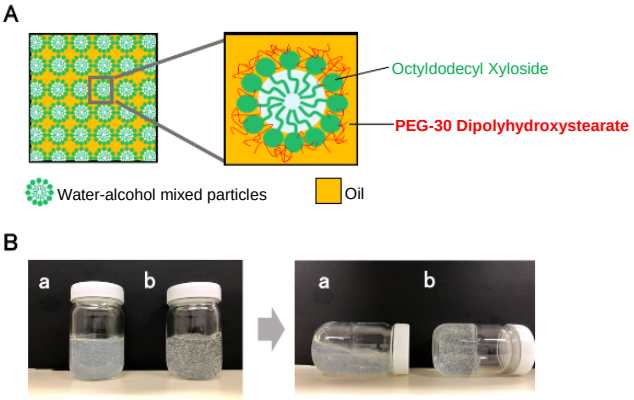
*2 Octyldodecyl Xyloside, PEG-30 Dipolyhydroxystearate

*3 (Ammonium Acryloyldimethylta Urate/VP) Copolymer

[Reference Materials]

Figure 1. A) Image of emulsified particles using two types of surfactants

B) Difference in thickening capability of alcohol solution at same concentration



(a) Thickeners commonly used for emulsifying

(b) (Ammonium Acryloyldimethylta Urate/VP) Copolymer

Figure 2. A) Unstable state of emulsification

B) Stable state of emulsification

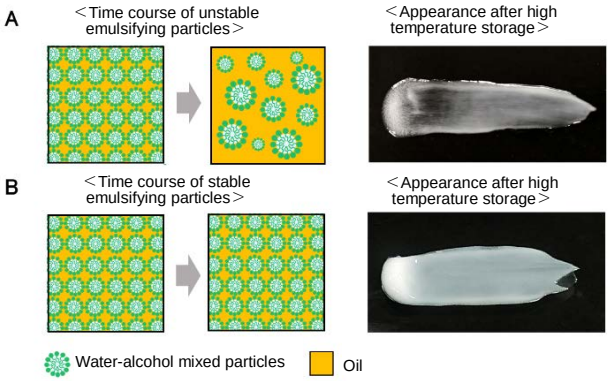
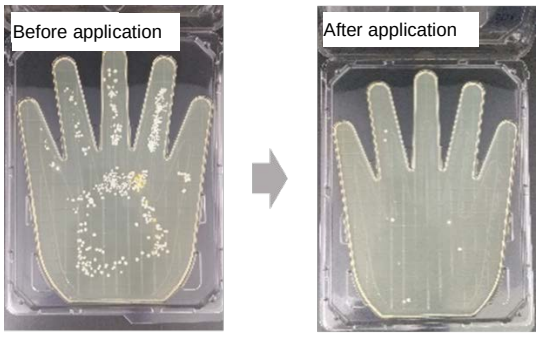


Figure 3.Results of stamp test before/after applying this formulation



Bacteria on white areas that change before and after application

Figure 4. Skin moisture content after the application of this formulation

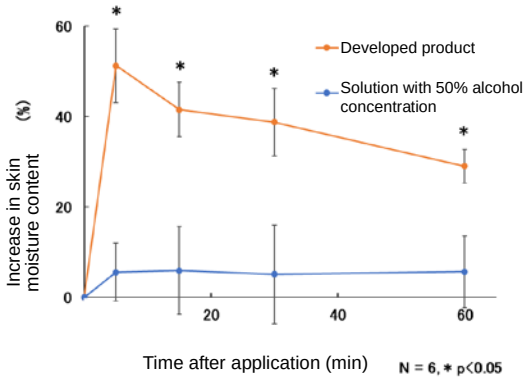


Figure 5. A) Condition of hand skin after application of this formulation

B) Hand skin texture changes after two weeks