MILBON

News Release

September 29, 2022

Milbon Develops Nanoemulsion Formulation with High Oil Content
Successfully promotes hair penetration of oil ingredients through finer emulsion particles

Milbon Co., Ltd. (head office: Chuo-ku, Tokyo, Japan; Representative Director, President, and CEO: Ryuji Sato), a manufacturer of hair cosmetics for salons, has developed an aqueous liquid nanoemulsion formulation[*1] with a high oil ingredient content. The new nanoemulsion formulation with a diameter of approximately 50 nm, compared to one with a diameter of approximately 200 nm made with the same ingredients, was confirmed to deliver its oil ingredients further inside hair and had an enhanced hair softening effect. We presented this research outcome at the academic conference referred to below.

[Presentation]

Academic conference: The 73rd Divisional Meeting of Division of Colloid and Surface Chemistry

Title of presentation: Oil-in-water Nanoemulsions using Low-Energy Techniques to Promote Oil Penetration into the Hair

Date of presentation: September 22, 2022

[Background of Research]

The increased interest in beauty in recent years has led to the diversification of hair care methods. Among products used, an aqueous liquid hair treatment is often capable of meeting consumer needs for light and smooth hair, and can be sprayed in a mist form to distribute evenly throughout hair, thereby providing different benefits from those of common cream or oil treatments. Aqueous liquid formulations, however, had an issue in that they have low viscosity, like water, making it difficult to stably formulate a high amount of oil ingredients that are expected to have hair care effects.

One way to solve this issue is to use a technique to finely emulsify (nanoemulsion) the oil ingredients in water. While studies on skin penetration of nanoemulsion formulations have been reported and utilized in the field of skincare, only a few studies have been reported on hair penetration of nanoemulsion formulations in the area of hair care products, and further progress is desirable. In addition, the nanoemulsion formulation production process requires high temperatures and the strong mechanical force of a mixer. For achieving the SDGs, it is necessary to develop a formulation method to realize energy-efficient nanoemulsion.

To achieve this, in this study, we developed a formulation technique for producing an aqueous liquid nanoemulsion formulation with a high oil content under relatively mild conditions and evaluated the formulation’s hair penetration and its effect on hair.

[Study Findings]

1． Establishment of a formulation technique to produce nanoemulsions with high oil content

In this study, we selected surfactants with the goal of obtaining nanoemulsions with high oil content using a low environmental impact method that only requires gentle mixing of ingredients at 60ºC, which is a relatively mild heating condition. Screening of a wide variety of surfactants led to the finding that a surfactant with multiple hydrophobic groups in its molecules is highly capable of creating fine emulsified particles. Together with such a surfactant, we used a surfactant with a bulky molecular structure with the aim of retaining oil ingredients within emulsified particles so that, once broken down finely, they would remain small and exist stably. As a result, we successfully obtained a stable nanoemulsion formulation holding about twice as much oil ingredients as the amount of surfactant (Figure 1).

The diameter of an emulsified particle in the nanoemulsion formulation obtained using the technique developed is approximately 50 nm. This is about 1/1800 of the average diameter of hair (approximately 90 µm) (Figure 2). Our technique has therefore enabled us to stably add a large amount of oil ingredients, which effectively treat damaged hair and make hair more manageable, to an aqueous liquid formulation with low viscosity.

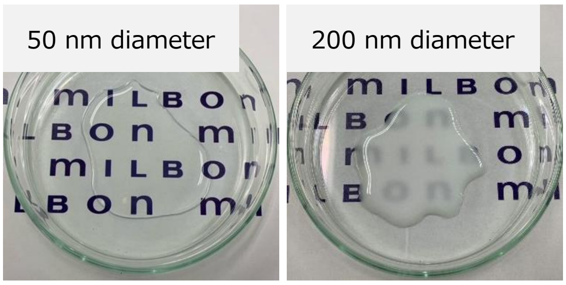


Figure 1. Appearance of the nanoemulsion formulation obtained

The formulation with a diameter of approximately 50 nm (left) has small emulsified particles and lets light pass through, while the formulation with a diameter of approximately 200 nm (right) is opaque.

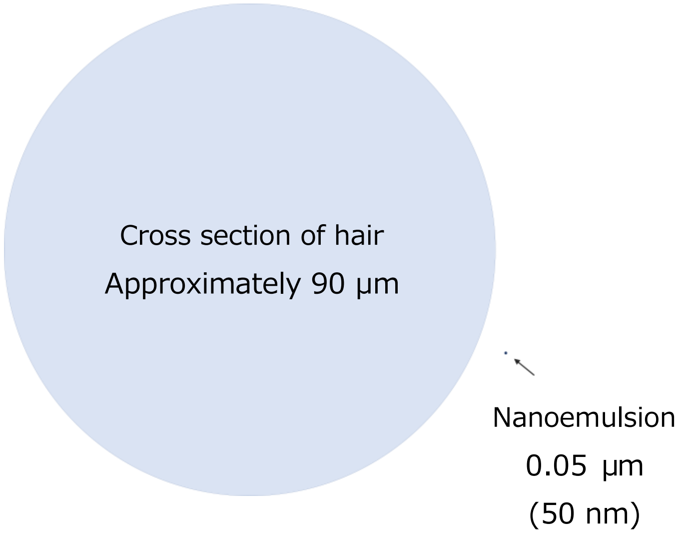
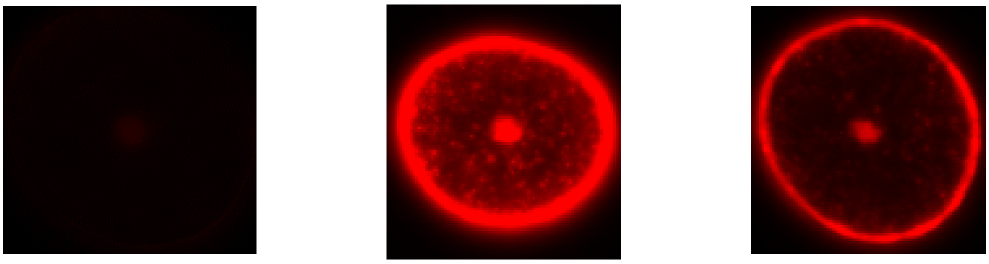


Figure 2. Diameter of an emulsified particle in the nanoemulsion formulation

It is approximately 1/1800 of the average diameter of hair.

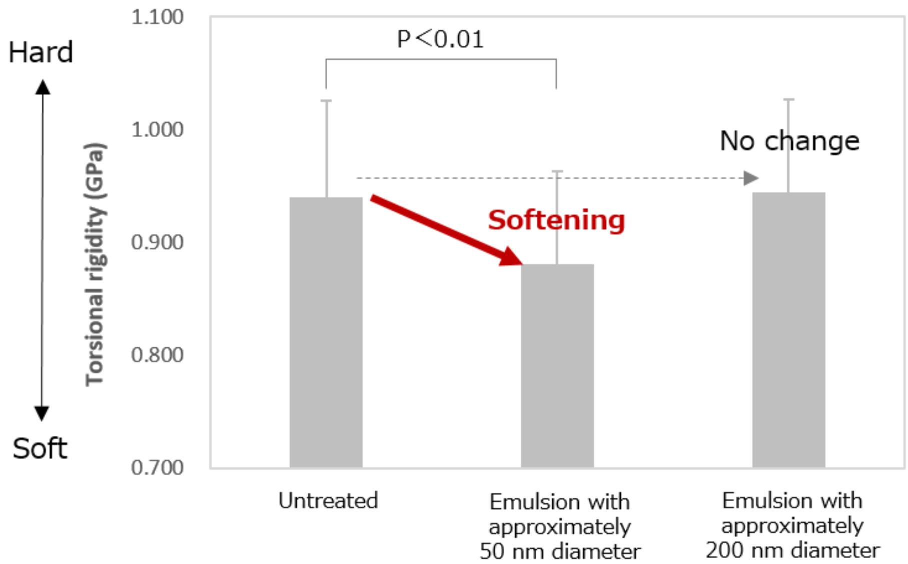
2. Confirmation of high hair penetration and enhanced hair softening effect of the nanoemulsion formulation

We examined the hair penetration of the oil ingredients in the nanoemulsion formulation we obtained. Using an oil-soluble fluorescent red dye as the target oil ingredients, we observed cross sections of hair through a fluorescence microscope to evaluate the penetration. It was confirmed that the obtained nanoemulsion formulation with a diameter of approximately 50 nm delivered its oil ingredients deeper inside hair, compared to the formulation with a diameter of approximately 200 nm made with the same ingredients (Figure 3a). Furthermore, use of each formulation on hair hardened by damage due to dyeing indicated that the nanoemulsion formulation had a high hair softening effect (Figure 3b).



Untreated | Emulsion with approximately 50 nm diameter | Emulsion with approximately 200 nm diameter

(a) Hair penetration



(b) Hair softening effect

Figure 3. Difference in hair penetration and hair softening effect by emulsified particle diameter

[Future vision]

This study has made it possible to stably add a large amount of oil ingredients, which are expected to produce a wide variety of beneficial effects for beautiful hair, to an aqueous liquid formulation. Using this technique, we will aim to develop a highly penetrating and effective hair care products that can be easily applied evenly over hair.

≪**Terminology**≫

*1 Emulsion

A liquid system in which liquids that do not mix with each other, such as water and oil, separate into two layers is called an emulsion when one liquid is broken down into small droplets (emulsified particles) and dispersed in the other. To obtain an emulsion, it is necessary to add an agent such as a surfactant to lower the surface tension between the liquids and suppress the merging of dispersed emulsified particles once they are dispersed.

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