Mandom successfully develops highly skin-permeable fine capsule formulation “bicelles”

~ For the development of skin care products with greater functionality ~

Mandom Corporation (hereafter, called Mandom; headquartered in Osaka city; president executive officer and director Motonobu Nishimura) has been involved in capsule formulation research with the aim to develop skin care products that have greater functionality. Studies of advanced capsule formulations, which are superior and have higher permeability than conventional capsule formulations, and the use of a specific component of bilayer membrane led Mandom to the successful creation of the capsule formulation “bicelles,” which is superior to conventional capsule formulations. The skin permeability of bicelles is confirmed to be high.

1. What is bicelle?

Conventionally, capsule formulations studied in the cosmetics industry include liposomes. A liposome has a spherical-like structure composed of many layers of bilayer membranes, consisting mainly of phospholipids overlapping in a radial pattern. Liposomes range in size from approximately one-hundred to a few hundred nanometers (Figure 1). A bicelle also consists mainly of phospholipids and has a spherical-like structure composed of overlapping bilayer membrane discs. However, it ranges in size between a few nanometers to tens of nanometers, which is considered the smallest among capsule formulations that contain a lipid bilayer structure (Figure 2). Bicelles has been used mainly as an in vivo membrane model for the assessment of pharmacological activity, toxicity, and pharmacokinetics of a new drug, but only a few research programs in the cosmetics industry have focused on the skin penetration function of bicelles.

2. Development of bicelles that can be applied in cosmetics

Two different types of phospholipids are usually used in bicelles, although a special processing requirement has made its application in cosmetics difficult. Mandom successfully created this form of bicelles, which can be used in cosmetics owing to the combination of phospholipid components suitable for cosmetic applications and different types of amphiphilic components (*1).

3. Bicelles has higher skin permeability than conventional liposomes

Bicelles and liposomes were evaluated in the human skin to compare their skin permeability. The results showed that the skin permeability rate of bicelles was faster than that of liposomes (Figure 3).

4. A model serum prepared with bicelle technology penetrated deep into the stratum corneum

A skin penetration test was performed by using TOF-SIMS(*2) in the human skin to evaluate a model serum

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that applied the bicelle technology. It was demonstrated that the model serum penetrated deep into the stratum corneum (Figure 4).

Mandom aims to apply the bicelle technology that was developed through the present research in the development of skin care products with excellent skin permeability.

*1 An amphiphilic component is made up of parts that easily blend with both oil and water.

*2 TOF-SIMS (time-of-flight secondary ion mass spectrometry)
An analysis method used to identify the presence of target molecules. The sample is irradiated with an ion beam, and the ions released from the surface of the sample are measured.

REFERENCES

Figure 1. Liposome structure and electron microscopic image

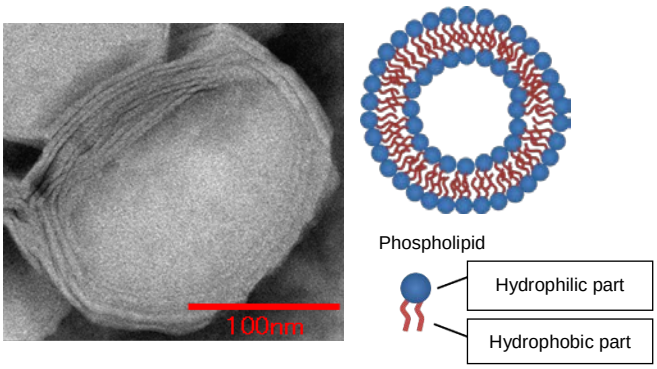
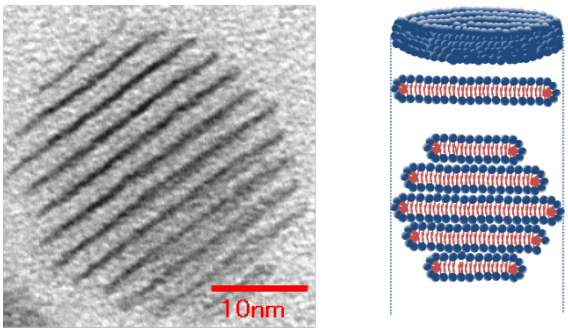


Figure 2. Bicelle structure and electron microscopic image

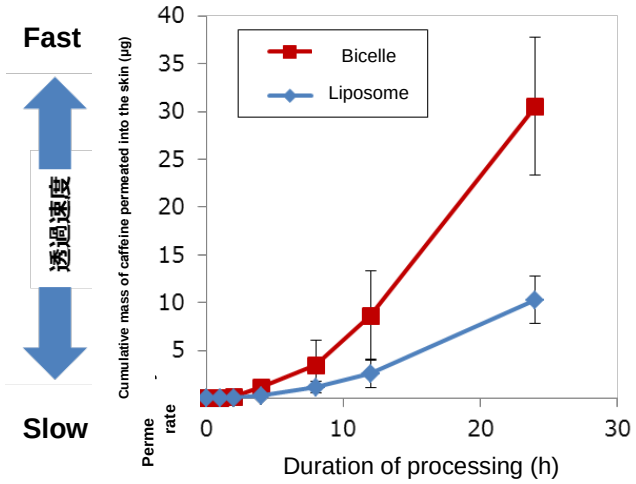


MODEL USED FOR IMAGING: Transmission electron microscope (JEM-1400Plus)

CCD CAMERA: EM-14830RUBY2

TECHNIQUE: Negative staining method

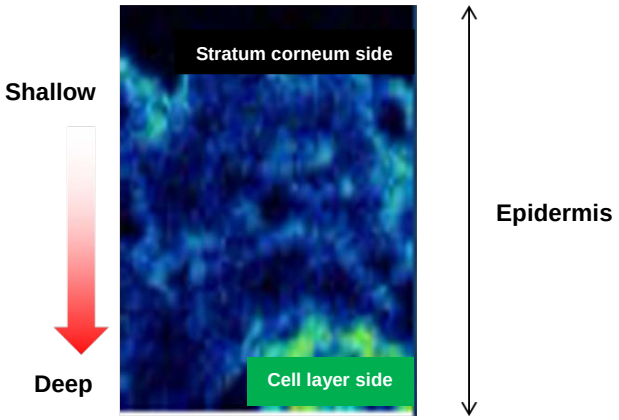
Figure 3. Comparison of skin permeation of bicelle and liposome



SKIN SAMPLE: Female, 44 years of age, skin thickness: 500 (400–600) μm, confirmation of healthy skin: 20 g/m^2 per hour or less by TEWL

EVALUATION METHOD: Amount of caffeine permeated into the skin from the stratum corneum to the dermal layer was quantitated by using an evaluation system called a Franz Cell (1.5 cm diameter, approximately 6.5 mL receiver volume [Hanson research]) (n=5).

Figure 4. Evaluation of the skin permeation of a model serum prepared with bicelle technology



SKIN SAMPLE: Female, 33 years of age, skin thickness: 500 (400–600) μm, confirmation of healthy skin: 20 g/m^2 per hour or less by TEWL

EVALUATION METHOD: A model serum was applied on the human skin. Skin cross sections were measured after 24 hours by using TOF-SIMS to evaluate the skin permeability of the model serum.

MEASURING CONDITIONS: Measuring device: TOF-SIMS, mass spectrometer: time-of-flight secondary ion mass spectrometry, primary ion: Bi

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