

## Mandom successfully developed “natural bicelles,” a highly permeable nanocarrier with 100% natural origin content

Mandom Corporation (Head office: Osaka City, President Executive Officer: Ken Nishimura, hereinafter referred to as Mandom) conducts research on permeation control technology that enables delivery of cosmetic ingredients deep into the skin so as to develop highly functional skincare products.

We have succeeded in the development of “natural bicelles,” a nanocarrier<sup>\*2</sup> with 100% natural origin content,<sup>\*1</sup> that can enhance the skin permeability of water-soluble ingredients. In the future, we will apply this technology to the development of skincare products with excellent skin permeability.

### Background of the research

Before now, Mandom had successfully developed bicelles, or nano-sized capsules with high skin permeability,<sup>\*3</sup> which had been used in our skincare products. To further develop this bicelle technology, we embarked on the development of natural bicelles using natural origin content as defined in ISO16128, an international standard for natural and organic cosmetic ingredients.

### 1. Development of natural bicelles with 100% natural origin content

Bicelles are disk-shaped structures composed mainly of phospholipids, which are biomembrane-mimetic substances. The size of the surface is anywhere between 20 to several dozen nm and the thickness is between a few to 10 nm, and they are considered to be the smallest in size for a formulation with a lipid bilayer membrane structure (Figure 1).

We investigated combinations of bicelle-forming ingredients using only 100% natural origin content and succeeded in developing natural bicelles that can be stably formulated into skincare products (Figure 2).



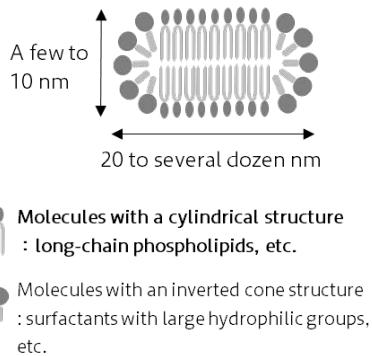
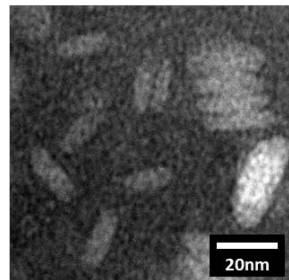


Figure 1. Structural diagram of the bicelle structure (cross section)



Equipment: Transmission electron microscope

Figure 2. Electron micrograph of natural bicelles

## 2. Permeability evaluation of natural bicelles

We evaluated the skin permeation effect of natural bicelles using two types of water-soluble ingredients that are, in general, not easily skin-permeable. After evaluating the human skin permeability of caffeine, it was confirmed that the permeability of caffeine was improved when applied with natural bicelles (Figure 3). In addition, we similarly evaluated the permeability of a water-soluble fluorescent dye and found that it penetrated all the way into the dermis when formulated with natural bicelles (Figure 4).

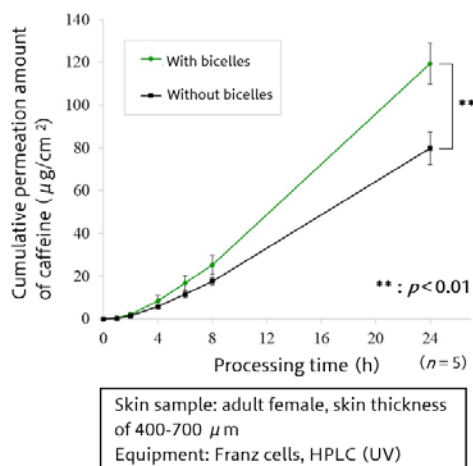


Figure 3. Comparison of skin permeability by caffeine

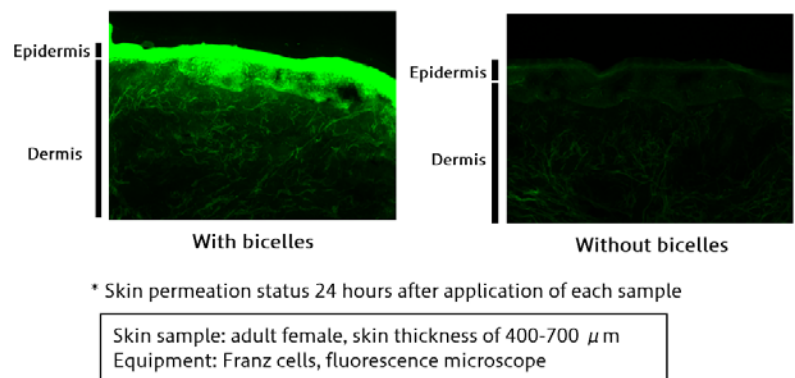


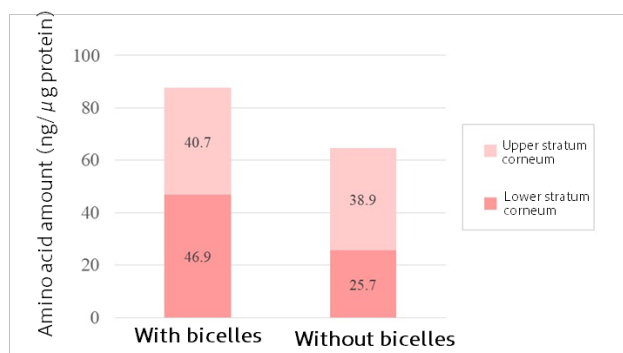
Figure 4. Comparison of skin permeability by fluorescent dye

## 3. Permeation effect of a model lotion containing natural bicelles

Focusing on amino acids, which play an important role in retaining moisture in the stratum corneum, we conducted a permeability evaluation using a model lotion containing ferment extract

rich in amino acids and natural bicelles and determined the impact on the amount of amino acids present in the stratum corneum. The evaluation confirmed that the amount of amino acids in the stratum corneum was higher when using the lotion containing natural bicelles, and in particular, the amount of them in the lower stratum corneum had significantly increased (approximately 1.8 times). It was suggested that natural bicelles allowed the ferment extract to permeate deeper into the stratum corneum (Figure 5).

Mandom will be applying this highly permeable nanocarrier, “natural bicelles,” to the development of high-performance skincare products that are desirable to various consumers, including the increasing number of those preferring natural or organic products.



\* Amount of amino acids in the stratum corneum 24 hours after application of each sample

Skin sample: adult female, skin thickness of 400-700 μm  
 Equipment: Franz cells, LC-MS/MS (triple quadrupole type)  
 Method: Collect each layer by the tape stripping method and measure the amino acid content

**Figure 5. Comparison of amino acid content in the stratum corneum using a lotion containing natural bicelles**

## Notes and glossary

\*1 Compliant with ISO16128, the international standard for natural and organic cosmetics (including water)

\*2 Nanocarrier: Nanometer-sized ingredient transporter

\*3 Mandom successfully develops highly skin-permeable fine capsule formulation “bicelles,” released on February 8, 2019