Understanding Liposome Technology

OVERCOMING THE SKIN BARRIER

One of the biggest challenges in skin care is the delivery of active ingredient into the skin. The skin is composed of three main layers: the epidermis, dermis, and hypodermis. The epidermis generates the stratum corneum, which is the outermost layer of the skin. The stratum corneum controls water loss from the skin and penetration of compounds through the skin. Because of it, many cosmetic ingredients can work only on the surface of the skin, i.e. water soluble substances are unable to pass through the epidermal barrier.

Skin care formulations are expected to meet high standards of efficacy for the sophisticated consumer of today. Cosmetic actives can be transported to the target site to ensure effectiveness of a cosmetic formulation. In recent years, modern technologies of active ingredient encapsulation have been used more frequently for delivering active substances to the skin. Liposomes are most commonly used for this purpose. In their liposomal form, cosmetic ingredients exhibit better stability, penetration, and efficacy at lower use levels.

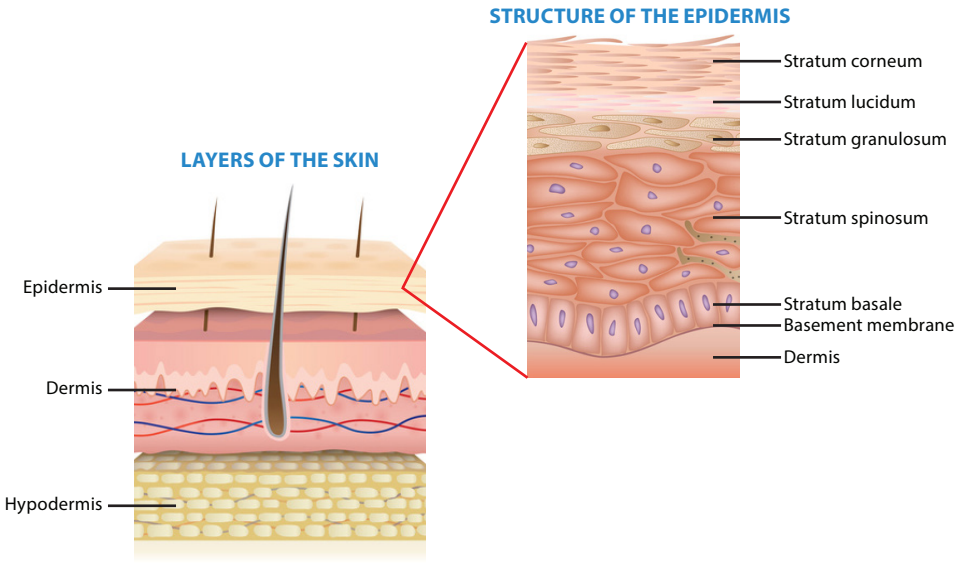

Figure 1. Schematic representation of the layers of the skin and structure of the epidermis.

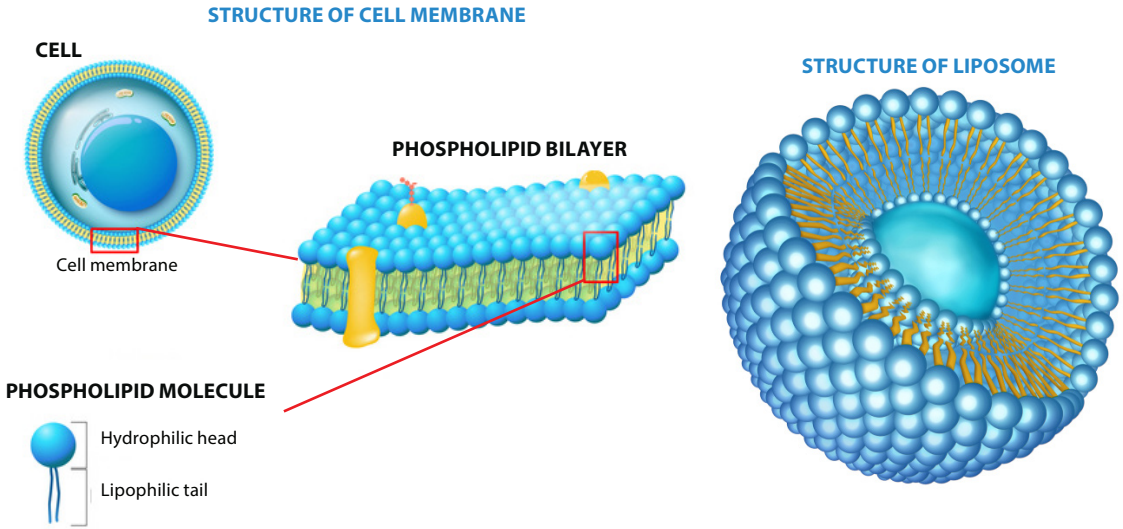

Figure 2. Schematic representation of cell membrane and unilamellar liposome structure.

WHAT ARE LIPOSOMES?

Liposomes are microscopic, spherical vesicles with a structure that closely mimics cell membranes and are generally used to enhance the stability and delivery of active ingredients in cosmetic applications.

When non-encapsulated materials are placed on the skin a range of factors determine the fate of the material. Stability, solubility, lipophilicity, and size are all obstacles the active must overcome to penetrate the epidermal barrier. Liposomes create a more beneficial interaction with skin cells. The structure and amphiphilic nature allows the liposomes to penetrate the epidermal barrier and travel deeper than free materials to deliver the anticipated results.

Formulator Sample Shop supplies unilamellar liposomes that are uniform, stable, and serve as an effective delivery system for both water soluble and oil soluble cosmetic actives.

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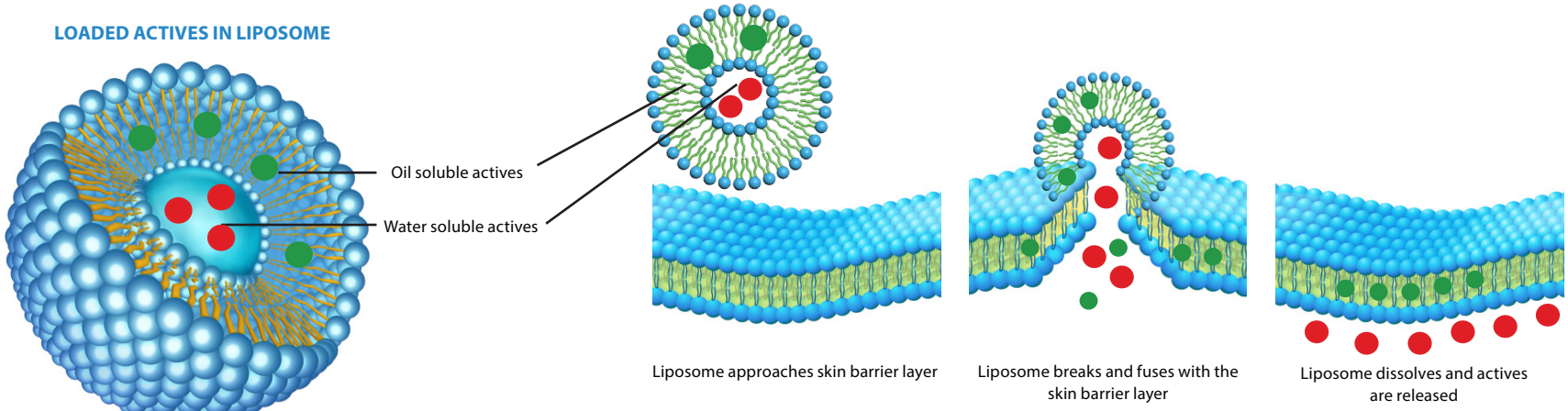

Figure 3. Release of liposomal actives.

WHERE DO THE ACTIVES EXIST IN THE LIPOSOME?

Liposomes are capable of delivering hydrophilic actives, which are loaded in the aqueous inner core, or lipophilic actives, which are loaded in the lipid bilayer.

HOW DO LIPOSOMES WORK?

In order to overcome the lipophilicity and high cellular adhesion of the stratum corneum, cosmetic liposomes must burst on the surface of the skin to enhance the delivery of the loaded actives. Cosmetic liposomes are designed to break on the skin and fuse with the epidermal lipids, creating pores that allow for delivery of the loaded actives. Greater penetration of the loaded active occurs as it is carried through the stratum corneum, with penetration stopping at the living epidermal cells.

Water soluble actives are immediately released when the cosmetic liposome breaks on the surface of the skin, whereas oil soluble actives remain solubilized in the lipophilic portion of the liposomal membrane and are slowly released over time.

Liposomes' proven delivery system yields a multitude of benefits; enhancing the penetration of actives yielding increased efficacy, offering time release mechanisms, protecting and delivering otherwise unstable ingredients, and opening the door to the ability to target specific cells.

HOW ARE LIPOSOMES LOADED?

The liposomes themselves represent the dispersed phase of a liposomal dispersion. The continuous phase is a water soluble solution. Water soluble actives do not need to be physically loaded into a liposome due to their porous nature. Liposomal bilayers are fluid, therefore they are permeable. By the law of diffusion, the concentration of water soluble components outside and inside of the liposome will be in equilibrium. Unless the liposome is filtered, the concentration of the water soluble active in the continuous phase is going to be equal to the concentration of the water soluble active inside the liposome. As long as the unloaded liposome is added with the water soluble active, the water soluble active will end up in equilibrium and loaded into the liposome.

Oil soluble actives can be loaded into liposomes using shear homogenization. Oil soluble actives would not exist freely in the continuous phase because their hydrophobicity would keep them present in the phospholipid bilayer of the liposome.