Development of Functional Cosmetics “ASTALIFT JELLY AQUARYSTA”

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Abstract

The stratum corneum is the outermost layer of the skin and serves as a barrier to suppress loss of moisture and protects the body against the hazardous external substances such as viruses and allergens. It is well known that ceramides, one of the components of intercellular lipids in the stratum corneum, are gradually lost with aging. As a potent countermersure to the decrease of ceramides, we mobilized our propriety NANO FOCUS TECNOLOGY to nano-disperse human-type ceramides down to 20 nm in diameter. The human-type nano ceramide dispersion exhibits permeability up to 9 times greater than that of precedent examples. Based on this invention, we have developed “ASTALIFT JELLY AQUARYSTA” that features the nano ceramide dispersion, for the purpose of improving barrier functions of the skin.

1. Introduction

We have been developing functional cosmetics by applying our technologies for “making beautiful pictures” to those for “making the beautiful skins”. The “ASTALIFT” is a basic skin care series developed by focusing on anti-aging for women since the late thirties. Bland concept of the “ASTALIFT” is “total collagen care” by using astaxanthin and 3 types of collagens.

“JELLY AQUARYSTA” (Fig. 1), a special care product in the ASTALIFT series, launched in September 2010, was developed with a goal of fundamental amelioration of the drying of the skin. While it has been said that aging of the skin is attributable primarily to “photo-aging” due to ultraviolet light or active oxygen, it has been known that inflammation caused by active oxygen is accelerated by drying of the skin. Accordingly, it is a matter of great importance for anti-aging to keep the skin fresh and moist.

Fig. 1 ASTALIFT JELLY AQUARYSTA.

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2. Barrier Functions of the Skin

The skin is composed of the epidermis, dermis and subcutaneous tissue from its surface toward the inside. Epidermis consists mainly of keratinocytes. Keratinocytes generated newly by cell division in the basal stratum undergo differentiation and induction gradually to change their configurations and functions, and then, they are pressed up by keratinocytes generated subsequently to move to the surface of skin.

Cells denucleated in the final stage of differentiation are referred to as corneocytes. During differentiation to corneocytes, they release some lipids around them to form intercellular lipids. The layer consisting of the corneocytes and the intercellular lipids which fill gaps among the cells is referred to as the stratum corneum (Fig. 2).

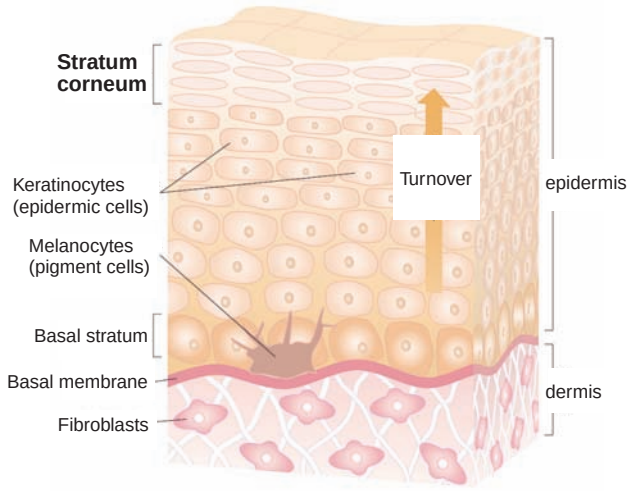


Fig. 2 Schematic diagram of skin.

2.1 Structure and Function of the Stratum Corneum

The stratum corneum, that is, the outermost layer of the skin, has a structure which is compared with one consisting of bricks (corneocytes) and mortar (the intercellular lipids). The layer serves as a barrier to suppress transepidermal loss of moisture and protects the body against external foreign bodies and stimuli.

The intercellular lipids corresponding to mortar consist of ceramides primarily (about 50%) and other lipids such as cholesterol and fatty acids. The ceramide forms a characteristic layered structure (lamellar structure) in which hydrophobic and hydrophilic domains are folded alternately. This lamellar structure provides the stratum corneum with strong barrier functions (Fig. 3)[1].

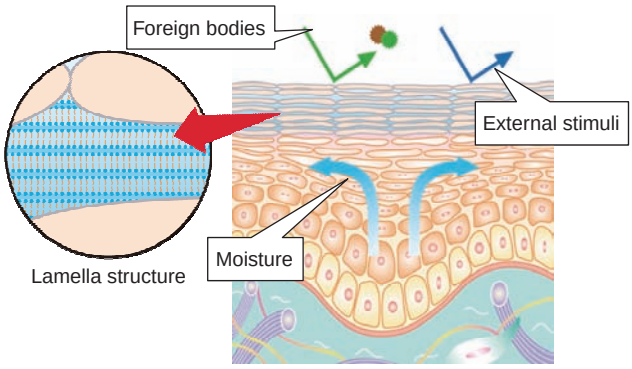


Fig. 3 Functions of stratum corneum.

2.2 Roles of Ceramides

It has been known that amounts of ceramides in the stratum corneum decrease with age[2]. If the amounts of ceramides decrease, it would become difficult to form a well ordered lamella structure which would be important for the barrier functions. Therefore, loss of ceramides may result in drying or inflammation of the skin.

3. Nano-dispersion of Human-type Ceramides

In order to supplement ceramides decreased with age and to regain the original barrier functions of the skin, we developed Nano-dispersion of human-type ceramides with high permeability into the stratum corneum.

3.1 Types and Properties of Ceramides

Ceramides in the stratum corneum are synthesized from L-serine and palmitoyl-CoA by the actions of a variety of enzymes in the stratum spinous or granular layer of the epidermis. After stored once as glycosylceramides or sphingomyelin, those synthesized ceramides are excreted extracellularly from the lowermost layer of the stratum corneum. Then, those extracellular ceramides are converted to ceramides again enzymatically to form the lamella structure[3].

Ceramides biosynthesized from L-serine in the stratum corneum are optically-active substances, while eleven types of structures are identified as basic skeletons. Ceramides with the same structures as those of ceramides in the stratum corneum are referred to as human-type ceramides (Fig. 4). Since transepidermal loss of moisture from the skin can be suppressed by applying the human-type ceramides to the skin, studies to treat patients with atopic dermatitis have been conducted with such ceramides[4].

It was difficult, however, to mix the human-type ceramides in cosmetics because of their low solubilities in water or oils due to their easy crystallization. Therefore, precedent cosmetics, often made use of ceramides with higher solubility, such as pseudo-ceramides, structural analogues of human type of ceramides, or glycosylceramides, precursors of ceramides in the stratum corneum. Nevertheless, these ceramides did not recovery the barrier functions of the stratum corneum in a satisfactory level.

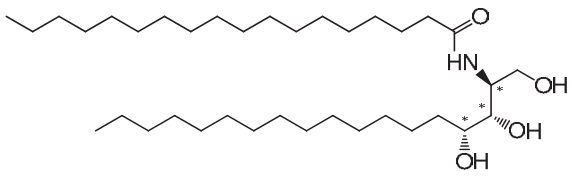


Fig. 4 Molecular structure of human-type ceramide.

3.2 Human-type Nano Ceramides by using NANO FOCUS TECHNOLOGY

By taking advantage of our originl NANO FOCUS TECHNOLOGY, we have succeeded in dispersing the human-type ceramides into nanoparticles in water without using solubilizing oils. We could prepare a transparent dispersion of particles with a mean diameter of 20 nm and a narrow size distribution. Moreover, transmission electron microscopy revealed that the solution has finer particles as compared with those found in the precedent dispersion (Fig. 5). The dispersion of ceramides prepared by NANO FOCUS TECHNOLOGY is referred to as the human-type nano ceramides.

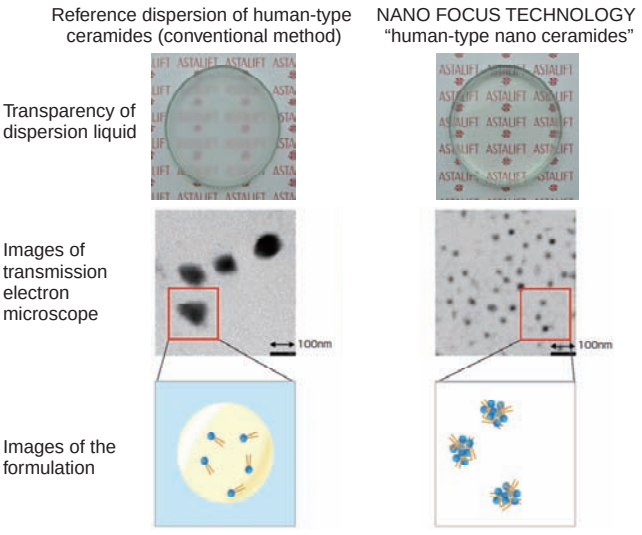


Fig. 5 TEM images and schematic diagrams of human-type ceramide dispersion.

3.3 Effects on the Skin

For demonstrating superior performance of the human-type nano ceramides on the skin, their permeation properties into the stratum corneum were assessed. Each of the human-type nano ceramides and its reference was applied on the skin of the medial side of arms in 5 healthy subjects for 7 days. Permeated amounts of ceramide were determined by the tape-stripping method after the end of application. It was demonstrated that permeability of human-type nano ceramides was 9 times greater than that of its reference (Fig. 6).

In addition, we succeeded in visualizing the differences in permeation between the human-type nano ceramides and its reference by using a three-dimensional skin model (a dermal model). Ceramides was detected with the use of anti-ceramide antibody and the fluorescent antibody method. While ceramides can be identified as green fluorescence images as shown in Fig. 7, it was confirmed that the human-type nano ceramides (right picture) are distributed in wider area of the stratum corneum as compared with the its reference (left picture).

Another test was conducted to compare how much recovery of the barrier functions in the stratum corneum is possible by application of the human-type nano ceramides or its reference. In 14 healthy adult subjects, skin on the medial side of arms was damaged by removing fats with an acetone-ether mixture.

Then, the same amounts of the human-type nano ceramides and its reference were applied on the damaged skins every day to follow up the recovery of the barrier functions as evaluated by the transepidermal water loss (TEWL). Fig. 8 clearly shows that the treatment with human-type nano ceramides allows in faster recovery of the barrier functions in the affected area as compared with the its reference.

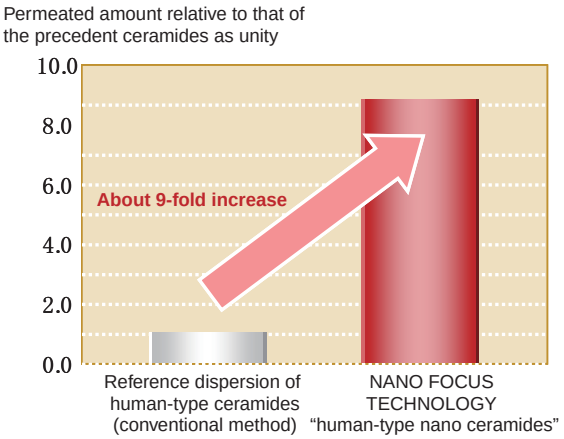
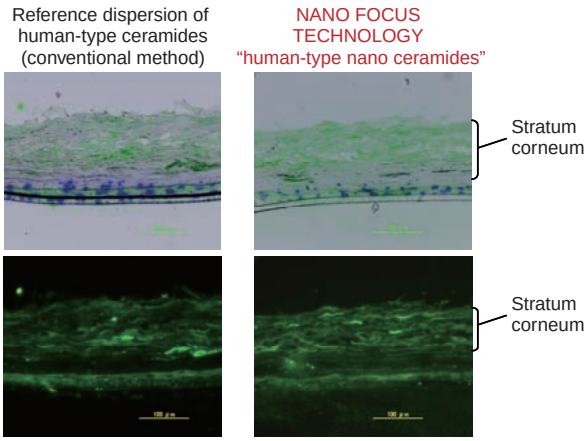


Fig. 6 Amount of permeated ceramide to stratum corneum.



Upper row : Images of light microscope
Lower row : Images of fluorescence microscope

Fig. 7 Optical and fluorescent microscopy image of 3-dimensional human dermal model.

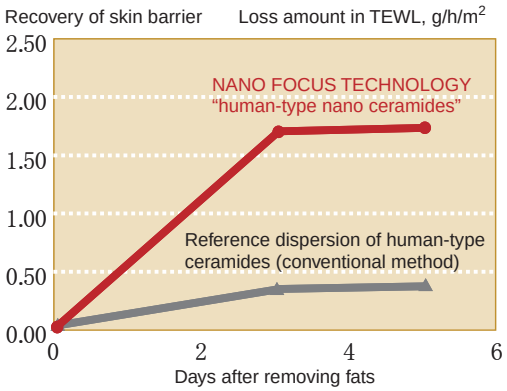


Fig. 8 Change of transepidermal water loss.

4. JELLY AQUARISTA

JELLY AQUARISTA contains high concentration of the human-type nano ceramides, which was developed under the concept of "leading to the flesh and moist skins by eliminating the origin of skin drying".

4.1 Gel-type formulation

For mixing high concentrations of the human-type nano ceramides in cosmetics, we selected a gel-type formulation. Since this gel-type formulation contains cross-linkage of materials via a weak interaction, it prevents precipitation of the highly crystalline human-type ceramides and enables mixing them in high concentrations.

In addition, this weakly gel-type formulation provides particular physical property, where the material deforms when touched but its surface flat after 1 - 2 min (Fig. 9). Due to such a physical property, it became possible to provide characteristic usability of a cosmetic product, with which one can take care of one's complexion with a fresh feeling every time.

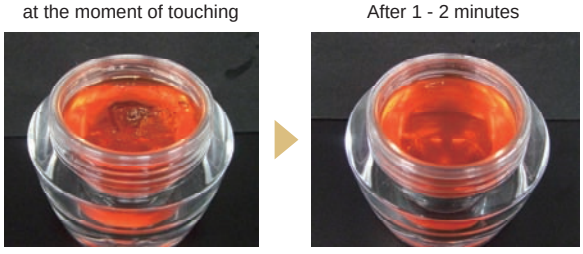


Fig. 9 Flatness of product surface.

4.2 Effects on the Skin

An 8 week continuous treatment study was conducted with JELLY AQUARISTA contains a high concentration of the human-type nano ceramides for the recovery of the barrier function of the skin. Ten female subjects used JELLY AQUARISTA for skin care every morning and night in addition to the usual skin care and their skin conditions were assessed before and after the treatment and in 2, 4 and 8 weeks. While moisture contents of skins are provided in Fig. 10, mean scores of texture, pore and wrinkle are shown in Fig. 11. It was demonstrated that post-treatment scores of moisture contents, texture, pore and wrinkle are improved significantly as compared with pre-treatment scores.

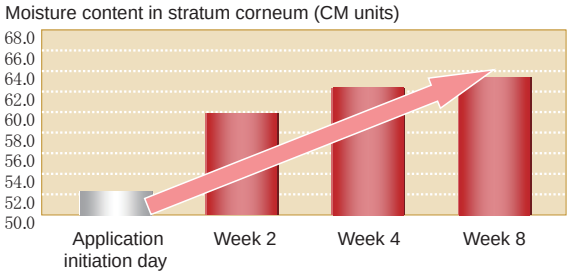


Fig. 10 Change of water content of skin.

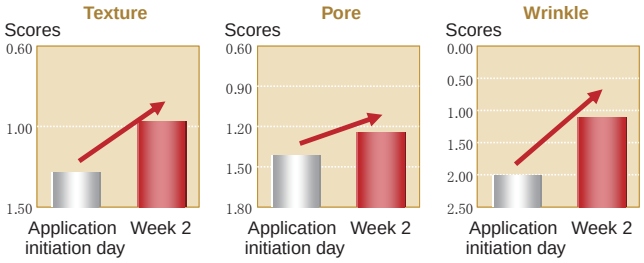


Fig. 11 Change of skin condition.

5. Conclusion

"ASTALIFT" is a series of functional skin care products developed by applying emulsification and dispersion technologies (NANO FOCUS TECNOLOGY) including the human-type nano ceramides reported in the present article, which has been accumulated through the development of photograph films. The products have characteristic components including the nano emulsion of astaxanthin having potent antioxidizing activity and a combination of multiple types of collagens with different molecular weights and roles. We will continuously develop characteristic technologies for cosmetics to achieve fundamental amelioration of the skin.

References

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