Cosmeceutical Critique

Barrier Repair Products

Cold atmospheric temperatures lead to lower humidity. In such conditions, water is more likely to evaporate from the skin, particularly in individuals with an impaired skin barrier. With the arrival of winter, a discussion of the importance of the skin barrier and how to repair it is appropriate. Notably, cosmeceutical barrier repair products have an important role to play.

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The Skin Barrier

Several important functions are served by the skin barrier: preventing transepidermal water loss (TEWL), shielding the skin from allergens and irritants, and protecting against infections. This defensive role depends largely on corneocyte function and the surrounding extracellular matrix (J. Invest. Dermatol. 2005;125:183-200).

The cornified cell envelope that encases the corneocyte is a 10-nm–wide, insoluble layer composed of various highly crossed proteins, particularly loricrin, the principal component, and involucrin, desmoplakin, and periplakin (J. Cell Sci. 2001;114:3069-70). The envelope structure is formed via cross-linking by the calcium (Ca^{2+})-dependent transglutaminase-1 (TG-1) enzyme.

The water barrier function of the skin is largely attributed to the lipids in the extracellular matrix that surrounds the corneocytes (Adv. Lipid Res. 1991;24:1-26). (Of note, TEWL is considered insensible water loss through the skin, which differs from active perspiration.) This lipid mixture is composed of approximately 50% ceramides, 25% cholesterol, and 15% fatty acids (J. Lipid Res. 2007;48:2531-46). Changes in any of these three components of the extracellular matrix can lead to a disruption in skin barrier function.

Ceramides

Ceramides constitute 40% of the lipids in the human stratum corneum (SC) (J. Invest. Dermatol. 1987;88:2S-6S), but they are not present in significant amounts in the stratum granulosum or basal layer. Consequently, terminal differentiation is likely an important factor in ceramide synthesis. The basic structure of ceramides consists of a fatty acid covalently bound to a sphingoid base.

In a study conducted by Unilever, ceramide levels were shown to increase in keratinocytes after the exogenous application of sphingoid precursors (specifically tetra-acetyl phytosphingosine or TAPS) (J. Invest. Dermatol. 1996;106:871). In another study by Unilever, TAPS, combined with the fatty acids 1% linoleic acid and 1% juniperic acid, also increased ceramide levels (J. Invest. Dermatol. 1996;106:918). In the latter study, researchers found that barrier integrity was improved in patients treated with TAPS, and the improvement was even greater when TAPS was combined with linoleic and juniperic acids. These findings imply that topically applied lipid precursors integrate into ceramide biosynthetic pathways in the epidermis, augmenting SC ceramide levels and thus ameliorating barrier integrity.

Cholesterol

Most cholesterol is synthesized from acetate in cells such as the keratinocytes, although basal cells can also absorb cholesterol from the circulation. Cholesterol production increases when the epidermal barrier is impaired ("Skin Barrier." New York: Taylor and Francis, 2006, pp. 33-42).

Both peroxisome proliferator–activated receptors and retinoid X receptors play a role in transporting cholesterol across keratinocyte cell membranes by augmenting expression of ABCA1, a membrane transporter that regulates cholesterol flow ("Fitzpatrick's Dermatology in General Medicine," 7th ed., New York: McGraw-Hill, 2007, pp. 386-7).

Fatty Acids

Free fatty acids and fatty acids in the skin are bound in triglycerides, glycosylceramides, ceramides, and phospholipids. The free fatty acids in the SC are mainly straight chained ("Skin Barrier." New York, Taylor and Francis, 2006, pp. 33-42). Essential fatty acids such as linoleic acid can be obtained only through the diet or topical application.

Currently, it is thought that no single lipid alone mediates barrier function, and that normal levels of ceramides, cholesterol, and fatty acids, in the correct ratio, are crucial for maintaining barrier integrity.

Interestingly, Man et al. evaluated barrier recovery by altering the barrier with acetone, then applying ceramides or fatty acids alone, or a combination of ceramides and fatty acids, and found that normal barrier recovery was achieved only with the application of all three extracellular matrix components—ceramides, fatty acids, and cholesterol (Arch. Dermatol. 1993;129:728-38).

Skin Barrier Repair

Occlusives. Occlusive ingredients, which are oily compounds often used in cosmetics because of their capacity to dissolve fats, coat the SC and inhibit TEWL. Occlusives also impart an emollient effect.

Petrolatum and mineral oil are two of the best occlusive ingredients available. Used as a skin care product since 1872 and considered one of the optimal moisturizing agents, petrolatum displays a water vapor loss resistance 170 times that of olive oil and is well known for being noncomedogenic (Dermatologica 1971;142:89-92; J. Am. Acad. Dermatol. 1989;20:272-7). By virtue of its long-standing status as the most effective occlusive moisturizing agent, petrolatum is typically thought of as the accepted standard to which other occlusive ingredients are measured ("Dry Skin and Moisturizers," Boca Raton, Fla.:CRC Press, 2000, p. 251).

Other frequently used occlusive ingredients include beeswax, dimethicone, grapeseed oil, lanolin, paraffin, propylene glycol, soybean oil, and squalene ("Atlas of Cosmetic Dermatology," New York: Churchill Livingstone, 2000, p. 83).

Significantly, occlusives are effective only when they coat the skin; upon removal, TEWL returns to its previous level. Occlusives are typically combined with humectant ingredients in moisturizers.

In 2004, investigators performing a randomized, double-blind, controlled trial observed that mineral oil and extra-virgin coconut oil were as efficacious and safe as moisturizers in treating mild to moderate xerosis in 34 patients, with both groups demonstrating enhanced surface lipid levels and skin hydration (Dermatitis 2004;15:109-16).

Natural oils. Given the increasing popularity of natural and organic ingredients, essential oils of botanic origin are now frequently used in moisturizing products or as moisturizing agents themselves. Some of the more effective include sunflower seed oil, evening primrose oil, olive oil, and jojoba oil.

Natural oils contain fatty acids that play key roles in maintaining the skin barrier. Linoleic acid, an omega-6 fatty acid, is present in sunflower, safflower, evening primrose, and jojoba oils. Besides its role as a component of structural lipids necessary for barrier integrity, linoleic acid is used by the body to produce γ-linolenic acid, a polyunsaturated essential cis-fatty acid important in prostaglandin synthesis and, thus, the inflammatory process.

Humectants. These water-soluble substances with high water absorption capacity can attract water from the atmosphere (if atmospheric humidity exceeds 80%) and from the underlying epidermis.

Application of a humectant results in a slight swelling of the stratum corneum, yielding the perception of smoother skin with fewer wrinkles. In low-humidity conditions, humectants may actually take water from the deeper epidermis and dermis, resulting in increased skin dryness (J. Biol. Chem. 2002;277:46,616-21), so these ingredients work better when combined with occlusive ingredients.

The most frequently used humectants include glycerin, sorbitol, sodium hyaluronate, urea, propylene glycol, α-hydroxy acids, and sugars, with glycerin especially important because it displays both humectant and occlusive qualities.

Glycerin. Glycerin (glycerol) exhibits hygroscopic characteristics closely resembling those of natural moisturizing factor (J. Soc. Cosmet. Chem. 1976;27:65). This allows the stratum corneum to retain high water content even in an arid environment.

Recently, glycerol was shown to play an important role in skin hydration, insofar as glycerol levels were shown to be associated with stratum corneum hydration levels (J. Invest. Dermatol. 2005;125:288-93).

Previously, two high-glycerin moisturizers were compared with 16 other popular moisturizers in 394 patients with severely dry skin ("Dry Skin and Moisturizers," Baton Roca, Fla.:CRC Press, 2000, p. 217). The high-glycerin products were found to be superior to all the other products tested because they rapidly restored dry skin to normal hydration levels and helped prevent a return to dryness for a longer period than the other formulations, even those containing petrolatum. Of note, glycerin is included in the new Vaseline Intensive Rescue Moisture Locking Lotion and Dove lotion.

Climatic and Endogenous Changes

Cold, low humidity, aging-related changes in hormone levels, and even cholesterol-lowering statin drugs can contribute significantly to dry skin. Therefore, products used last year or even last month might not be ideal today.

When patients plan to travel from a warm-weather climate to colder areas during the winter, I remind them that the skin needs 3 days to acclimate and marshal its defensive capacity against cold temperatures. I also suggest that they moisturize on airplanes, where air is very dry, and plan to moisturize more frequently in cold-weather environments.

Specifically, I recommend what I consider to be the best barrier repair moisturizers: the Dove Proage product line, AtoPalm MLE Face Cream, MoistureWorx by DermWorx Inc., and Kinerase Ultra Rich Night Repair cream. For the body, I recommend TriCeram Ceramide Dominant Barrier Repair, Dove Proage Beauty Body Lotion, Vaseline Intensive Rescue Moisture Locking Lotion, Cetaphil Moisturizing Cream, and CeraVe Moisturizing Cream.

Regardless of the climatic conditions, for patients with dry skin, I always caution against using foaming cleansers, bubble baths, and bar soap, which denude the epidermis of lipids. Rather, I suggest a cleansing oil such as Shu Uemura or Laura Mercier cleansing oils. CeraVe, Dove, Aveeno, and Cetaphil are appropriate cleansers for moderately dry skin, and cold creams, such as Ponds and Noxema, are well suited for very dry skin. For nonfacial dry and sensitive skin not prone to body acne, a suitable product is Grandma Minnie's Oil's Well Nurturing Do-It-Oil (patients with a tendency to get acne should be advised to avoid this product or any other than contains coconut oil).

Finally, I remind patients that the skin and skin barrier can be repaired through diet and dietary supplementation. Specifically, omega-3 fatty acids, borage seed oil, and evening primrose oil may strengthen the skin barrier and ameliorate dryness and itching. ■

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