Acta Dermatovenerol Croat 2006;14(2):104-108 REVIEW

Moisturizers

Jasna Lipizenčić, Zrinjka Paštar[1], Sandra Marinović-Kulišić[2]

University Department of Dermatology and Venereology, Zagreb University Hospital Center [1]Health Department, Ministry of Defence, Republic of Croatia, Zagreb; [2]Policlinic Matulić; Split, Croatia

Corresponding author:
Professor Jasna Lipozenčić, MD, PhD
University Department of Dermatology and Venereology
Zagreb University Hospital Center
Šalata 4
HR-10000 Zagreb
Croatia
jasna.lipozencic@zg.htnet.hr

SUMMARRY Moisturizers combine occlusives and humectants to enhance the water-holding capacity of the skin. Further diversity in moisturizer formulation is created through the addition of special ingredients, designed to enhance the functions of the skin. These agents mimic natural ingredients. Application of moisturizers can serve as important adjunctive therapy for patients with various dermatologic disorders.

KEY WORDS: moisturizers; humectants; occlusives; additives to moisturizers

Received: January 12, 2006
Accepted: March 5, 2006

INTRODUCTION

Moisturizers are externally applied compounds comprising multiple components, including occlusive ingredients and humectants (1). They are used to replace natural skin oils, to cover tiny fissures in the skin, and to provide a soothing protective film. Thereby they lower evaporation of the skin's moisture, maintain hydration, and improve the appearance and tactile properties of dry and aging skin (2,3).

The terms *emolient, moisturizer, and lumbricant* are used interchangeably but have a more precise meaning (1). *Emoliency* refers to the ability of a product to fill in the crevices between the desquamating corneocytes (1). *Moisturizing* refers to the net decrease in transepidermal water loss (TEWL) after product application (1). *Lubrication* refers to the ability of the product to increase skin smoothness (1). All three qualities can be achieved through the substance known as emollient. Therefore, substances with emollient properties can moisturize the skin and improve lubricity (1).

SKIN BARRIER

Skin barrier is understood as the barrier function of the stratum corneum and is termed the "bricks and mortar" model. This model gives the stratum corneum the role of an active membrane (2,4). Bricks are corneocytes and mortar are intercellular lipids. These lipids are sphingolipids, free sterols and free fatty acids (5). Their major lipids by weight found in the stratum corneum are ceramides and possess most of the long-chain fatty acids and linoleic acids in the skin (1,5). The stra-

Acta Dermatovenerol Croat
2006;14(2):104-108

tum corneum should have a 20% to 35% water content and lipids prevent excessive water loss (1,6)

Water originates from the deeper epidermal layers and moves upward to hydrate cells in the stratum corneum, eventually being lost to evaporation. Water is lost by both sweating and TEWL. Dry skin is noted when the water content is less than 10%, and there is loss of continuity of the stratum corneum (2,7). However, studies have shown that skin attempts to heal itself as increased TEWL of only 1% can stimulate lipid synthesis (8).

Moreover, natural moisturizing factor (NMF), a natural mixture of amino acids, lactates, urea and electrolytes, helps the stratum corneum retain the water.

Loss of both epidermal lipids and water content leads to xerosis.

Furthermore, the skin is protected by a variety of antioxidants that provide protection against oxidative stress and free radicals (9). These include enzymatic antioxidants such as glutathione peroxidase, superoxide dismutase, catalases and nonenzymatic low-molecular weight antioxidants such as vitamin E isoforms, vitamin C, glutathione (GSH), uric acid and ubiquinol (10,11).

MOISTURIZERS

Moisturizers are formulations that mimic the role of skin lipids with the effect on TEWL and on the increase of water content in order to regain and maintain an intact skin barrier. That is possible as they are comprised of occlusive ingredients, humectants, emollient substances, and additionally, of special ingredients that are added in order to enhance their therapeutic potentials.

Occlussive function of moisturizers is characterized by physical block of TEWL in the stratum corneum (6,12). Consequently, water percolates up from the viable epidermis without loss (3). It is important to emphasize that the complete occlusive dressings, that are impermeable to water, do not initiate lipid synthesis because of reduction of the TEWL to zero. On the contrary, the use of a semi-permeable dressing can help restore barrier function (1).

Occlusive moisturizing ingredients are divided in several categories (1-3,5,6,13):

- hydrocarbon oils and waxes (petrolatum is the most efficacious; mineral oil is a frequently used ingredient but can reduce TEWL only by 30%; paraffin; squalene)
- vegetable and animal oil (cocoa butter; lanolin is rarely used because of its expense, characteristic odour, and possibility of allergic contact dermatitis)
- fatty acids (lanolin acids and stearic acid)
- fatty alcohol (lanolin alcohol, cetyl alcohol)
- polyhydric alcohol (propylene glycol)
- wax esters (lanolin, beeswax, stearyl stearate)
- vegetable waxes (carnauba, candelilla)
- phospholipids (lecithin)
- sterols (cholesterol)
- silicones (dimethicone, cyclomethicone) are hypoallergenic, noncomedonic, without strong odour, used in many of oil-free moisturizers.

Natural ceramides themselves, or their syntheses, because of physiological role of water-holding, are at present too expensive to be commercially available. Several pseudo-ceramides have been synthesized and clinically shown to be effective in preventing and improving dry skin (14).

Moisturizers exhibit their **humectant function** by attraction of water from viable skin layers and therefore theoretically improve hydration of the stratum corneum. The water that is drawn to the skin is trans-epidermal water, and not an atmospheric water *(*1,2,6). Therefore, remoisturization occurs from the inside out, rather than from the outside in (1,2). Furthermore, the topical application of water in the form of mists or sprays is ineffective, unless an occlusive agent is immediately applied to trap the water on the skin surface (1). Moisturizes that would contain only humectants, actually would increase TEWL when applied to skin possessing a defective barrier and further evaporation would actually exacerbate dryness (1,2,6). Therefore, a good moisturizer formulation with occlusive and humectant ingredients rehydrate the skin optimally, and keep TEWL and lipid production in balance (1,6).

Synthetic humectants in moisturizers are glycerine, sorbitol, urea, sodium lactate, propylene glycol, pyrrolidone carboxyl acid (PCA), gelatine, hyaluronic acid, vitamins and proteins, alpha hydroxyl acids (AHAs) such as lactic acid (1,2,6). High concentrations of prolylen glycol and urea, and pure solutions of glycerine are ineffective, while propylene glycol itself can be irritating (2,7). Although amino acids belong to NMF, pure mixtures of amino acids are useless in moisturizer products (2,7). In addition to their humectant prop-

Acta Dermatovenerol Croat
2006;14(2):104-108

erties, urea and lactic acid are keratolytics. Urea is a humectant in lower concentrations (10%), but in higher concentrations (20-30%) it is a mild keratolytic agent as it disrupts hydrogen bonds or epidermal proteins (2).

Emollient substances of moisturizers smooth skin by filling spaces between skin flakes, improve the lubricity, and restore epidermal lipids (1-3,6). On mouse model it has been shown that applied lipids can permeate to granular layer where they become part of lamellar granule membranes and are then extruded into the intercellular space to form the intercellular lamellae (15). These findings, however, have to be confirmed with additional animal and human models.

Emollient ingredients are alcohols such as octyl dodecanol, hexyl decanol, oleyl alcohol, and alcohol esters such as oleyl oleate, octyl stearate, PEG-7 glyceryl cocoate, coco caprylate/caprate, myristyl myristate, cetearyl isononanoate, isopropyl myristate. Alcohols represent one of the most commonly used classes of emollients with excellent skin smoothing and moisturizing qualities without drying effect (1).

Emollients are divided according to greasiness and spreading characteristics into poor spreading/greasy emollients, medium spreading/creamy emollients and easy spreading/nongreasy emollients (1). The aesthetic properties of a moisturizer are adjusted by combinations of emollients with different spreading characteristics in order to balance the greasiness and long-lasting efficacy of smoothness of the skin.

Therefore, the moisturizers repair the skin barrier, reduce TEWL, increase the water content, and restore the lipid barriers` ability to attract, hold and redistribute water.

Additives to moisturizers

Ingredients are added to moisturizers to enhance their therapeutic potential. Some of these are sodium PCA, urea, AHAs, betahydroxy acids, combination hydroxyl acids, polyhydroxy acids, vitamin A, C, E, panthenol, protein rejuvenators and niacinamide (1,3,5,6).

Sodium PCA duplicates the water-holding capacity of glycosaminoglycans in the dermis (1). It is a humectant, which draws water from the dermis and lower epidermis into the stratum corneum.

Urea, a component of the natural moisturizing factor discussed previously, is used because of ability to diffuse into the outer layers of the stratum corneum and disrupt hydrogen bonding, which exposes the water-binding sites on the corneocytes, as well as promotion of desquamation. Moreover, it enhances the water-holding capacity of the stratum corneum (1).

AHAs are a group of organic carboxyl acids. There are three subcathegories of the AHAs: monocarboxyl acids (glycolic cid), dicarboxyl acids (malic acid) and tricarboxyl acids (citric acid) (1). Sophisticated hydroxyl acid formulations are now combining the hydroxyl acids to create trihydroxy acids or triple fruit acid formulations (1).

AHAs, such as lactic acid or glycolic acid, improve appearance of photodamaged skin (16). Glycolic acid increases corneocyte desquamation (17). AHAs can promote cell proliferation and increase collagen synthesis in cell culture, can modulate stratum corneum barrier function and prevent skin irritation (18).

Salicylic acid is the only beta-hydroxy acid. It reduces corneocyte adhesion (19). It enters the pilosebaceous unit and increases exfoliation on the oily areas of the face as well as decreases the oil production by the sebaceous gland. Due to its exfoliating effects on the stratum corneum, salicylic acid is beneficial in aging skin (6).

Combination hydroxyl acid formulations combine the AHAs and the BHA salicylic acid. These products are difficult to formulate optimally (1). However these formulations do not offer the maximum benefits of AHAs and BHA ingredients (1).

Polyhydroxy acids, such as the most commonly used gluconolactone, are similar to AHAs. They are larger-molecular-weight hydroxyl acids that exfoliate only the skin surface. Due to the decreased dermal penetration they theoretically cause less stinging, burning and irritation (1).

Natural and synthetic vitamin A derivates, retinoids, are able to prevent, reverse and improve facial wrinkles, lentigines, rougness, photoaging, wound healing, and striae distensae (1,6). They can act as humectants if the concentration is high enough (6). As anti-aging substances they increase the thickness of the epidermis and deposite of new collagen within the dermis (6). Furthermore, the retinoids are difficult to formulate because of their photoinstability. Retinyl palmitate is the easiest to formulate topicaly and is often found in cosmetic creams but in the skin it has to be transformed to retinoic acid that is a biologically active form. In high concentrations they act as humectants (6).

Acta Dermatovenerol Croat
2006;14(2):104-108

Vitamin C is an antioxidant. In cell culture studies it leads to collagen production (20). Some studies claim that vitamin C is necessary for wound healing as it stabilizes the triple helical structure of collagen and that in the form of magnesium L-ascorbyl-2-phosphate produces depigmentation (21,22). Proper formulation of vitamin C is essential in order to achieve penetration into the skin because of inactivation of the molecule on exposure to light, moisture and oxygen. Oral ingestion is the best way to maintain vitamin C concentrations in the skin (23).

Vitamin E is a common additive, with limited data of the actual benefit to skin. Due to its antioxidant and light absorbing capacities, it functions as a weak sun-screening agent. It prevents oxidation of chemical components found within the bottle of the moisturizer (6).

Panthenol has humectant properties, attracts and holds water, and stimulates proliferation of basal epidermal cells (1,6).

Protein rejuvenators, collagen, keratin, and elastin claim to rejuvenate the skin by replenishing its essential proteins. This is unlikely to occur since these proteins are too large to penetrate the dermis. Protein additives may provide temporary relief of dry skin by filling irregularities in the stratum corneum. When they dry they shrink slightly, leaving a protein film that appears to smooth the skin and stretch out some of the fine wrinkles (2).

CONCLUSION

Moisturizers are important in cases of xerosis and dermatitis treatment. Moisturizers decrease inflammation in damaged and irritated skin as well as prevent irritant contact dermatitis. As the population ages, the number of people suffering from dry skin will increase. Simple moisturizers combine occlusives and humectants. Special ingredients are added to enhance their therapeutic potentials. They mimic physiological mechanisms of the skin in order to preserve skin barrier, to enhance the water-holding capacity of the skin as well as to influence on the aesthetic properties of the skin. Further development of physiologically effective products for the prevention and treatment of dry skin and its related skin conditions is necessary.

References

1. Draelos ZD. Therapeutic moisturizers. Dermatol Clin 2000;18:597-607.
2. Lynde CW. Moisturizers: what they are and how they work. Skin Therapy Lett 2001;6:3-5.
3. Engasser PG, Maibach HI. Cosmetics and skin care in dermatologic practice. In: Freedberg IM, Eisen AZ, Wolff K, Austen KF, Goldsmith LA, Katz SI, editors. Fitzpatrick`s Dermatology in General Medicine. 6th ed. New York: Mc Graw Hill; 2003. p. 2369-79.
4. Elias PM, Feingold KR. Lipids and the epidermal water barrier: metabolism, regulation, and pathophysiology. Semin Dermatol 1992;11:176-82.
5. Madison KC. Barrier function of the skin: “la raison d’etre” of the epidermis. J Invest Dermatol 2003;121:231-41.
6. Flynn TC, Petros J, Clark RE, Viehman GE. Dry skin and moisturizers. Clin Dermatol 2001;19:387-92.
7. Harding C, Bartolone J, Rawlings A. Effects of natural moisturizing factor. In: Loden M, Loden M, Maibach H. Dry skin and moisturizers chemistry and function. New York: CRC Press; 1999.
8. Jackson EM. Moisturizers: adjunct therapy and advising patients. Am J Contact Dermat 1996;7:247-50.
9. Valacchi G, Fortino V, Bocci V. The Dual Action of Ozone on the Skin. Br J Dermatol 2005;153:1096-100.
10. Packer L, Valacchi G. Antioxidants and the response of skin to oxidative stress: vitamin E as a key indicator. Skin Pharmacol Appl Skin Physiol 2002;15:282–90.
11. Thiele JJ. Oxidative targets in the stratum corneum. A new basis for antioxidative strategies. Skin Pharmacol Appl Skin Physiol 2001;14; 87–91.
12. Rawlings AV, Scott IR, Harding CR, Bowser PA. Stratum corneum moisturization at the molecular level. J Invest Dermatol 1994;103:731-41.
13. De Groot AC, Weyland JW, Nater JP. Unwanted effects of cosmetics and drugs used in dermatology. Amsterdam: Elsevier; 1994. p. 498-500.
14. Loden M, Maibach H. Dry skin and moisturizers chemistry and function. New York: CRC Press;1999.

15. Mao-Qiang M, Brown BE, Wu-Pong S, Feingold KR, Elias PM. Exogenous nonphysiologic *vs* physiologic lipids. Divergent mechanisms for correction of permeability barrier dysfunction. Arch Dermatol 1995;131:809-16.
16. Thibault PK, Wlodarczyk J, Wenck A. A double-blind randomized clinical trial on the effectiveness of a daily glycolic acid 5% formulation in the treatment of photoaging. Dermatol Surg 1998;24:573-7.
17. Berardesca E, Distante F, Vignoli GP, Oresajo C, Green B. Alpha hydroxyacids modulate stratum corneum barrier function. Br J Dermatol 1997;137:934-8.
18. Kim SJ, Won YH.The effect of glycolic acid on cultured human skin fibroblasts: cell proliferative effect and increased collagen synthesis. J Dermatol 1998;25:85-9.
19. Draelos ZD. Hydroxy acids for the treatment of aging skin. J Geriatr Dermatol 1997;5: 236-40.
20. Darr D, Dunston S, Faust H, Pinnell S. Effectiveness of antioxidants (vitamin C and E) with and without sunscreens as topical photoprotectants. Acta Derm Venereol 1996;76: 264-8.
21. Darr D, Combs S, Dunston S, Manning T, Pinnell S. Topical vitamin C protects porcine skin from ultraviolet radiation-induced damage. Br J Dermatol 1992;127:247-53.
22. Kameyama K, Sakai C, Kondoh S, Yonemoto K, Nishiyama S, Tagawa M, *et al.* Inhibitory effect of magnesium L-ascorbyl-2-phosphate (VC-PMG) on melanogenesis in vitro and in vivo. J Am Acad Dermatol 1996;34:29-33.
23. Pinnell SR, Yang H, Omar M, Monteiro-Riviere N, DeBuys HV, Walker LC, *et al.* Topical L-ascorbic acid: percutaneous absorption studies. Dermatol Surg 2001;27:137-42.

For nice hands – Nivea cream, year 1935.
(from the collection of Mr. Zlatko Puntijar)