Moisturizing factor

Fig.1. Destructured horny layer. Severe transepidermal water loss.

Fig.2. Normal horny layer. Reduced transepidermal water loss.

INTRODUCTION

Water is the most important substance for skin smoothness. The water content in the higher horny layer of young skin amounts to 10-20 per cent of total water in the organism. Without the action of natural moisturizing factors, this water would rapidly evaporate, leaving the skin dry and tight.

Water supply from the innermost skin layers (transepidermal water) and normal sweating maintain the skin moisture level. Several factors may increase the outward movement of water, for example, deficiency in water-retaining substances or excessive environmental dryness. The most exposed areas, such as face and hands, generally suffer the most severe water loss.

The Natural Moisturizing Factor (NMF) is a natural skin protector against dehydration; it also plays a major role in the physical properties of the outermost layer of skin, the horny layer. Good moisturizing of this layer is essential for skin smoothness.

These body natural substances, which fixate the water in the horny layer, are produced during keratinocyte cornification (e.g. pyrrolidocarboxylic acid), sweat and secretion by sebum glands (including urea, salts and organic acids).

The cytoplasm of deepest korneocytes includes dense masses of proteins (keratin and filagrinin) with marked hydrophobicity. It is accepted that the skin barrier function is based on these horny cells since, in intermediate and superficial korneocytes, part of the filagrin is separated from keratin fibers and
hydrolyzed into its constituent amino acids; furthermore, some metabolites appear (pyrrolidone carboxylic acid, urocanic acid); all of this implies that those horny cells are expressing hydrophilic osmolites, which are more permeable to water.

Thus, NMF is a mixed complex of water soluble low molecular weight substances, produced within korneocytes through the degradation of filagrin (Tavera Zafra M, 2005).

*Moisturizing Factor* is a substance complex aimed at reconstructing the skin Natural Moisturizing Factor (NMF).

**CHEMISTRY**

Nowadays, the composition of NMF is well known (table 1).

<table>
<thead>
<tr>
<th>Composition of NMF</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amino acids</td>
<td>40</td>
</tr>
<tr>
<td>Ammoniac, uric acid and other organic acids</td>
<td>1.5</td>
</tr>
<tr>
<td>Pyrrolidone carboxylic acid (PCA)</td>
<td>12</td>
</tr>
<tr>
<td>Ions (Na(^+), K(^+), Ca(^{2+}), Mg(^{2+}), PO(_4)^{3-}, Cl(^-))</td>
<td>18.5</td>
</tr>
<tr>
<td>Urea</td>
<td>7</td>
</tr>
<tr>
<td>Lactate</td>
<td>12</td>
</tr>
<tr>
<td>Citrate</td>
<td>0.5</td>
</tr>
<tr>
<td>Sugar, organic acids, peptides</td>
<td>8.5</td>
</tr>
</tbody>
</table>

Table 1. Chemical composition of NMF (Soler C, 2005).

- **Amino acids**

  NMF amino acids directly derive from the hydrolysis of keratin proteins and the secondary degradation of the constituent amino acids. Some authors have reported different amounts of free amino acids for healthy and dry skin. In general, both the proportion of amino acid conversion into metabolites and the amount of essential amino acids are altered in dry skin (Carbajo Espejo JM et al, 2004).

  Filagrin, within keratinocytes, is a cohesive protein that integrates the keratin mesh. Filagrin degradation in the upper half of the horny layer releases a number of amino acids, which are partially metabolized into hygroscopic molecules (Pons LI, 2004).
• **Urea**

The proportion of urea – another NMF component – in the horny layer is between 1 and 1.5 %. It comes from the degradation of arginine or from sebaceous glands. This substance is a major skin hygroscopic agent. Because of its small size, urea penetrates to the deepest layers of the stratum corneum, where it breaks keratin hydrogen bonds and retains water molecules because of its osmotic properties (Carbajo Espejo JM et al, 2004).

• **Pyrrolidone carboxylic acid (PCA)**

PCA (pyrrolidone carboxilic acid or pyroglutamic acid) is produced in the skin through the arginine-citrulline-ornitine-glutamic pathway. The free acid is not hygroscopic; however, the sodium salts of this acid are more hygroscopic than glycerine. Therefore, formulation of this acid is suggested as a defense against dehydration, for skin conditions involving desquamation (Carbajo Espejo JM et al, 2004).

• **Lactic acid and lactate**

The chemical structure of α-hydroxy acids (AHA) includes multiple hydroxyl groups, which allow for higher water retention and absorption. Thus, these highly hygroscopic compounds boost skin moisturizing and strengthen the skin barrier function. AHAs have regulatory properties on keratinization.

The sodium salts of these acids are also highly hygroscopic and enhance the horny layer flexibility.

**COSMETIC PROPERTIES**

The main cosmetic use of Moisturizing Factor is related to moisturizing products for every kind of skin, especially for dry skin, or to products to be used in areas with low environmental humidity.

• **Amino acids**

Because of their small size, amino acids have the ability to penetrate to the deepest horny layers, where they exert their moisturizing action.

Challoner NI et al (1997) evaluated the moisturizing effects of different proteins. In a first assay, they evaluated the moisturizing effects of an O/W emulsion containing 1% of a protein hydrolyzate. The results showed that the emulsion containing the protein hydrolyzate significantly increased immediate skin extensibility (Ei).
Thus, products from protein hydrolysis (including amino acids) are good moisturizing factors for the deepest skin layers.

- **Urea**

Urea is considered the best natural moisturizer because of its ability to capture water (hygroscopic action). Furthermore, it has mild keratolytic effects, since it cleaves keratin molecules, thus reducing the thickness of the horny layer and restoring the hydration-evaporation process to normal. As the urea concentration decreases, its keratolytic action also decreases, but the moisturizing action is maintained. A raise in urea concentration consequently produces a raise in the keratolytic action.

- **α-hydroxy acids and their salts (lactates)**

In 1972, a researcher observed that lactate salts – one of the NMF components – had noticeable moisturizing ability. In 1974, a researcher reported that lactate salts were suitable to treat skin dryness and scaling. The sodium salt is the most hygroscopic one and it plasticizes the horny layer, over 50% humidity, although it can be readily absorbed as a free acid. These compounds act by adsorbing on the polar groups that adhere to keratinocytes, thus reducing the interactions among them (ionic bonds) and promoting desquamation.

In general, this is a generic behavior of α-hydroxy acids (AHA); these are molecules with an alcohol group on position alpha, the carbon adjacent to the acid group. Under normal conditions, AHAs are free; it is the proximity between the alcohol and the carboxylic group what gives these molecules their functionality (Carbajo Espejo JM et al, 2004).

- **Pyrrolidone carboxylic acid (PCA)**

This is a moisturizing molecule that increases the water fixation capacity. It enhances skin moisture, smoothness and elasticity without producing irritation.

### COSMETIC APPLICATIONS

<table>
<thead>
<tr>
<th>Action</th>
<th>Active</th>
<th>Cosmetic Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisturizing</td>
<td>Amino acids</td>
<td>Moisturizing</td>
</tr>
<tr>
<td></td>
<td>Urea</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lactates</td>
<td>Soothing</td>
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<tr>
<td></td>
<td>PCA</td>
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</table>
RECOMMENDED DOSE

The recommended dose is between 0.5% and 5.0%.

BIBLIOGRAPHY


