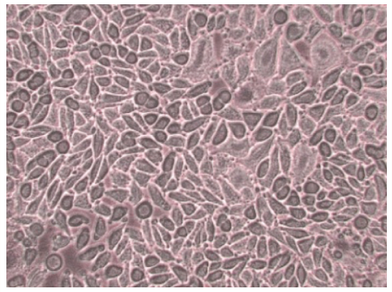
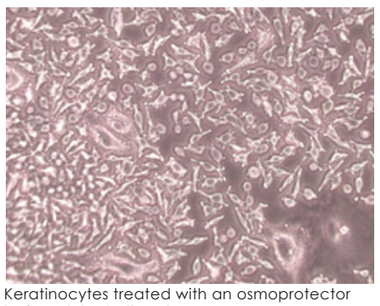
Behind the claim

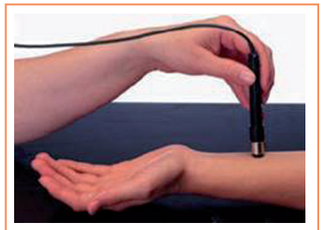
Skin moisturizing:
How to choose the best assay

To keep skin healthier and younger, the very first thing we need to do is maintain a good level of hydration. It may seem obvious, but the importance of this simple fact is often underestimated. As an example, people tends to believe that gel and water rich products are a better way to hydrate the skin, while actually we do not have to supply water to the skin from an outside source. The moisture reaches the skin from the inner tissue, and we need to avoid water loss. Our skin receives water from body fluids, and it is built up as a very specialized organ to regulate the perspiration through trans-epidermal water loss (TEWL). The hydrolipidic film in the stratum corneum, and the whole epidermis in physiological conditions, work as a barrier to avoid excessive water loss from the body. Sometimes this barrier function is compromised, like for example in some pathological conditions (dermatitis, inflammation, xerosis), when exposed to climatic stress (wind, sun, high temperature) or when skin is ageing and getting less sensible to hormonal stimuli. The right level of skin hydration makes the skin appearance smoother, tighter and plump. Filming ingredients, emollients and oils are generally effective in helping skin moisturization. The claims "hydrating" or "moisturizing" for a cosmetic product cannot be given as granted but must be demonstrated with instrumental tests. One of the most used technique is *corneometry*, an impedometric technique able to indirectly assess the water content in the skin. A Corneometer® is a probe that measures the capacitance of the upper layer of the skin (down to about 15 µm deep). This method is based on the difference between water dielectric constant and the dielectric constant of other substances. Measures are generally taken on the volar surface of the arm, with at least 3 replicas per site, and the average values are compared between treated and untreated arms and before/after treatment, as well as versus a placebo when a moisturising ingredient is the object of the investigation. Values are expressed in arbitrary units ranging from 0 to 130, and the measurement accuracy is ±3% at a relative humidity (HR) between 30% and 70%.
Results from forearm tests are interpreted as very dry skin (<30), dry skin (30-45) or sufficiently hydrated skin (>45).

Short term hydration can be measured from 30' from the application (not before) up to i.e. 6/24 h from product application, while long-term effects may be measured after a defined period of use, i.e 7-28 days. We must remember that this method may not provide reliable results in some situations such as when tested products contains high levels of electrolytes like salts, small proteins or organic acids that can increase conductivity and lead to an overestimation of the measures. On the other hand, it is even more frequent to underestimate the corneometric values while testing products with an important lipophilic component such as barrier occlusive creams, W/O emulsions, or fatty creams.
The dielectric constant ($\in_r$) is a physical feature of each chemical ingredient and is a measure of its polarity. Many oils, waxes, and fats are apolar, have a high $\in_r$, a low conductivity and behave as insulators interfering with corneometric measures and causing an underestimation of the water content.
For this kind of products, as well as for film formers, the best way to assess skin moisturization is to perform *TEWL (Trans Epidermal Water Loss)* measures.
The Tewameter® is based on the diffusion principle and measures humidity in an open chamber, detecting the water that evaporates from the skin. It is a sort of hollow cylinder with two pairs of sensors inside, for temperature and humidity, capable of measuring a density gradient between the skin and the upper side of the cylinder. The lower is the value, the higher the quantity of water retained in the skin and hence the moisturizing effect. The TEWL reduction is a parameter suitable to support the restoring activity for occlusive products, barrier cream, Oils and W/O emulsions and is an index of recovery of barrier function of the skin.
The instrument has a measurement range that normally falls between 5 and 45 g/hm^2. A water loss between 0 and 10 is indicative of a very effective moisturizer; results between 10 and 15 are good; values between 15 and 25 are average, while results between 25 and 30 are indicative of skin drying. Any result greater than 30 indicates severe water loss.
In order to obtain reliable results it is very important to stabilize the parameter before reading, for example by leaving volunteers to acclimate in the room for at least 30' before the test, and by controlling and stabilizing the local humidity in the areas of measure. The instrument has an accuracy of ±1.5% when environmental humidity is between 30 and 90%. The accuracy drops to ±2.5% when humidity exceeds those values.
Beyond these instrumental measures that are carried out on the skin, it is possible to perform hydration measures *in vitro*, when testing the osmoprotective properties of some ingredients like oligo- and polysaccharides that can work by retaining water. Keratinocytes can be treated in vitro with dilutions of the investigated substances, and their protective effects against dehydration can be investigated. Dehydration is simulated in vitro by adding increasing percentages of salts (NaCl) to the cells or by removing culture medium. Undergoing these stresses, cells change in shape and enter stress related transformations until they die, but these effects can be delayed or blocked by adding different osmoprotectors and thus assessing and comparing their efficacy.
Assessing water content of in vitro 3D epidermis is a much more difficult challenge, because the epidermis units must be placed in contact with a water-based cell medium, and the high percentage of humidity in the surrounding environment interferes with any kind of physical instrumental measure.
The moisturizing power of ingredients can vary a lot depending on the kind of finished formulation we are dealing with and on the basis of other components. It is not always possible to extrapolate the final effect on the skin only from the presence of a specific ingredient, even if it had been proven effective.

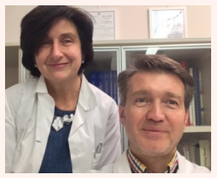

The same keratinocytes undergoing dehydration stress without protection.


Keratinocytes treated with an osmoprotector before dehydration stress.


Corneometry


TEWL

Summarizing our conclusions, even if skin hydration may seem to be a very straightforward claim, it is of primary importance for skin health, and must be proven and supported with instrumental measures when claimed.



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Please send your reaction/comments/topics you would like to analyze to Dr Gayle De Maria at gayle@teknoscienze.com placing in the subject line "Behind the claim column".