

APPENDICES

Galenic definitions

EMOLLIENT

This is a raw material or substance that makes the skin softer and suppler, and improves the characteristics of a cream (long-lasting effect, spreading power, slippery feel, stickiness, etc.) These emollients are different chemically and can be more hydrophilic (water soluble), light and non-sticky, or more lipophilic (oil soluble) and therefore more oily and rich.

They can thus act as moisturizing agents or nourishing agents. They help restore the skin's physiological balance and maintain the hydrolipidic film.

E.g.: capric caprylic triglyceride, squalane, vegetable oils, paraffin oil, isopropyl palmitate, glycerin, etc.

MOISTURIZING AGENT OR HUMECTANT

The role of a moisturizing agent is to improve or restore hydration in the skin. The moisturizing agent will either retain or transport water since its molecules capture the water in the skin or in the formula (e.g.: glycerin, sorbitol, propylene glycol, NMF and intercellular cement components, urea). Another possibility is through a more mechanical action, where one occlusive molecule can have moisturizing properties by preventing the water from escaping from the skin (anti-dehydrating).

E.g.: vaseline, mineral oil, silicone...

NOURISHING AGENT

Agent that helps compensate for the skin's natural lipid deficiency, and helps strengthen the skin structure, i.e. improve cohesion in the intercellular cement and thus avoid water loss and skin alteration (e.g.: vegetable oils rich in essential fatty acids (safflower, evening primrose, avocado, hazelnut, etc.) Triglycerides, shea butter, lipid components for the epidermis (sterols, waxes, etc.).

Skin and Galenic texture

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1 OVERVIEW OF ANATOMY AND PHYSIOPATHOLOGY

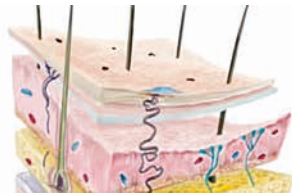
The skin is the largest organ of the human body: it makes up 16% of its total weight. Composed of several layers of tissues, it forms a protective barrier for the body against the external environment, but also guarantees other vital functions.

From a chemical point of view, the skin includes on average:

- 70% water
- 27.5% proteins
- 2% fatty substances
- 0.5% mineral salts and trace elements

It is composed of three tissue layers:

- the epidermis, the uppermost layer
- the dermis, the middle layer
- the hypodermis, the deepest layer



The epidermis is characterized by its organization in layers, corresponding to an increasing state of keratinocyte differentiation, from the deepest layer (stratum basale) to the uppermost layer (stratum corneum), within which anucleated elements (corneocytes) are included in the multi-lamellar extracellular lipid structure, the intercorneocyte cement, which acts as a hydric barrier for the skin.

This lipid matrix is composed of ceramides, cholesterol and fatty acids that form a successive stack of lamellar phases positioned parallel to the skin's surface. Keratinocyte differentiation is accompanied by radical changes to their lipid metabolism and by the lipid composition of the different epidermal layers.

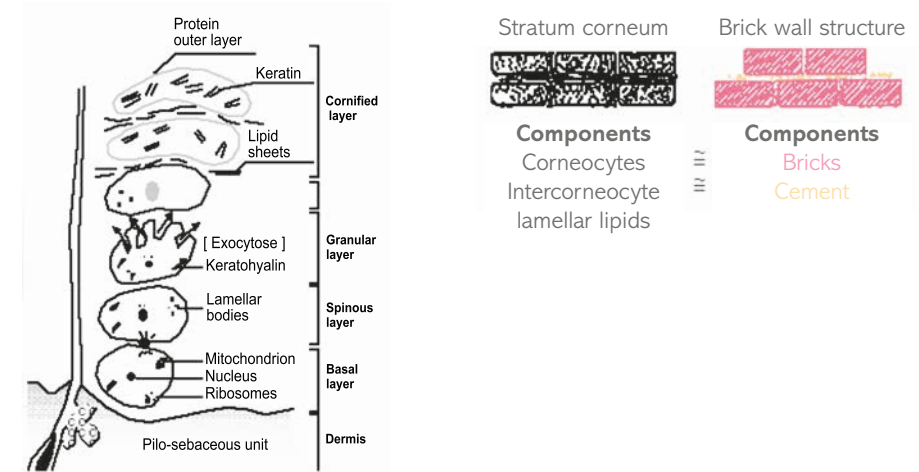
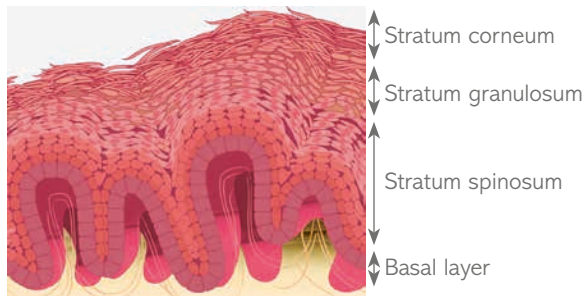
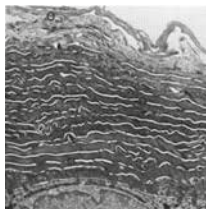


DIAGRAM OF EPIDERMAL STRUCTURE

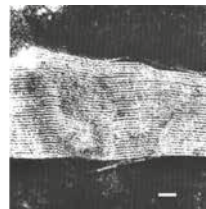


Appearance of the Stratum Corneum under electronic microscope (x 1 200)



According to Goldsmith L.A. 1991 Oxford University Press

Lipid structures in multisheets between two corneocytes (x 300 000)



According to Swartzendruber D.C., et coll. J. Invest Dermatol, 1989, 134: 460-464

The intercellular cement always contains the same components in varying quantity and quality.

The main role of the ceramides, some of which are found only on this level, in the function of the skin's hydric barrier, is debated in relation to the structural details that it produces in the intercorneocyte lipid barrier.

Table 1. Evolution of the percentage of various lipids based on gradual keratinocyte differentiation, from the deepest area (basal/spinous) to the uppermost cornified layer, and also the granular layer, where the lipids are stored within the Odland bodies. We observe a drop in phospholipid levels, an increase in ceramides, free fatty acids and non-esterified sterols, as well as the highest level of glucosylceramides (acylglucosylceramides) in the granular layer (where they contribute to the stacked lipid structures) and they practically disappear in the cornified layer (according to Lampe et al. [40]).

Composition	Basal/Spinous	Granular layer	Cornified layer
Phospholipids	44.5 ± 3.4	25.3 ± 2.6	6.6 ± 2.2
Cholesterol sulfate	2.6 ± 3.4	5.5 ± 1.3	2.0 ± 0.3
Neutral lipids	51.0 ± 4.5	56.5 ± 2.8	66.9 ± 4.8
Free sterols	11.2 ± 1.7	11.5 ± 1.1	18.9 ± 1.5
Free fatty acids	7.0 ± 2.1	9.2 ± 1.5	26.0 ± 5.0
Triglycerides	12.4 ± 2.9	24.7 ± 4.0	Variable
Sterol/fatty esters	5.3 ± 1.3	4.7 ± 0.7	7.3 ± 1.2
Squalene	4.9 ± 1.1	4.6 ± 1.0	6.5 ± 2.7
n-alkanes	3.9 ± 0.3	3.8 ± 0.8	8.2 ± 3.5
Sphingolipids	7.3 ± 1.0	11.7 ± 2.7	24.4 ± 3.8
Glucosylceramides	3.5 ± 0.3	5.8 ± 0.2	Trace
Ceramides	3.8 ± 0.2	8.8 ± 0.2	24.4 ± 3.8
Total	99.1	101.1	99.9

According to John Libbey text. Article by Jean-Claude Mazières 2007

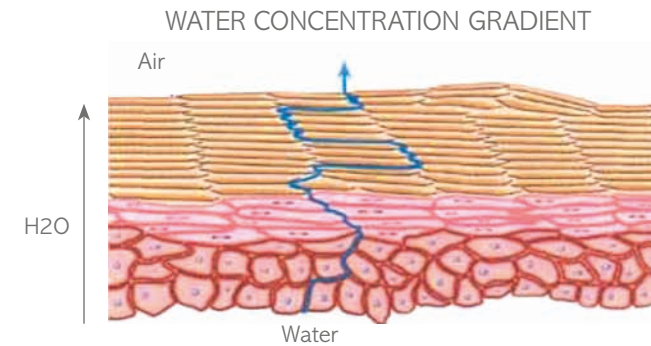
WATER AND THE SKIN

The skin forms an interface between the body and the outside environment, and it therefore fulfills not only a protective role against the penetration of chemical or microbial elements, but it must also guarantee stability of the body's physiological environment by limiting water loss. **To do so, the uppermost layer of the epidermis, the stratum corneum, plays a major role in osmotic homeostasis whose function is to maintain a hydric gradient** and thus reduce the drying effects caused by the environment. Under physiological conditions, the water content of the upper layer of the epidermis varies from **70 to 30%** from the last living layers (stratum granulosum) to the stratum corneum. Water content is even lower in the last corneocyte layers, reaching **15%**.

Water mobility in the skin makes up the **hydration and dehydration mechanisms**. The water **spreads passively** from the Malpighi layer to the cornified layer, and then passes through the cornified layer to the exterior. This diffusion is invisible, and is referred to as insensible perspiration or **transepidermal water loss (T.E.W.L.)**. Under normal conditions, with a whole skin barrier, T.E.W.L. occurs at **5gr/m²/hour**. Transepidermal water loss must not be confused with perspiration and sebaceous secretion, which are different processes.

Factors retaining water in the cornified layer.

These are intracellular substances called "**Natural Moisturizing Factors**" or **N.M.F.** They are formed during the transformation of keratinocytes into corneocytes within the granular layer, and during the transformation of Profilaggrin into Filaggrin. N.M.F.s are composed of **Urea**, amino acids, pyrrolidone carboxylic acids, **lactic acids**, **mineral ions**, sugars (Hexoses, pentoses).



This capacity to maintain hydric balance comes directly from the structure of the stratum corneum, by its flattened keratinized cells, the corneocytes, stacked within a lipid matrix composed of ceramides, cholesterol and fatty acids as we discussed earlier.

In a state of dryness, the water content in the upper layers decreases and the stratum corneum has a tendency to retract and to lose its mechanical properties. The skin becomes hard and rough, causing a sensation of discomfort and tightness. At a more severe stage, the stratum corneum loses its barrier quality, which triggers the following responses in particular: increase in intra-epidermal perspiration, excessive keratinocyte proliferation, modification of supramolecular arrangement in the lipid matrix. Clinically, the skin becomes thicker and squamous, making it more prone to cracking.

Links between the Stratum Corneum (cornified layer), transepidermal water loss and the skin barrier.

If the Stratum Corneum is altered by a dermatological condition or external aggression, this causes a loss in porosity and an increase in Transepidermal Water Loss. For atopic skin, (on non-eczematous dry skin) TEWL occurs at 18 gr/m²/hour compared to 5 gr/m²/hour in normal skin. The same rate is observed in normal skin if the outside temperature is high with low humidity. Transepidermal Water Loss is a reflection of the condition of the skin barrier.

THE HYDROLIPIDIC FILM

The hydrolipidic film is found on the skin's surface, and it supports the concept of a barrier, participating in exchanges between the skin and the outer environment.

The skin's surface is covered by what is called a hydrolipidic film, namely an emulsion of water (hydro) and fat (lipos). Its main function is to act as an external barrier to defend the body against bacteria and fungi. Moreover, it keeps the skin supple. In healthy skin, the balance between the fatty component and the aqueous component remains intact. The quantity and composition of the hydrolipidic film varies according to body parts but also according to exogenous and endogenous factors such as time of day, season, air humidity, diet, stress and disease.



Composition of the hydrolipidic film

Analysis of the skin's structure and of the keratinization process indicates the presence of the following substances on the skin's surface:

- Perspiration and sebaceous lipids
- Substances from the cornification process (protein breakdown substances)
- Cornified cells detaching themselves
- Water from the deepest layers arriving at the surface (transepidermal water, insensible perspiration)

The following components form a protective film on the skin's surface that is continuously renewed:

- 1 • Perspiration
- 2 • Sebaceous lipids
- 3 • Corneocytes detaching themselves
- 4 • Cells undergoing cornification
- 5 • Transepidermal water

One of the functions of the hydrolipidic film is to repel foreign bodies. It also helps maintain the skin's suppleness. Thanks to the presence of mildly acidic components, such as lactic acid, pyrrolidone carboxylic acid and amino acids, the hydrophilic components of the hydrolipidic film can form an acidic protective cloak.

DRY SKIN, DEHYDRATED SKIN AND STEPS TO BE TAKEN

The quality of the epidermal components and those of the hydrolipidic film therefore determine the various conditions of the skin. This is described as dry skin or dehydrated skin.

• DRY SKIN

In dry skin, the hydrolipidic film has not fulfilled its role; there is more water evaporation and not enough lipids in the epidermis. The skin is thin, smooth and dull, fragile and delicate with wrinkles and fine lines showing up early. The skin feels tight, does not tolerate soap and reddens easily in the cold. Dry skin will always become dehydrated if no action is taken.

This condition comes from insufficient sebaceous secretions (sweat) due to **genetic factors**, ichthyosis, climate or the use of detergents and harsh products.

• DEHYDRATED SKIN

Dehydrated skin lacks water, and can affect all types of skin. This **is a reversible condition**, with various origins (wind, cold, excess sun, lack of humidity in the atmosphere, detergent products, etc.). Dehydrated skin still has its hydrolipidic film, and water loss is more in-depth. The skin is dull, lacking radiance, rough, lacking suppleness, fragile, irritable and it wrinkles easily. It then tends to desquamate and become dry but it is possible to have dehydrated skin that is not very dry.

• TREATING DRYNESS

We can hydrate the skin but however water cannot be added directly to the inside of the skin; water cannot penetrate the skin by itself!



The water must be transported via glycerides which intervene through the hydrolipidic film and penetrate the upper layers, or through the Stratum Corneum (SC) with water-retaining molecules, to reduce transepidermal water loss and thus increase water content.

There are therefore 2 possibilities:

- Retain the water already contained in the skin, whether on the surface (the role of the hydrolipidic film) or in the deeper layers (the role of the intercellular cement).
- Allow water in the deep layers to travel up to the surface when needed (role of the intercellular cement and the cell membranes).

The outermost layers of the SC can thus be strengthened with vaseline by example, since its long-chain C-26 structure falls into place in the ceramidic bilayers of the stratum corneum. This practically occlusive action induces a reduction in water evaporation through the stratum corneum. Similar actions can be obtained by using symmetrical long-chain esters, which have the advantage of being less occlusive than vaseline and therefore more pleasant to use. Among the most well known are myristyl myristate, cetyl palmitate and isostearyl isostearate. These approaches aim to strengthen the functional aspect of the intercorneocyte lipids under conditions of dryness, and are generally combined in emulsions with hygroscopic humectants (which retain water) such as glycerol, urea, sorbitol and others.

We can therefore classify the moisturizing agents into 3 sub groups based on their lipophilic characteristics.

- **occlusive agents**, which reduce transepidermal water loss,
- **emollients**, which are partially occlusive and which fill the intercorneocyte spaces,
- **humectants**, which are hygroscopic and capable of absorbing water from their surroundings.

A cosmetic product containing a high proportion of occlusive agents can be considered to be oily. After adding an emollient with excellent spreading power, the finished product will be noticeably improved in terms of texture and sensation when applied.

2 GALENIC FORMS

Galenic terminology (in the literal sense of the term) is different to marketing terminology.

It's all about emulsion!

- The "cream" and "fluid" forms are void of terminological significance, since these are in fact emulsions.
- The "cream" form suggests a rich emulsion whereas the "fluid" form suggests a light emulsion.
- The "serum" form is not a galenic form; it is a relatively thick lotion, gel or emulsion highly concentrated in active principles..

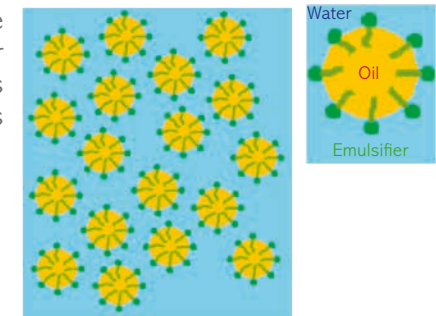
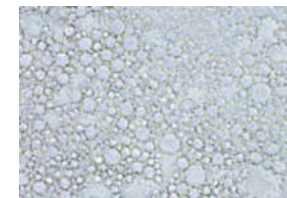


"PHYSICAL" DEFINITION OF AN EMULSION

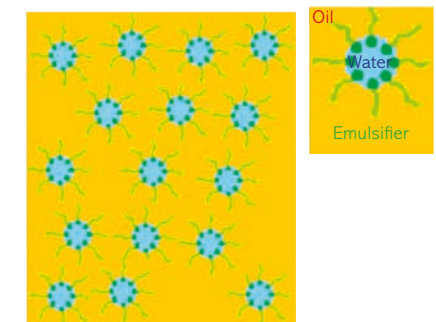
Homogenous mixture resulting from the dispersion of two immiscible non-homogenous phases of different types. To obtain a smooth final product, stabilization must be permitted for the two-phase mixture through an emulsifier or a surfactant.

• TWO TYPES OF EMULSIONS

- **Oil-in-water:** drops of oil (oily phase) are suspended in water (aqueous phase); the water forms the continuous phase which gives it its hydrating properties, hence the name continuous aqueous phase.



- **Water-in-oil:** drops of water (aqueous phase) are trapped in oil (oily phase) forming a continuous film. A lipid film is created on the skin, hence the long-lasting properties and the "barrier effect".



The difference between W/O and O/W emulsions is not visible macroscopically or microscopically. The difference is in their **spreading power, cosmetic qualities, cosmetic appeal, and the sensation** upon application.

O/W emulsions are easier to spread; they have more slip and a more aqueous, "wet" feel. They are also lighter and more fleeting in composition than the W/O emulsions which require more massaging action to be absorbed into the skin, leaving a sensation of oil or butter and a more shiny, sticky appearance with a heavy feel.

There are fewer W/O than O/W emulsions because of these poor cosmetic qualities (stickiness, difficulty to spread) and their feasibility and stability. O/W emulsions are preferred since all these factors can be modified by adapting the composition. There is a wide range of raw materials that allow us to modify a formula's feel, texture and visual appearance.

What's also important is the choice of emulsifier that structures the formula and can transport its water content or emollients, reservoir system (emulsifier forming liquid crystals or spherulites, etc.) to the core of the epidermis.

• DIFFERENT TYPES OF TEXTURES FOR THESE EMULSIONS: LOTION, EMULSION, CREAM, BALM...

Lipid content is in descending order: water-in-oil W/O balms, oil-in-water O/W rich in oils, oil-in-water less rich in oils.

Lotions and milks with a large proportion of water and a small quantity of glycerides. The difference is also in the product's viscosity, the natural composition and oily phase content and the relatively "oily" sensation especially on the fingertips and when spreading.

For light textures (lotion, emulsion): preference is given to lightweight emulsifiers or emulsifying gelling agents with oily phase content of 5 to 15% composed of emollients light to the touch, non greasy, non oily, non sticky with good "slip" without too many sticky glycols or vaseline-type oils.

For rich textures (cream, balm): preference is given to more waxy emulsifiers, to which oily emollients are added with a rich greasy feel, such as shea butter, paraffin derivatives, evening primrose oil, safflower oil, beeswax and often high content in glycerin and vaseline, the % of these oily phases can reach 40 or 50% of the product's composition.

- **LOTION:** the texture is fluid to very fluid (flows easily), non oily, generally oil in water, allowing it to be spread easily over the entire body without too much oily residue (non filmogenic) or sticky effect. The product is rapidly absorbed, leaving an "aqueous", "wet" sensation. It contains light emollient agents that have no sticky effect, no greasy oil, wax or butter, and often with gel-like textures that provide the light feel. Hydrating properties claimed but with a low glycol level to always limit the sticky effect and facilitate rapid absorption.

- **EMULSION:** this is a light, fine texture that does not contain a large oily phase or emollients with a rather light feel, less fluid than the lotion. The formula is often designed for the face, and stays put on the fingertips, and is rapidly absorbed. Used for hydration claims, for oily or combination skin. Emulsions are similar to lotions in terms of formula and composition of the oily phase. Sensation of comfort without residue on the skin and no sticky effect.

- **CREAM:** the texture of a cream is much more consistent and thicker than an emulsion. It is richer, smoother, more filmogenic and oilier, and can be W/O or O/W. Used for relatively significant nourishing claims. Designed for the driest skin types, in need of nourishment. Anti-dehydration claims, night product or product for atopic skin.

- **BALM:** very rich texture with a high level of nourishing (oily) agents and oils, very filmogenic for very dry, atopic skin. Balms can have varying viscosity (more or less thick). They have a longer-lasting effect than creams. Very smooth. The product has to be manipulated while spreading it, and worked into the skin by massaging action.

• CERATE/OINTMENT

Ointments and cerates were initially anhydrous products (without water), a homogenic monophasic mixture of liquid glycerides, miscible pastes and solids (waxes, butters, oils).

Cerates evolved gradually, and distilled flower water and other similar waters were introduced to obtain "Galen's wax", and then a more modern version, COLD CREAM. These products are extremely rich and oily with a more limited spreading power, hence their use on smaller areas, sometimes in thick layers for in-depth nourishment.

NOURISHING POWER / "OILY" PHASE CONTENT GRADIENT

