Shelf life of cosmetics - what makes cosmetic products unstable?

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Cosmetic products have a life of their own, all the more the higher the content of physiologically usable skin care substances. Also external influences have to be considered specifically when the products are bottled in jars. In the end, a mix of different influences determines the shelf life of the products. The following article will provide an overview on this issue.

Many of the substances used in cosmetics have a quite extended shelf life if we look at their pure state. In other words, this means that substances like glycerol, urea and amino acids which support the NMF (natural moisturizing factor) of the skin have a nearly unlimited shelf life. The same applies to lipids and oils like neutral oil (saturated triglycerides gained from palm or coconut oil), paraffin oil and synthetic esters.

Water - a delicate substance

Cosmetics are produced by mixing active agents, lipids and oils with the help of emulsifiers and water. This is how creams, lotions and cleansing products are produced. Within these mixtures interactions between the different substances will occur. Components may chemically react with each other, physically separate or degrade microbiologically due to their water content. And, if on top of it vitamins or lipid substances with essential fatty acids are used which already have a short shelf life in their pure form, matters still become more complicated. Additives like preservatives, antioxidants or substances to control the consistency may extend the shelf life however only for a short period of time.

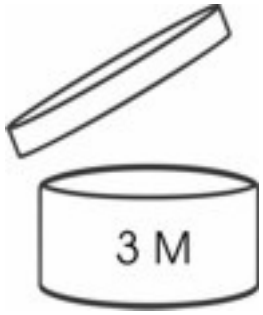
Indifferent substances

It is a matter of fact that cosmetic trade as well as consumers rather prefer the longest possible shelf life. However a long shelf life can only be achieved with quite indifferent and unphysiological ingredients as for example mineral oil products like paraffin oil. During their storage all natural oils including the above mentioned neutral oil are submitted to change in chemical, microbiological and sensory respect. Compromises are therefore necessary regarding the durability of physiological skin care products.

Best before...

Unfortunately legislation was not consequent enough in regulating the shelf life labelling. A minimum durability of up to 30 months has to be marked on the product. A durability of more than 30 months has to be shown with an open jar symbol and the number of months the product still is fresh from the date of opening as for example 6 M for 6 months (see fig.).

Fig.: open jar symbol



The open jar symbol shows the freshness date after opening (in months), e.g. 3 M for 3 months.

It is self-evident however that products with sensitive vitamins and extracts (shelf life up to 30 months) should only be used over a short period of one, two or three months. In other words though, the open jar labelling would definitely make more sense in this specific case than it does for insensitive and highly preserved products. A number of responsible cosmetic manufacturers however now also voluntarily labels their products with a shelf life of less than 30 months with the open jar symbol in particular as the consumers are not really familiar with the complicated labelling procedures. It should also be mentioned that there is no regulation regarding the date stated in combination with the open jar symbol.
In addition to that the Cosmetic Degree makes no distinction between jars and dispensers.

Dispensers cannot be contaminated from outside as there is no direct contact between fingers and the product in the dispenser.

Cloudiness, discoloration & Co

Not all the visible changes in a product will also signify the knockout regarding its further use. Pure oils for example may **appear cloudy or show precipitations** when stored in the refrigerator. Top-quality avocado oil e.g. precipitates phytosterols when stored in low temperatures (refrigerator). What may lead to irritations in optical respect actually is a quality feature here.
Discolorations though have to be seen from a more critical standpoint as they may result from oxidation processes. Discolorations in aqueous, yellowish marigold-containing products (calendula officinalis) belong to this specific type.
Sediments may form in pigment-containing creams with low viscosity. But also this defect only concerns the appearance of the product and can be remedied by shaking before use.
If an emulsion **disperses into oily and watery components** the functionality of the product is affected. This however should not happen before the best of date.
Changes in the viscosity of a product seem quite normal to a certain extent especially if natural products are used with different agent content depending on their specific provenance and their harvesting time. If substances like sodium carbomer or related substances are used to control the consistency, already a slight decline of the pH level (the acidity grade) may lower the viscosity of the products during their storage.

Chemical reactions

A **decline of the pH-level** may be caused by the release of organic acids from triglycerides - the slow reaction with water results in a hydrolysis of esters. The process as such is not specifically critical, subject to the condition that the released acids will not develop unpleasant odours. Neutral oil for example may develop a buck-like smell, which of course should not happen before the expiry date.
An increased pH-value may occur if alkaline metal oxides like zinc oxide bind acids and hereby form metallic soaps. Zinc oxide may also cause saponification. This is the reason why it mostly is combined with indifferent paraffin oils. The pH-value may also increase in the presence of urea; with water available it slowly is transformed into ammonium carbaminate.
The reverse process of the saponification is the **ester formation** from acids and alcohols with formation of water. This process is characterized by a lightly fruity smell especially if acetic acid (from acetates) and ethanol are present and ethyl acetate is formed. Said process however will not influence the shelf life of the product. In case of perfumed products these processes are blanketed and there are no sensory changes noticeable.
Quite bad odours develop however during the **oxidation and splitting of unsaturated fatty acids**. The human nose already detects the rancid odour of the developing long-chained aldehydes in the ppb (parts per billion) range.
Oxidations by atmospheric oxygen usually are a limiting factor for the shelf life as the formed oxygen compounds as e.g. from ethoxilized alcohols (emulsifiers) may cause irritations, or the unsaturated fatty acids may be stimulated to polymerize by radical formation which means that they are no longer available for the skin. This is the reason why antioxidants like vitamin C and E are indispensable in formulations that contain natural substances. Vitamin A and its derivatives also are sensitive to oxygen, e.g. their efficiency is gradually decreasing during the life cycle of the product. As there are no immediate side effects to realize it is up to the cosmetics manufacturers to decide at which state the product still is effective.

Microbiologically stable?

With respect to health the microbiological stability has first priority for the shelf life specification. Hence, new products are closely scrutinized and **microbiologically tested with problematic germs** already during the development phase. And by the way, this applies for preserved as well as non-preserved products.
The assumption that non-preserved products will earlier contaminate than preserved ones exclusively applies for ampoules which can only be stored for a few days in the refrigerator after opening.
Non-preserved means, that none of the preservatives listed in the Appendix of the Cosmetic Decree (potentially sensitizing substances) are contained in the product. Alcohol or substances with alcoholic hydroxyl groups (glycols, sorbitol etc.) as well as water phases with high osmotic pressure (hypertonic) also stabilize the products however without a sensitizing potential worth mentioning.
Long term effects may become a risk when preservatives from container materials (plastic, seals) are absorbed or e.g. the alcohol evaporates after opening of the products, and as a result the alcohol content gradually falls short of the microbiologically effective concentration. The manufacturer is required to accurately test

this and subsequently adjust the shelf life of the products.
Based on the results of the microbiological tests it is decided whether the products are appropriate for bottling in **dispensers or also in jars**. Oleogels i.e. water free products are very stable in microbiological respect as germs cannot survive in this environment.

Sensory changes

Concluding, the sensory changes should also be mentioned as e.g. the fact that volatile perfumes may evaporate, be absorbed by the container materials or that perfume substances may react with each other or with atmospheric oxygen or water. The manufacturer has to decide, what still is acceptable for consumers during the product's lifespan.

Summing it up: physiological or extended shelf life?

Products with a quite **extended shelf life** usually contain substances which are highly stable in chemical and microbiological respect. The more **physiological** the products are the more sensitive substances are contained and hence, the shorter the shelf life. This can also be experienced with groceries: food which is rich in vitamins cannot be found in cans with a long shelf life.

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