

Waxes – an indispensable family

published in Kosmetik International 2014 (10), 52-56

What comes into your mind when you hear the term waxes? Maybe beeswax, candle wax or floor wax? It may not sound familiar in a cosmetic context but waxes are more common in cosmetics than you might think.

Except for beeswax that still is used in a number of natural cosmetics today, waxes seem to have little in common with modern cosmetics. The family of waxes however plays a more important role than you may assume. In the field of cosmetics it is indispensable even if the particular substance is hard to recognize in a cream.

Most of the waxes are characterized by their semi-solid to solid consistency and fatty surface feel. The accurate physico-technical definition of the family of waxes is highly complex. This also applies for the rather varying chemical compositions and the naming of the different representatives. Still obvious are terms starting with "cera". Cera is the Latin term for wax. Thus *cera flava* is beeswax whose yellow colour is induced by carotenoids. The colourless *cera alba* is gained by means of purification and bleaching. In cosmetics it is used as an emollient, i.e. a smoothing component with fatty character and contained above all in the classic cold cream formulations that are characterized by their high lipid and low water content. Cold creams can be manufactured without using preservatives but have a short shelf life. Characteristic for beeswax are wax esters consisting of long chained acids and alcohols (C₁₆-C₃₀). The alcohols are the distinguishing features in waxes in comparison with lipids (triglycerides) which are composed of long-chained acids and glycerin. Higher concentrations of waxes in skin care preparations generally are water-in-oil emulsions (W/O). This also applies for creams and ointments with *cera lanæ* (wool wax).

Unsaponifiable matter in vegetable oils

Purified wool wax actually originates from the sebum gland secretion of sheep. Besides the above mentioned wax esters, it contains further components that are typical for animal and vegetable waxes, in particular sterols (steroid alcohols), which in their turn are esterified with long-chained acids (up to C₄₀). Among other ingredients, wool wax contains cholesterol which has an important protective function in the skin. According to the German Pharmacopoeia (DAB 10), lanolin consists of a mixture of

about 65% of wool wax, 20% of water and 15% of viscous paraffin. The Swiss variant (Ph. Helv. 7) contains olive oil instead of paraffin. Wool wax also is qualified for the use in cold creams since the hydrophilic groups of the steroids, hydroxy fatty acids and the partly polyvalent alcohols can stabilize water in the form of W/O. The European Pharmacopoeia describes the formulation of an aqueous wool wax with 25% of water. While in pharmacological applications wool wax is used as a base for the absorption of active agents, in cosmetics it is utilized in barrier creams. However it is not suitable for the fatty, bad or acne-prone skin. Similar to other adhesive re-fattening bases it can intensify the formation of comedones. A further point of criticism on the part of vegan consumers is the animal origin. The allergenicity of wool wax due to pesticide residues can almost be neglected today since the substance is meticulously purified. Individual reactions to particular components or additives such as BHT (antioxidant) cannot be excluded though.

The herbal equivalent of both cholesterol and the sterols of wool wax are phytosterols (also called phytosterols) which have a similar structure. In skin care applications, they can replace the barrier-active cholesterol of animal origin. Phytosterols are a main component of the unsaponifiable matter of vegetable oils. The term "unsaponifiable" originates from the time when soaps were largely made from vegetable oils. In this process, fatty acid salts (soaps) and glycerin but also residues of waxes rich in phytosterols are formed from the triglycerides of oils, although in varying amounts. Among others, avocado oil is rich in unsaponifiable matter which explains its excellent skin care characteristics.

Another source for phytosterols is shea butter which is often used in cosmetic applications. It is gained from the nuts of the karité tree and a common ingredient of barrier creams. Its melting point is just under or above body temperature. That is the reason why it already easily spreads on the skin in its pure form. Further components are long-chained fatty acids that also integrate well into the skin barrier layers.

While shea butter can be classed with waxes, this does not apply for cocoa butter which mainly consists of triglycerides. Hence, per definition it is categorized as a typical fat substance. "Butter" does not automatically classify as a "wax". Actually there is a fluent transition between the numerous so-called „butter“-raw materials on the market.

Jojoba oil is fluid in the very sense of the word even if it unmistakably is a wax according to its content of wax esters, contrary to the above mentioned definition of waxes. The jojoba bush is cultivated in deserts and semi-deserts. Due to its excellent resistance to oxidation, the oil gained from the seeds will not become rancid and penetrates easily into the skin. The unrefined oil contains vitamin E and carotenoids which can be recognized by its yellowish colour. Owing to its universal field of applications, jojoba oil is a common ingredient of skin care preparations.

Wax esters are a major component of the herbal cuticle (fruit skin, leaves, and blossoms) where they reduce the water loss - similar to their skin care applications. The human sebum contains about 25% of wax esters which also consist of long-chained alcohols and long-chained fatty acids.

Synthetically produced

The human sebum contains wax esters of saturated or monounsaturated C₁₆-alcohols and -esters, among others. These components also occur in the spermaceti (forehead of the sperm whale) and hence are excellent for the care of the dry skin. Since the product can no longer be produced from animal sources, cetyl palmitate (hexadecyl palmitate) today is manufactured synthetically. Due to the low melting point from 43 to 45°C, the product can easily be spread on the skin - in a mixture with other cream components though. In the European Pharmacopoeia the compound has been listed as a carrier for active agents, as a re-fattening ingredient and consistency agent for pharmaceutical creams. It is a component of cooling ointments which basically have the same formulation as the above-mentioned cold creams. In the meantime, there is a multitude of wax esters with similar functions on the market.

Long-lasting

In comparison to triglycerides (fats) to which the human body is accustomed to, it takes more time to break down wax esters. That is the reason why the consumption of fish rich in wax esters, such as for instance a smoked escolar, may induce gastro-intestinal disorders

in the form of temporary diarrhoea (cf. statement of the BfR (Federal Institute for Risk Assessment, 2.11.2009). In terms of skin care purposes however, the slow break-down in comparison to triglyceride-containing vegetable oils is beneficial since it results in a longer lasting skin protection. Contrary to the paraffins used for the same applications (see below) wax esters will be broken down by the body.

Herbal waxes with a higher melting point such as carnauba wax (about 80-87°C) and candelilla wax (67-79°C) are more difficult for the body to break down. The waxes gained from the leaves and the stalks are regarded as indigestible and licensed without stated maximum permissible quantities in the food industry (E 903 resp. E 902); they are used for instance as anticaking and consistency agents (also in cosmetics). They are components of lipsticks, camouflage preparations, kajal sticks and other make-up products.

Besides wax esters, phytosterols, wax alcohols and free fatty acids the natural waxes frequently contain hydrocarbon fractions: beeswax 15%, carnauba wax 2%, candelilla wax 45%. They are particularly common in the waxes of fruit skins.

Waxes also are found in the abiotic environment. In this context we speak of mineral waxes. Considering their composition, they range from highly enriched wax esters up to pure hydrocarbons. Lignite extracts are called montan wax (INCI: also Montan Cera) and used in mascaras for instance. The characteristics are similar to those of carnauba wax. That is the reason why frequently combinations of both of the waxes are found. Montan wax mainly consists of wax esters - such as for instance of the montanic acid (C₂₈; octacosanoic acid). Since the wax is inexpensive, it is used to polish fruit skins (E 912) and as an ingredient in the floor wax and shoe polish production.

Ceresin waxes (INCI: Ozokerite) and the ceresin produced thereof almost exclusively consist of hydrocarbons. Together with microcrystalline wax (INCI: Cera Microcristallina) which is gained from petroleum residues, these waxes are used in the oil phase of cosmetic creams. They reduce the transepidermal water loss (TEWL) and smooth the skin. In the context of hair care, they are sometimes used as conditioners. Together with vaseline products (petrolatum) they belong to the paraffins and their use is controversially discussed. A long term use of higher concentrations can affect the skin's ability to recover.

Highly purified fractions have found their entrance in the pharmacopoeias in the form of

ointment and suppository bases. Their skin tolerance is excellent however it should be mentioned that higher concentrations may lead to swellings of the skin. This particular feature is disadvantageous for the skin but nevertheless still utilized in conventional night and anti-wrinkle creams. By the way, hard paraffins also are the basis for the candle waxes mentioned at the outset of the article. Various sorts of waxes serve for hair removal purposes by being applied on the skin in molten form (hot wax) and then removed after cooling down. Occlusive paraffin masks applied on top of active agent concentrates and sera improve their penetration.

There are waxes with similar features consisting of poly-alpha-olefins (PAO). In this case synthetic hydrocarbons such as propylene, butylene and decene are polymerized to produce waxes with customized consistency without annoying contaminations. The acceptable daily intake (ADI) value is more favourable compared to that of paraffins from petroleum production. That is why they are also used in lipsticks.

Polyethylene glycols

Highly molecular polyethylene glycols (PEG) and their methylated representatives (MPEG) are a completely different type of waxes. In the pharmaceutical context they serve as ointment and suppository bases or tablet additives. A common trade name is carbowax. In the cosmetic field they are used as consistency agents. PEG derivatives of beeswax and lanolin are called PEG beeswax or PEG lanolin. They are utilized as gelling agents in oleogels or re-fattening agents in cleansing products such as shampoos and shower creams.

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