

# A focus on nerves – on intended and adverse effects

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In our private and professional life, we come across quite a few things that literally get on our nerves and also under our skin in the true sense of the word. We feel how we break into perspiration, how we blush or turn pale. Also cosmetic products have an effect on our nerves.

**N**ervous stress affects the skin. Worry lines increase e.g. and lacrimal sacks can no longer be concealed. Magic words in this context then are relaxation, sleep and slowing down. Though, our natural environment and also cosmetics and beauty care offer a lot more than that – they provide a whole armoury of substances that influence the dermal and sensorial nerves.

## Constant companions

Nerves transmit information from the body to the brain in a very complex way. This applies for instance for pain, pressure, heat and cold sensation (cryesthesia). Due to our sensorial nerves, we are able to taste, smell and feel. Neural stimuli trigger muscle contractions and vasoconstrictions (narrowing of the blood vessels). They often occur locally and unconscious for us. In reverse, decreasing neural stimuli cause relaxation and vasodilatations (widening of blood vessels). Nerves can be manipulated. Just to mention sensitizations, de-sensitizations and injuries in this context. The following basic examples are intended for illustration:

- Cold sensations (cryesthesia) can be intensified by always keeping the body warm in warm clothes. They can however be avoided if the body is regularly exposed to cold stimuli. As far as the skin is concerned, this has desirable and undesired effects. It is beneficial that the resistance of the skin can already be built up with cold water. The microcirculation is stimulated and adrenal hormones are released. An adverse effect however occurs if the facial skin is constantly exposed to the dehydrating cold air (wind) without any protection. The connective tissue and the micro capillaries will be damaged in the long run. Rosacea and couperosis will develop.
- We also get used to heat sensations. Although heat can be a warning signal, it does not keep people from exposing

themselves to the intense infrared radiation of the sun for hours and hours every summer. The consequences are well-known: The tissue will be damaged and a premature skin aging is preprogrammed.

- Nicotine is a neurotoxin that works via the acetylcholine receptors of the body. In the final analysis, a vasoconstriction is induced with the effect that the temperature of the skin surface is lowered. The skin turns pale and colourless.
- Alcohol leads to a temporary vasodilatation of the periphery skin vessels and an increased blood flow. That is the reason why alcohol is contraindicated as a first aid for hypothermia (avalanche and naval accidents) - contrary to a very popular belief. It still would increase the already existing heat loss.
- Caffeine has an overall energizing effect on the organism and is regarded as a stimulant in general. The vasodilatation in the periphery skin vessels supports the microcirculation. That is why caffeine is a frequent ingredient in cosmetic products for atrophic skin, cellulite and hair growth disorders.

## Rather numbing

Substances that locally block the experience of pain of the skin are called local anaesthetics. Typical representatives in medical treatments are lidocaine, procaine and benzocaine; they are subcutaneously injected and temporarily numb the specific local area. Local anaesthetics directly influence the nerve cells and inhibit the transmission of sensorial impressions like pain, temperature and pressure. They are used in the context of minor local surgery. Polidocanol (INN) takes a special position as it is used in dermatology as local anaesthetics to treat excessive itching and neurodermatitis. It also reduces the experience of pain of the skin. Polidocanol is a polyethylene glycol (PEG) and well-known in cosmetics as laureth-9 (INCI). The Federal Institute for

Risk Assessment (BfR, 2003) classifies leave-on preparations respectively skin care products (that stay on the skin) containing antipruritic or analgesic substances as health hazards for consumers due to the fact that the locally numbing substances also suppress symptoms and warning signals of the skin such as itching or experience of pain which may be signs of a skin damage. In cosmetics, laureth compounds with different chain lengths serve as emulsifiers for the production of emulsions. Laureth-9 is produced through ethoxilation of lauryl alcohol.

A number of pungent substances is related with local anaesthetics. Chilli influences the gustatory nerves and an increased consumption results in a significant surge of the tolerance levels. Furthermore, in the form of the main ingredient capsaicin with the chemical term N-(4-Hydroxy-3-methoxybenzyl)-8-methyl-6-nonenamide, it stimulates the blood flow - similar to ginger and vanillin ester. Capsaicin therefore is an ingredient of hot patches. Similar effects have nicotinic acid esters and salicylic acid esters and particularly their respective benzyl esters.

### **Affecting the muscles**

Spilanthol (N-2-Isobutyl-2,6,8-decatrienamide) with its fatty amide structure like capsaicin also belongs to the pungent substances. Spilanthol is the main active agent of paracress. It reduces the muscle contractions of the mimic wrinkles, relaxes them and hence leads to a fast and visible smoothing of the wrinkles of the skin. Since pungent substances frequently accumulate in form of depots in the stratum corneum due to their chemical structure, their dosage may gradually be decreased. On the other hand, the conditioning of nerves and muscles allows a dosage reduction, an experience that already has been made with botox (see below). Applying capsaicin (chilli) on the skin may initially cause an itching sensation; the application of paracress extracts will involve a light formication for several minutes. Subsequently, the treated skin areas become insensitive.

Apart from that, also other fatty amides such as palmitic acid monoethanolamide suppress the itching. This particular substance has an endocannabinoid-like effect and is applied in the case of atopic skin. Cosmetics manufacturers also use the substance as a foam stabilizer (INCI Palmitamide MEA) however due to the nitrosamine problems (contamination through secondary amines) it can only be processed in first-rate chemical purity.

### **Let's go for the crinkles**

A number of synthetic peptides act like the muscle-relaxing spilanthol. One of the first representatives was acetyl-hexapeptide (acetyl-glutamic acid-glutamic acid-methionine-glutamic acid-arginine-arginine). This short-acting type of peptide influences the neuromuscular synapses of the mimic wrinkles and relaxes the muscles, thus causing a smoothing of wrinkles. The effects are derived from the neurotoxic polypeptides that are discharged by a series of clostridium bacteria and summarized under the term botulinum toxin (clostridium botulinum). Botulinum toxin is a highly noxious substance and predominantly occurs in foul meat. In order to prevent related food poisonings, specific regulations regarding the refrigeration of stored meat have been passed. On the other hand, meat can be preserved with sodium nitrite respectively nitrite curing salt.

Botulinum toxin impedes the release of acetylcholine at the synapses and hence the transmission of nerve impulses. The muscles can no longer be contracted which leads to a lethal respiratory paralysis (apnea).

In reverse, muscle cramps appear if the acetylcholine breakdown is inhibited by disabling the acetyl cholinesterase. This is the active principle of nerve agents such as tabun, sarin and soman.

For quite some time now, particular medical indications have been treated with specific local dosages of isolated and purified botulinum toxin. In particular, spasmodic conditions have been remedied. In the case of hyperhidrosis, the sweat formation can be reduced. The local injection of the toxin in order to smooth out wrinkles is reserved for the aesthetic dermatology. For reasons of product safety, the toxicity of the botulinum toxin has to be redefined for each new lot of production. For this purpose, the lethal dose (LD<sub>50</sub>) for mice is determined, among others.

### **The nose – a highly complex sensory organ**

As regards odours, scents and fragrances, it is important to know, that our olfactory nerves (olfactory sense) have to be conditioned to the corresponding substances in order to be able to smell them. This cannot be taken for granted, though. Interviews in perfumeries have shown that for instance less than 50 % of the interviewees perceive a perfume as an agreeable scent. A high percentage of individuals cannot perceive androstenone, which is a main ingredient of the smell of perspiration in the armpits. On the other hand, there are also molecules which can modify the olfactory sense. After a certain while, we no longer per-

ceive hydrogen sulfide, which smells like bad eggs. We also get used to a vast number of everyday odours. Certain scents are able to modify the olfactory nerves in such a way, that

afterwards we even perceive fresh air as an objectionable odour.

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