Skin and body odours

published in medical Beauty Forum 2016 (6), 12-17

Our body odour surrounds us like an aura. It contributes to whether we feel an instant attraction or dislike for another person.

The individual body odour is innate with humans and continually changes until we reach old age. This concerns our skin, our breath and the various glands and emunctories. Odours reveal information on how we feel, on the habits we cultivate, on what we eat and on the state of our physical health.

A literal translation of a German idiom says you need to have the "same farmyard smell" to be successful in a political party. The same selection takes place every day when people meet or become acquainted with each other. The body odour has a determining influence whether friendships or partnerships develop respectively whether the genes make a good match or not.

Looking more closely at the issue, we realize that body odours send a lot more signals. Many things we only notice in other people; some details we observe in our own body. Nature has endowed us with this kind of perception ages and ages ago, even before we could interact with each other by way of speech. It serves for information and for the exchange of information. Among other things, we can literally "smell" diseases and related metabolic disorders.

Metabolism and disease

Diabetics give off an acetone-like smell in the case of hyperglycaemia. As a matter of fact, acetone can be found in the urine, mouth odour, breath and on the skin. Insulin deficiency induces the body to metabolize more proteins and fats for energy production. Acetoacetic acid and acetone are formed in this process. Acetone also is produced in healthy persons when they are very hungry and there is not enough glucose available, or in other words, when they have hypoglycaemia or, in extreme cases, ketoacidosis. Hence you can also smell hunger.

Also diseases of the internal organs as e.g. liver and kidneys change the mouth odour. The breath of persons with kidney insufficiency may smell like urine.

In the case of infections of the urinary tract and the inability to control urination, people joke about the smell of ammonia and pickled cucumbers. As a matter of fact, the bacteria involved in the infection and the endemic bacteria of the genital area metabolize the urea of the urine into ammonia and carbonic acid. A similar smell forms with the innate metabolic disorder called trimethylaminuria (TMAU). Breath, sweat and urine smell like trimethylamine. This smell also occurs in the urine of healthy persons after the consumption of fish.

Diseases of the pancreas not only manifest themselves via changed stool colour but also via its odour. Conditioned dogs can recognize lung and breast cancer at a very early stage via the smell of the breath. At later stages of breast cancer, a foul smell develops on the skin due to cell decay. Similar conditions occur with decubitus and ulcus cruris (diabetes). Diphtheria causes a mawkish, foul smelling mouth odour. Further examples are:

- hypermethioninaemia (disorder of the methionine adenosyltransferase in the amino acid metabolism) – rancid smell
- phenylketonuria (phenylalanine hydroxylase defect in the amino acid metabolism) – smell like mice droppings
- isovaleric acid acidosis (isovaleryl-CoA dehydrogenase defect in the amino acid metabolism) – sweat-like smell
- maple syrup urine disease (MSUA – several subspecies due to defects in the citric acid cycle and in the amino acid metabolism) – among others a Maggi® seasoning sauce like smell.
- hypothyroidism can manifest itself via mouth odour and sweat
- ozaena forms when bacteria settle in the nose and destroy the nasal mucous membrane

Hormones

Hormones programme metabolism, bodily functions and sexuality from birth to death. They decide on whether we have a fresh-faced youthful look, the face shows the first wrinkles, the skin loses its tonicity or whether the typical signs of elderly skin become apparent. Up to old age, the quantity of hormones produced by our body changes and also the relation among them – this also has effects on our skin.

Changes in the metabolism can also influence the body odour.
During puberty above all the changed sweat odour in young men becomes apparent; its main component is androstenone which is a metabolic product of testosterone. Sweat odour of men and women not only differs because of the gender-specific hormonal balance. Men and women secrete different substances which the skin flora then again metabolizes with the result of particular odours which can have attractive or rather repellent effects – among the substances are isovaleric acid and branched, partly unsaturated C6-C11 acids. A prolonged hyperhidrosis can gradually decline into bromhidrosis with the characteristic feature that the correspondingly adapted skin flora metabolizes parts of the horny layer with the result of particularly ill smelling metabolic products. Our state of mind also influences the secretion of the emotionally sensitive apocrine sweat glands so that fear, stress and sexual excitement become noticeable. Contraceptive pills and pregnancy also make an impact on the body odour, particularly around nipples and in the genital area.
The female vaginal secretions contain copulins (female pheromones) that change their composition, concentration and smell during the menstrual cycle. They are volatile short-chained and partly branched fatty acids with a smell that induces an increased testosterone level in men when women are ready for conception. When women spend a longer period of time together, their menstruation cycles are synchronized in a similar way. As a matter of fact, choice of partners, sexuality as well as the mode of behaviour in the family is largely determined unconsciously. As far as further pheromone-like substances are involved has not yet been found out.
The intestinal flora also contributes to the body odour. This is most noticeable shortly after birth when the intestinal flora changes from lactobacillus bifidus to the later on predominant escherichia coli bacteria.

Food

Worn textiles are an indicator for the volatile aromas that the skin emits into the environment. Their smell can inform on the meals we consumed hours ago. Urine and the exhaled breath then also have their characteristic smell. As from a chemical point of view, we speak of low molecular substances which are retained in sweat and textile fabrics or discharged via urine. The dermal microbiome further metabolizes and intensifies the odour of some of them. Besides amines, aldehydes, ketones and carboxylic acid esters, the sulphur compounds and short-chained carboxylic acids are predominant.
A popular example in this context is **garlic** smell which is mainly formed of diallyl disulphide and diallyl trisulphide. Both the sulphur compounds are excreted via skin and breath. Various sulphur compounds are released during cooking, as for instance of **onions**, some of them also during cooking and after consumption, such as garlic. As both the vegetables are widely used in our nutrition as for instance in sausage products and seasonings, their smell can be frequently noticed after the meals. **Asparagus** rather becomes noticeable in urine shortly after a meal as it contains thioacrylic acid-S-methylester and 3-(methylthio)thiopropionic acid-S-methylester with their characteristic smells. Both the sulphur compounds are metabolic products of asparagusic acid (1,2-dithiolane-4-carboxylic acid). In the case of **radishes** and **cabbage** there are also the short-chained sulphurous compounds which then enrich the breath. This also applies for various types of **cheese** which not only have a strong smell on their own but also shed a nasty aroma after consumption due to dimethyl disulphide and dimethyl trisulphide. Dimethyl sulphide is a rather loyal companion of **seafood** and low concentrations of it even dominate the smell of the air above the ocean. It forms in the process of bacterial degradation of algae, among others. **Saltwater** but also **freshwater fish** release an ammonia-like smell in the urine which is due to trimethyl amine (see above). The consumption of **meat** and particularly smoked meats releases characteristic smells on the skin and in the urine.

Smoking

Nicotine activates the natural acetylcholine receptors of the body. It triggers vasoconstriction and decreases the surface temperature of the skin. The skin becomes pale and livid. In addition, enzymes such as matrix-metalloproteinases are stimulated.[1, 2] It is possible that besides proteases also esterases or other enzymes of the skin are stimulated. Personal observations by the author suggest that individual components of cosmetic creams are subject to an increased degradation process in smokers combined with the release of objectively noticeable unpleasant smells on the

[1] Lahmann C, Bergemann J, Harrison G, et al. Matrix metalloproteinase-1 and skin ageing in smokers. Lancet 2001; 357:935-936
[2] Sorensen LT, Zillmer R, Agren M, et al. Effect of smoking, abstention, and nicotine patch on epidermal healing and collagenase in skin transudate. Wound Repair Regen. 17(3):347-53 (2009)

skin. The subjectively changed olfactory sense of smokers is immaterial in this context.

Pharmaceuticals

Pharmaceutical active agents can trigger body odours in a variety of ways:

- Dryness of mucous membranes in mouth, nose and vagina is an adverse effect of pharmaceuticals. This dryness changes the microflora and leads to odd smells.
- Oral antibiotics to treat infectious diseases not only disturb the intestinal flora but also the vaginal microflora. Also spermicidal contraceptives such as gels, foam and suppositories change the natural balance of the body and hence influence the body odour.
- In rare cases the degradation products of pharmaceuticals can be smelled. Usually it is a matter of sulphur compounds. A particularly pungent garlic-like smell develops on the skin after the application of ointments containing dimethyl sulphoxide to treat sport injuries and oedema. The anti-inflammatory penetration booster is metabolized into gaseous dimethyl sulphide (thioether) and excreted via skin. Small amounts of the gas also develop when cooking vegetables and particularly cabbage.

Different body areas, different smells

Bad breath (halitosis) is induced by bacteria that degrade organic compounds and release volatile sulphur compounds such as hydrogen sulphide (fermentation gas) in this process. Potential causes of bad breath can be dryness of the mouth (see pharmaceuticals), food residues between teeth or coating of the tongue. The same applies for infections of pharynx and oesophagus.

Foot odour: Under normal conditions, isovaleric acid prevails in the foot area. Additional ill smelling sulphurous compounds, among them mercaptans, thioethers and thioesters, can form after particular types of bacteria have infested the skin on the feet. Moist sweat-prone feet easily facilitate such processes.

Genital area: The warm and humid milieu of vagina and vulva is an ideal playground for bacteria and fungi. The own natural flora already emits an individual, typical body odour which primarily is not perceived as being unpleased though. Disorders in the genital area – mostly triggered by overdone hygiene – change the local microclimate and the secretions, though.

Cosmetic products: If cosmetic products are fragrance-free, the natural odours of the different components become noticeable on the skin. In this case the major function of fragrances, namely the covering of annoying aromas is missing. After application of the products, the body temperature of about 37 °C (skin: 32-34 °C) in particular releases volatile components which also can occur as concomitant substances in otherwise odourless substances. Their presence in natural substances is more pronounced. Hence shea butter or vitamin A can be easily detected by their smell. The presence of highly unsaturated acids such as linoleic acid and alpha- as well as gamma linolenic acid already can be recognized in ppb quantities by their metabolites pentanal, hexanal and heptanal as well as the particularly odorous unsaturated compounds 2-nonenal, and 1-octen-3-on (1ppb = part per billion = 0.000 000 001). Opinions also differ on certain non-avoidable natural odours such as algae and yeast extracts. What one person may love profoundly may be disgusting for others. Products with untreated extracts cannot be sold on the Arabic-Islamic market.
As already mentioned in the context of smoking, the individual dermal microbiome can contribute to the fact that cosmetics create different scents on different skins. The reason is that the microflora of the skin changes with cosmetic care. A remaining film of lipids and hydrocarbons for instance promotes the proportion of anaerob germs while preservatives selectively or generally inhibit the growth of germs. As the germ flora not only subsists on the stratum corneum components but, depending on its specialization, also metabolizes cosmetic ingredients, volatile metabolites with various scents are produced. The typical smell test as observed in the context of cosmetic testing also makes perfect sense in the case of fragrance-free products. It is recommended to wait a little while after application and then repeat the testing.

Dr. Hans Lautenschläger