

The Skin Microbiome

The **HUMAN SKIN** is colonized by billions, mostly harmless microorganisms. This community is called microbiome, also known as the skin flora or microbiota, and is composed of different species in different quantities. The microorganisms do not only live on the skin, sometimes called a 'living layer' but also in deeper regions, for example in glands and on the hair shaft. Bacteria, fungi and viruses are found on the skin as well as mites, tiny arthropods.

The **MICROBIOME** is highly individual for every person and body site specific. It can be even regarded as a kind of unique fingerprint. These interpersonal and site specific variations are determined by the chemical and physical skin parameters such as pH, moisture, temperature and nutrients, for instance. Some microorganisms prefer oily, others moist and still others only like dry areas. Many aspects such as genetic, age, gender, environment, life-style and personal care routines influence the skin parameters and therefore also the microbiome.

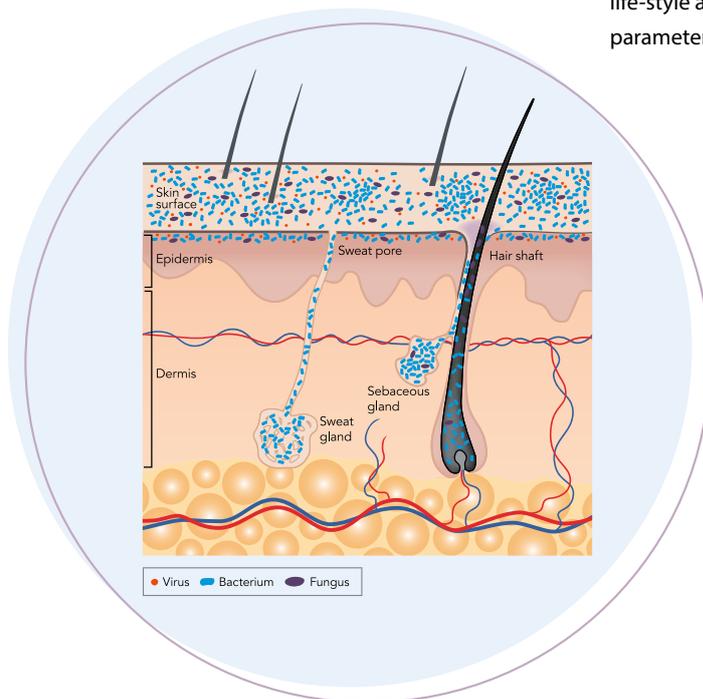


Fig. 1: Microorganisms mainly colonize the surface of the skin and the first layers of the epidermis. In addition, bacteria and fungi are also found in glands and hair follicles.

A Balanced Microbiome

The microbiome contributes to healthy skin and also seems to play a role in various skin diseases. It has been shown that the skin microbiota as well as the intestinal microbiota can additionally influence the immune system and could therefore also play a role in well-being. Although the distinction between cause and effect is not always clear, the microbiome is believed to play an important role in (skin) health. Therefore, a balanced microbiome contributes to skin health and vice versa.

The relative distribution of the species in relation to the total number of microorganisms present is called diversity. The more different species occur relatively frequently on the skin, the higher is the diversity of the microbiome.

In every movie there is a hero and a villain but most of the time the story is not that straight forward. The dependencies and interactions can be extremely complex, but to make things simple: heroes can go bad, villains can be bettered by heroes and everything is influenced by external circumstances and other characters. All this is also true for a microbiome. The individually optimal and healthy composition of microbiome has not been found yet but is usually directly linked to a healthy sustained skin barrier.

Atopic dermatitis can be used as an example to demonstrate the link between the skin barrier and the microbiome. Patients with atopic dermatitis have a disturbed skin barrier function and usually show an imbalanced microbiome

with a low diversity. In these cases *Staphylococcus aureus* is prevalent and overly represented. Research suggests that certain skin microorganisms such as *Staphylococcus epidermidis* and *Staphylococcus hominis* protect against pathogens and inhibit colonization of *S. aureus* in atopic dermatitis patients.

In this case we can clearly distinguish between good and bad. Although *S. epidermidis* is good in this case, it can cause infection and is frequently found in hospital acquired infections. Also, *S. epidermidis* can be a reservoir for antibiotic resistance markers which could be transferred to the more virulent *S. aureus*. Good or bad - not that simple but:

A balanced microbiome should be protected so the community is well equipped to cope with external changes!

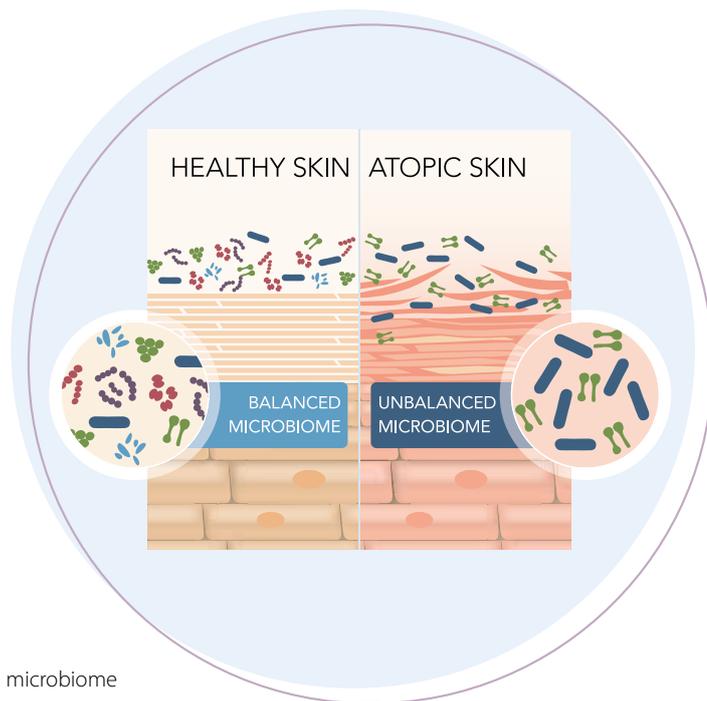


Fig. 2: Healthy skin usually has a balanced microbiome with a high diversity of microorganisms which is individual and site specific. In atopic skin patients, the skin barrier is altered, which can be accompanied by irritated and itchy skin. In addition, the balance of the microbiome is disturbed through an excessive colonization of *S. aureus*.

The Microbiome in the Personal Care Industry

The number of product launches with microbiome related claims increased dramatically in the past years. Keywords used by suppliers and manufactures are for example “microbiome”, “prebiotic” and “probiotic”. All products can be divided into two strategies.

The first strategy is to add specific substances to the formulation that are believed to optimize the skin microbiome or that are known to have good effects on the gut microbiota and substances generally associated with a microbiota. These substances are called prebiotic, probiotics and postbiotics.

The other strategy is more general, which promotes “microbiome gentle” products which “respect” the microbiome. These claims are often supported by other functions such as moisturizing, smoothing and regenerating the epidermal barrier.

Many products with microbiome related claims use preservatives, mostly sodium benzoate, benzyl alcohol, phenoxyethanol but also isothiazolinones and DMDM-hydantoin. Multifunctional additives are also used, particularly ethylhexylglycerin and diols.

Microbiome related claims are used even with preservatives and multifunctionals!

Pre-, Pro- and Postbiotics for the Skin Microbiome

Substances that are used to influence the microbiome can be divided into prebiotic, probiotic, and postbiotic substances. The distinction is based on the terminology used for the intestinal microbiome.

Prebiotics: Describes nutrients, such as *sugars* and *proteins*, which are used to promote growth of certain beneficial microorganisms in a microbiome. Prebiotics used in the personal care market include *Maltodextrin* and *Avena Sativa Kernel Flour (Oat)*.

Probiotics: The term is used for living microorganisms that are intended to optimize or balance the microbiome. In the cosmetics industry, however, the term is also used for dead microorganisms, either intact, lysates or ferments, which are said to have a similar effect to living ones. Examples for ingredients with probiotic claims are *Bifida Ferment Lysate* or *Lactococcus Ferment Lysate*.

Postbiotic: Lysates and secrets of microorganisms would usually fall under this category, although this term is so far not used in the personal care industry.

Preservative and the Microbiome

Of course, the biggest question is if preservatives have an impact on the microbiome. The primary function of preservatives is to protect the product from microbial contaminations and therefore have to impair microbial growth. This would suggest that also microorganisms on the skin might be affected.

In order to protect against a variety of species preservatives and multifunctionals have a broad spectrum of activity. Thus, they have no true selectivity against specific microorganisms. In addition microorganisms are able to regrow quite quickly, especially the prevalent species, and thus, an overall reduction could be compensated. To support regrowth, optimal physical and chemical skin parameters are advantageous which can be influenced by a good overall formulation of the cosmetic product.

Moisturizing, re-fattening and regeneration of the epidermal skin barrier are important factors to maintain a healthy skin and therefore support the natural skin microbiome. In conclusion the formulation components despite the preservative system have also a major impact on the skin health and consequently also on the skin microbiome.

Several studies have been published in which the influence on the microbiome of personal care products with preservatives, has been investigated. So far, the results are inconclusive and much research is still needed to fully answer this question. It is also unclear whether a shift in the microbiome is necessarily problematic, as it occurs naturally during the course of life and is also dependent on multiple external factors, as previously described. In addition, it is uncertain at which point a microbiome is unbalanced and therefore problematic.

It can be expected that under the above mentioned circumstances the effects of preservatives on the microbiome are negligible especially because the overall formulation will most likely have more impact.



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