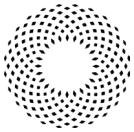
CODEX
BEAUTY LABS

Chapter: Microbiome

SECTIONS



01 What is the skin microbiome?

Skin, the body's largest organ, is colonized by a diverse collection of bacteria, fungi and viruses commonly referred to as "microorganisms". The diversity of microorganisms living in these colonies is highly dependent on the skin's ecology, topographical location, intrinsic host factors and extrinsic environmental factors.

Human skin is first colonized by maternal microorganisms shortly after birth. Over time, the composition of the microbiome changes in response to various intrinsic and extrinsic factors. Intrinsic factors include a person's age, genetic makeup and overall health. Extrinsic factors include their diet, the climate in which they live and their personal hygiene routine. The microbial makeup (i.e. diversity) of these colonies also depends on where they are located on the skin and that location's microenvironment. This is because microorganisms feed off of the sweat and oil released by skin when it is cooling and lubricating itself. Hence, areas of the skin having a higher number of oil glands, such as one's face, tend to host colonies that feed off of the fats (lipids) found in the sebum these glands produce. One's armpits, on the other hand, represent an area that is inherently warm, moist and dark, resulting in there being a preponderance of microbial colonies that thrive in those types of microenvironments. Then there are those areas of the skin that are typically dry and cool, such as one's forearms, that have fewer colonies of microorganisms, in general, due to the relative scarcity of nutrients (oil and sweat) present in those locations.

The majority of microorganisms residing on the skin are harmless to healthy individuals. That being said, there are microorganisms considered beneficial (health promoting) to skin, and those that are pathogenic (infection promoting). Beneficial microorganisms impart health benefits to the skin by, for example, secreting antibacterial peptides that eliminate pathogens present on skin so as to prevent them from colonizing the skin. It should be noted, however, that even beneficial microorganisms can become problematic and cause infection such as when the skin's physical barrier is damaged by trauma or injury.

02 What does the skin microbiome do?

Skin's microbiome serves several functions. The first is to prevent pathogens from colonizing the skin. The existence of pathogens in our environment, and their presence on the surface of skin, is a natural part of life. The skin and its microbiome serve as the first line of defense against environmental pathogens. Beneficial microorganisms secrete bioactive antimicrobial peptides that eliminate pathogens, thus keeping their numbers in check and preventing them from colonizing the skin. As long as the pathogens do not outnumber the beneficial microorganisms, the microbiome remains balanced. It is when the balance is tipped in favor of the pathogens that skin health and appearance begin to suffer with skin becoming inflamed and appearing dry, irritated and flaky.

Another important function served by skin's microbiome is to support skin's barrier function in order to prevent pathogens from penetrating the skin and causing infection. Certain beneficial microbes secrete bioactive molecules such as fatty acids and lipids that help to nourish skin cells and fill in the spaces between the cells in order to strengthen the skin's cellular matrix and enhance its barrier function.

The other important function served by the microbiome is communication with the body's immune system. In the event the microbiome is overrun by pathogens, this imbalance causes the beneficial microbes to band together and send messages to the body's immune system, asking it for assistance. This coordinated effort, on a cellular level, stimulates keratinocyte-derived immune mediators, and immune cells located in both the epidermis and dermis to trigger the immune system into action, resulting in the release of pathogen-destroying and wound-healing molecules.

03 What causes microbiome imbalance?

As was mentioned above, in order for the microbiome to function properly, it must be properly balanced. There are, unfortunately, numerous intrinsic and extrinsic factors that can tip the balance in favor of the pathogens. Examples of intrinsic factors include a person's age, genetic makeup, and health. The aging process causes the body to produce less sweat and oil which the beneficial microorganisms of the microbiome need for sustenance. The lack of adequate supply of such nutrients has a negative impact on the microbiome making it less capable of effectively doing its job of protecting the body from pathogens. Consequently, as the skin's barrier function weakens, skin becomes dry, flaky and irritated triggering a response by the body's immune system that leads to skin inflammation. Similarly, a person's inherent genetic makeup can affect the composition and diversity of their skin microbiome in a way that prevents it from being and/or remaining balanced. The health of an individual also plays a key role in the proper functioning of their skin microbiome. Poor health and/or disease will also negatively impact the microbiome's composition and balance by unnecessarily triggering certain biological processes associated with the body's immune system that lead to excess inflammation and a shift in microbiome balance.

Examples of extrinsic factors include the climate in which a person lives, as well as their personal hygiene routine. When it comes to climate, whether hot, cold, dry, humid or some combination thereof, these variations will influence the composition and balance of the microbiome. Exposure to excessive amounts of UV radiation and pollutants will cause the skin to become compromised (ex. sunburn) which in turn will throw of the microbiome's balance, rendering it more susceptible to attack by foreign pathogens.

As for personal hygiene, few people realize the impact it has on the microbes colonizing their skin. For example, the simple act of washing one's face can have a dramatic impact on the microbiome. Not only are microbes physically removed from the skin's surface by the actual washing process but, depending on the type of cleanser used, the skin's pH can also be unfavorably altered. Beneficial microbes require an acidic environment in order to survive and thrive. The exterior surface of the skin has a pH of around 5 (acidic). Use of an alkaline product (pH around 8 or higher) to cleanse one's skin will, in turn, increase the skin's surface pH to a more alkaline level, thereby impacting colonies of beneficial microbes that cannot survive in such an environment. Similarly, the application of cosmetic products that are more alkaline in nature because of the ingredients contained therein, also increase the pH of the skin's surface resulting in the microbiome becoming unbalanced.

04 What can be done to keep the microbiome balanced?

Company's today are utilizing their research and development resources in an effort to develop products that support and/or restore microbiome balance. These topically applied products claim to contain pre- and/or probiotics that facilitate the proliferation of beneficial microbes for skin microbiome balance. The concept is of course analogous to the oral consumption of pre-/probiotics meant to promote increase of beneficial microbes in the gut, which is where the body's other microbiome resides. However, as is the case with the use of all such products, the jury is still out with regards to efficacy. While various studies have been conducted in an effort to try and ascertain their validity, proof-of-concept has yet to be affirmatively established.

The best current strategies for skin microbiome maintenance involve staying healthy and avoiding the use of products that can strip beneficial microbes from the surface of the skin. Proper diet, exercise, and the performance of any activity that can reduce and/or eliminate stress and anxiety (ex. yoga, meditation) will help your body, and its microbiome, operate at an optimum level.

The use of topical products that support, rather than undermine, the skin's microbiome, is also highly recommended. For example, when it comes to cleansing one's skin, harsh/alkaline cleansers should be avoided in favor of milder one's. Since virtually all dirt, grime and makeup that people wash from their faces has an oil component, just like iron sharpens iron, oil removes oil. Hence, the use of an oil-based facial wash for daily cleansing will have the least negative impact on the skin's microbiome, thereby helping it to remain balanced.

The reason for this is because oil cleansers are mildly acidic in nature. As was mentioned above, the pH of skin is naturally acidic, i.e., around 5. Therefore, the use of topical products like oil cleansers which have a pH similar to that of skin, should be used whenever possible since their use will have less of an impact on the skin's natural pH and, consequently, the skin microbiome.

Oil-based products, such as the aforementioned oil cleansers, are free of preservatives because they contain no appreciable amount of water. Skin care products in the form of creams and lotions (i.e. emulsions), on the other hand, contain both water and oil, which gives them their creamy texture. Whenever a product contains water, the use of preservatives is essential in order to prevent harmful pathogens from growing in the product, which can then be transferred onto the skin during consumer use. While the use of preservatives is, therefore, necessary for product preservation, their impact on the skin's microbiome becomes an issue when the preservative-containing product is applied onto the skin. There is a growing belief that preservatives not only kill harmful pathogens, but beneficial microorganisms such as those colonizing the skin as well. Hence, the mere use of preservative-containing products might also cause microbiome imbalance. This is why the use of microbiome-neutral preservative systems in personal care products such as skin creams and lotions is highly recommended.

05 How can preservatives affect the microbiome?

Cosmetic products require the use of preservatives in order to prevent microbial contamination during their useful shelf-life. Otherwise, microorganisms will proliferate within the product and ultimately be deposited onto the surface of the skin causing it to suffer.

Studies have shown that the use of cosmetic products containing traditional preservatives can have a deleterious effect on the average biodiversity of the skin's microbiome. Preservatives commonly used in cosmetic products, such as parabens and triclosan , are being studied for their effects on skin microbiology, especially in children and adults with compromised skin. Although they are effective at inhibiting microbial spoilage, they can also destroy both pathogenic (bad) and commensal (good) bacteria. Hence, when a product containing such preservatives is applied onto the skin, the delicate balance of its microbiome is invariably changed and potentially compromised.

One of the ways in which this has been established is through the use of Histone Deacetylases (HDAC) which are used as a biomarker to evaluate microbiome balance. HDAC are a class of enzymes expressed in skin cells whose function is to promote healthy skin by regulating the relationship between commensal bacteria and cell function. When HDAC activity is lowered, the skin's commensal bacteria are no longer as effective at protecting the skin against pathogenic bacteria because of the imbalance in the microbiome. This imbalance, in turn, negatively impacts the immune system causing the skin to become overly dry, leading to inflammation and overall poor skin health.

[1] Parabens, 1,2-hexanediol and phenoxyethanol inhibited the growth of pathogens, as well as skin-resident bacteria such as Staphilococcus epidermidis, Shigella flexneri, Enterobacter aerogenes and so on. The application of a basic cream containing phenoxyethanol to human skin was shown to disturb the skin microbiota: at the phylum level, Proteobacteria increased and at species level, 4P004125_s increased and Propionibacterium humerusii decreased. Based on these findings, parabens, 1,2-hexanediol and phenoxyethanol have antimicrobial activity and cosmetics containing phenoxyethanol may disturb skin microbiota.
Effects of Cosmetics and Their Preservatives on the Growth and Composition of Human Skin Microbiota, June 2015Journal of the Society of Cosmetic Scientists of Korea 41(2):127-134

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Medina S. Jackson-Browne, Noelle Henderson, Marisa Patti, Adam Spanier, and Joseph M. Braun, Curr Environ Health Rep. 2019 Dec; 6(4): 214–224.

https://clinicaltrials.gov/ct2/show/NCT04476732

Recent studies have shown that the use of certain ingredients, including fermentation-based preservatives, not only has less of an impact on microbiome balance but, depending on the type of ingredient used can actually reinforce it. For example, biotech-based preservatives in the form of antimicrobial peptides derived from the fermentation of lactic acid have been found to effectively destroy pathogenic bacteria, while at the same time supporting HDAC activity and, hence, commensal bacteria balance. This finding was substantiated using biological assays that showed the peptides failed to inhibit HDAC activity, as compared to their traditional preservative counterparts. The microbiome thus remains properly balanced and the skin healthy and protected against harmful pathogenic bacteria. In short, natural preservatives appear to be superior to their synthetic counterparts when it comes to maintaining a healthy, well-functioning skin microbiome.

06 Is properly hydrated skin important to the skin microbiome?

When it comes to the interplay between moisture and the microbiome, there is not much current information available on this topic. However, one connection between the two that scientists have observed relates to the diversity and number of microorganisms that reside on hydrated versus dry skin, particularly with respect to the bacteria genus (family) whose members (species) are known to be associated with acne formation, i.e., Propionibacterium genus and, specifically, its P. acnes species.

This acne-related bacteria family contains lipophilic (oily) skin commensals that are typically found in sebum-rich areas of the skin like the head, chest and back where acne formation is typically most problematic. Studies have shown that well hydrated areas of the skin contain fewer members of this acne-related family of bacteria. Hence, there appears to be a correlation between increased hydration levels and decreased sebum content/production. Consequently, one can extrapolate this finding to conclude that properly hydrated skin may decrease one's chances of developing acne due to a decrease in the number of P. acnes residing in the microbiome at that hydrated location on the skin.

Summary

While there are certain strategies that can currently be employed to both support and maintain microbiome balance like eating properly, exercising and avoiding the use of pH lowering (i.e. alkaline) products on the skin, this field of science is still under development so stay tuned.

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