

How cutaneous microbiota interacts in sensitive skin?

SKIN SENSITIVITY FOCUS

Human skin is a complex barrier organ that provides an ecological niche for a wide range of microorganisms.

The majority of these microflora are harmless or beneficial, providing protection against pathogens and playing an important role in modulating the host's cutaneous innate and adaptive immune systems.

The symbiosis depends on a complex "dialogue" necessary for healthy skin and an efficient skin barrier function between :^{1,2}

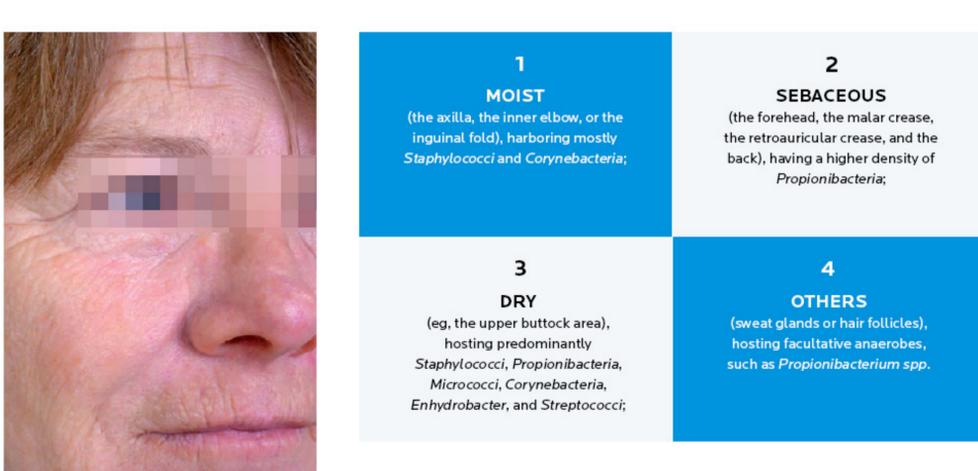


What is the skin microbiota?

A single square centimeter of the human skin contains up to one million microorganisms, including diverse communities of viruses, bacteria, fungi, and mites. While bacteria account for only 0.1% of this total (1 million/cm²), they are generally considered to be the most important living organisms in this ecosystem. Bacteria are present on the skin surface, deeper layers of the epidermis, the dermis, and dermal adipose tissue.⁵

Culture-based studies indicated that *Staphylococcus epidermidis*, other coagulase-negative *Staphylococci*, and *Coryneforms* of the *Actinobacteria phylum* were primary bacterial colonizers of the skin. However, many organisms may be present that are said to be uncultivable or are outcompeted by organisms that grow more readily in culture.⁶

The microbiota of the skin varies across its surface, and four main "environments" have been described: ³



What is the relationship between skin barrier and skin microbiota?

The skin barrier, as well as the microbiota, protects the body against a wide range of external dangers. This barrier consists of the epidermis and several layers below it that influence function and harbor microbes. It is becoming increasingly accepted that commensal species of microorganisms that naturally reside on the surface of the skin's bacterial landscape is highly dynamic with both the composition and relative abundance of bacteria varying considerably across individuals.³

The diversity and abundance skin are an integral part of the innate immune system. These bacteria contribute to protection against pathogen growth by competing for nutrients and space.² There is a balanced interplay between the host cells and resident and/or transient bacterial populations that is continuously affected by intrinsic (host) and extrinsic (environmental) factors (Figure 1). These factors alter the composition of the skin micro-organism community and may influence skin barrier function by inducing an unbalanced microbial state or dysbiosis that may be evidenced in chronic skin diseases, such as atopic dermatitis, psoriasis, rosacea, or acne.³



Figure 1: Current model of relationship between skin barrier and skin microbiota. ³

HOW SKIN MICROBIOTA INTERACT WITH HUMAN SKIN BARRIER	
Proteases	May affect corneocytes desquamation and many skin proteins (ie, filaggrin) involved in stratum corneum cohesion
Lipases	Break down surface lipids with potentially irritant by-products including fatty acids
Ureases	Virulence factor found in various pathogenic bacteria; essential in host colonization and in maintenance of bacterial cells in tissues
Biofilm	Protect bacterial colonies on the skin
Bacteriocins	Bactericidal peptides regulating bacterial population
Quorum sensing	Needed for microbiota balance; effect not known on the skin
Skin nutrition	Support commensal bacterial growth
Skin education	Immunology by lipopolysaccharides (Gram-negative bacteria) and teichoic acids (Gram-positive bacteria)
HOW HUMAN SKIN BARRIER INTERACTS WITH SKIN MICROBIOTA	
Provides nutriment	Specific culture medium depending on microenvironment (moist, sebaceous, dry)
Control climate	pH, temperature, moisture, and sweat controlled depending on skin area
Climate and nutriment	Counter-select bacteria growth
Bacterial balance regulation	B-defensins production

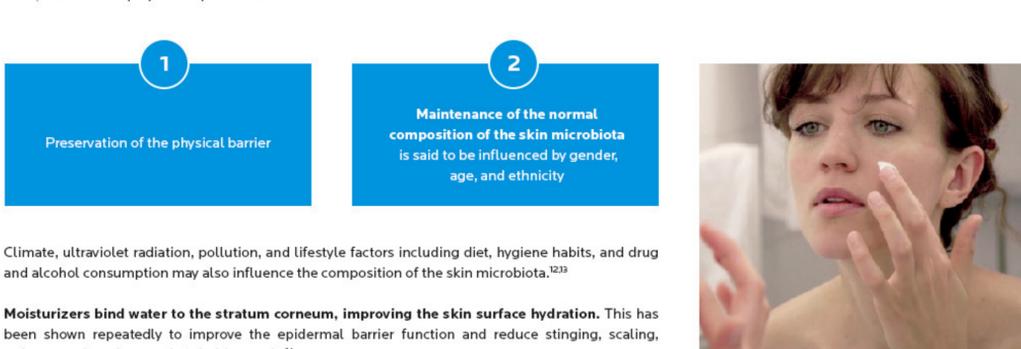
Table 1. Interactions between Skin barrier and Skin Microbiota

Skin microbiota can affect skin barrier function via bacterial enzymes, such as proteases, that may impact corneocyte desquamation or lipases that may break down skin surface lipids (Table 1). Antibiotics, corticosteroids, radiotherapy, and chemotherapy can all influence the composition of the skin microbiota. It has also been shown that frequent hand washing disturbs skin barrier function, resulting in irritation and changes in the hand skin microbiota.³

What's to be done in practice currently?

These microorganisms require water, sources of carbon, nitrogen, macro-, and microelements. Maintaining the normal, highly diverse skin microbiota appears to be important for skin health, and moisturizers may help to maintain this diversity.⁹ Moisturizers modify the water activity of the skin and so change the growth of a wide range of bacteria with the potential to compete with potentially pathogenic organisms.^{10,11}

Thus, moisturizers play two important roles in the barrier function of the skin:³



Climate, ultraviolet radiation, pollution, and lifestyle factors including diet, hygiene habits, and drug and alcohol consumption may also influence the composition of the skin microbiota.^{12,13}

Moisturizers bind water to the stratum corneum, improving the skin surface hydration. This has been shown repeatedly to improve the epidermal barrier function and reduce stinging, scaling, redness, and cracks associated with xerosis.¹⁴

"To moisturize" does not only mean providing moisture, it also signifies preventing moisture evaporation from the skin. Moisturizers can be formulated with emollient, humectant, moisturizing, or occlusive agents; and some formulations have potential prebiotic activity since they may provide food for the skin microbiota.³

Moisturizers can be formulated with thermal water:

The physicochemical characteristics of thermal water depend on the nature of the geologic materials through which the groundwater has moved. Common soluble minerals include:¹⁵

Ca²⁺ Calcium	CO₃H⁻ Bicarbonate	Si Silicates	Fe Iron Compounds	NaOH Sodium and Magnesium Salts	S⁺ Sulphur Compounds	M Metals
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Trace elements, including selenium or strontium, as well as purity and pH are also important parameters that may influence the specific biological activities of thermal waters. For example:



Bibliography

- Salava A, Lauerma A. Role of the skin microbiome in atopic dermatitis. *Clin Transl Allergy*. 2014;4:33.
- Sanford JA, Gallo RL. Functions of the skin microbiota in health and disease. *Semin Immunol*. 2013;25(5):370-7.
- Baldwin HE et al. The Role of Cutaneous Microbiota Harmony in Maintaining a Functional Skin Barrier. *J Drugs Dermatol*. 2017 Jan 1;16(1):12-18.
- Zeeuwen PL, Kleerebezem M, Timmerman HM, Schalkwijk J. Microbiome and skin diseases. *Curr Opin Allergy Clin Immunol*. 2013;13(5):514-20.
- Weyrich LS, Dkitt S, Farrer AG, Cooper AJ. The skin microbiome: Associations between altered microbial communities and disease. *Australas J Dermatol*. 2015;56(4):268-74.
- Grice EA, Segre JA. The skin microbiome. *Nat Rev Microbiol*. 2011;9(4):244-53.
- Chen YE, Tsao H. The skin microbiome: current perspectives and future challenges. *J Am Acad Dermatol*. 2013;69(1):143-55.
- Selte S, Zelenkova H, Martin R, Fieffer N. Using a specific emollient to manage skin microbiome dysbiosis. Poster presented at the World Congress of Dermatology, 2015.
- Lynde CW, Andriessen A, Bertucci V, et al. The skin microbiome in atopic dermatitis and its relationship to emollients. *J Cutan Med Surg*. 2016;20(1):21-8.
- Flores G, Caporaso G, Henley J, et al. Temporal variability is a personalized feature of the human microbiome. *Genome Biology* 2014;15:531.
- Martin R, Henley JB, Sarrazin P, Selte S. Skin microbiome in patients with psoriasis before and after balneotherapy at the thermal care center of La Roche-Posay. *J Drugs Dermatol*. 2015;14(12):1400-5.
- Costello EK, Lauber CL, Hamady M, et al. Bacterial community variation in human body habitats across space and time. *Science*. 2009;326(5960):1694-7.
- Blaak J, Kaup O, Hoppe W, et al. A long-term study to evaluate acidic skin care treatment in nursing home residents: impact on epidermal barrier function and micro-ora in aged skin. *Skin Pharmacol Physiol*. 2015;28(5):269-279.
- Ring J, Mohrenschiager M, Weidinger S. Molecular genetics of atopic eczema. *Chem Immunol Allergy*. 2012;96:24-9.
- Al-Ghazwani FH, Tester RF. Impact of prebiotics and probiotics on skin health. *Benef Microbes*. 2014;5(2):99-107.
- Selte S. Thermal waters as cosmeceuticals: La Roche-Posay thermal spring water example. *Clin Cosmet Invest Dermatol*. 2013;6:23-8.
- Staguet M, Peugeot-Navarro J, Latorre F, et al. In vitro effects of a spa water on the migratory and stimulatory capacities of human epidermal Langerhans cells. *Eur J Dermatol*. 1997;7:339-42.