6. Discovering Human Microbiota
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http://chemistscorner.com/the-human-skin-microbiome-and-cosmetics-part-i/

A staggering number of microorganisms inhabit the human body, out numbering our cells by 10 to 1. With skin being the largest exposed organ, it is also one of the largest microbial habitats. However, we are just beginning to understand the microorganisms' complex relationships with each other and our bodies in addition to the cosmetic and drug products we apply to our skin.

Until recently, methods used to identify and study these microbes (our skin microbiota) relied on the ability to culture individual species in the laboratory. Culture methods depend on an understanding of the nutrients and environmental factors that promote the growth of specific microorganisms, but in reality the many different habitats of the skin are too diverse and dynamic to truly replicate in a Petri dish. Now, new sequence-based metagenomic techniques allow for the analysis of entire environmental niches and have demonstrated that previous culture techniques substantially under estimated the skin's microbial population and diversity.

The Human Microbiome Project (HMP), launched in 2008, has already begun to dramatically change our understanding of the skin's microbial ecology. The project aims to define the skin microbiome in addition to 4 other human microbiomes. A microbiome is defined as all the microbes and their interactions with each other and their host in a defined habitat. Future goals of the project are to identify the role of our microbiome in disease and in maintenance of our health.

Microbiome Research

This metagenomic research has already provided new insights into the skin microbiome in terms of its diversity and composition. Grice et al. sampled the inner elbow of 5 volunteers and found Pseudomonas and Janthinobacterium, two genera both commonly found in soil, water and the gut which are not typically considered skin microbes based on culture assays.(1) It is possible that these organisms may have initially been acquired from transient environmental exposure and colonized because they were not eliminated from the habitat by physical or immune defenses.

Additionally the data indicated that Staphylococcus epidermidis and Propionibacterium acnes in total accounted for less than 5% of the microbiota recovered which is in contrast to the commonly held belief that S. epidermidis is a dominant member of the epidermal habitat from culture-based studies. But, it is important to keep in mind that this study was limited by small sample size and selection of only one microbial habitat. In a second study, published in May of 2009, Grice et al. probed 20 sites on ten healthy individuals to develop a larger body map of the skin microbiome. This study showed that Corynebacteria (62%) were, by far, the most frequently detected followed by Propionibacteria (23%) and Staphylococci (16.8%). (2)

Diversity in the Microbiome

A 2009 publication by Costello, et al., found that body sites across individuals (n= 7 to 9) such as the palm and forearm exhibit high levels of microbial diversity by phylotype (a measure of evolutionary similarity) while other sights like the forehead showed lower levels of diversity.(3) The high level of diversity on the hands is not a surprise considering the frequency with which our hands touch various surfaces and the ability of various microorganisms to persist on inanimate surfaces for days or months.(4) The lipid rich environment of the forehead may favor adhesion of organisms like P. acnes, which hydrolyze triglycerides to free fatty acids that can inhibit other microorganisms.(5,6)

These studies suggest the diversity of the entire skin microbiome is more complex than previously expected. In fact, high diversity sites harbored as many or more phylotypes than the gut or oral cavity.(3) A high degree of inter-individual differences also exist in the composition of skin microbiota and these differences in microbial populations were shown to be distinct enough to distinguish individuals in forensic identification.(7)

More research ahead

It is clear that the skin microbiome is quite complex and there still is much to learn. These studies and further advances in metagenomic research will allow us to better understand the role of microbes in skin disease and health, which could provide more holistic approaches to the development of topical products that consider the integral contributions of skin microbiome.

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