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Commentary on "The Effects of Probiotics on Immune Regulation, Acne and Photoaging"

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With more than 500 bacterial species living on the skin expressing more than 2 million genes, the skin micro biota presents a delicate balance between pathogenic and commensal bacteria. Given that dysbiosis of the mircroflora can lead to pro-inflammatory states (1), precipitating conditions such as acne and rapid photoaging, treatment modalities to shift the spectrum toward commensal flora continue.

Enter probiotics. At the most basic level, probiotics are live microorganisms that provide a health benefit to the host. Through their interaction with the immune system, probiotics have been shown to modulate gene expression and cellular differentiation, boosting the host's immune response to true threats while inhibiting pro-inflammatory pathways linked to chronic inflammatory diseases.

The probiotic industry continues to grow annually, and in 2016, the probiotic industry was valued at 35.9 billion US dollars (2). Probiotics come in both oral and topical formulations. Oral intake of probiotics likely exerts their influence on the skin via the gut-skin-brain axis. According to this theory, alterations in the gut microflora may lead to increases in local and systemic inflammation, which at times manifest or contribute to the formation of dermatoses (3). When oral probiotics are consumed, they interact with the gut-associated lymphoid tissue (GALT) and have been shown to reduce systemic inflammation and influence systemic absorption. Indeed, oral administration of the probiotic *L. reuteri* demonstrated lower rates of perifollicular inflammation when compared to controls (4). These immune modifications are beneficial in acne treatment as well as to partially alleviate the UV-induced changes and oxidative stress seen in photoaging. Topical applications of probiotics interact with the cutaneous flora as well as with the local cutaneous immune system. For instance, topical formulations of *Enterococcus faecalis* demonstrate a 50% reduction in facial inflammatory acne lesions when compared to placebo (5), while strains of *B. coagulans* provide significant antioxidant and free radical scavenging properties to aid in photoaging prevention (6). Peripheral blood mononuclear cells (PBMCs) and polymorphonulcear cells (PMNs) were incubated with supernatant and cell wall fragments of B.coagulans. This incubation promoted mature phenotypes of antigen-presenting cells and suppressed stress-induced reactive oxygen species (ROS) formation. (7).

Within the probiotic realm, fermented extracts are emerging as an alternative way to deliver probiotics. A recent study evaluated the efficacy of topical Lactobacillus-fermented *Chamaecyparis obtuse* in the treatment of acne. After 8 weeks, inflammatory lesions were reduced by 65% compared to a 38% reduction in those treated with tea tree oil (8).

Although more research is needed to fully determine the role of fermented extracts, these early studies demonstrate that they provide an efficacious alternative delivery method for probiotic strains.

As our understanding of the skin microbiome continues to grow, we deepen our appreciation for its complexity and begin to understand the factors that may allow us to shape it. Tailoring an oral and skin care regimen to each patient's specific microbial make-up may provide an opportunity for individualized treatment plans. Although further research is needed, we can see that oral and topical probiotics as well as fermented extracts hold promise for the treatment of acne, photoaging and immune regulation, and their benefit will likely extend to a myriad of other conditions. However, further randomized controlled trials, including at the histopathologic level, are needed to best define the role of probiotics and their derivatives, such as prebiotics.

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