The Impact of Gut and Skin Microbiota on Acne Vulgaris: Exploring Probiotics and Prebiotics as Preventative Measures and Possible Treatments

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INTRODUCTION

- Acne vulgaris is a prevalent disorder amongst teenagers and young adults that has a significant psychosocial impact.
- Recent studies on the pathophysiological processes that contribute to the development of acne have focused on the role of the skin and gut microbiota in these mechanisms.
- The microbiota helps to provide a natural defense against pathogens and interacts with the immune system to trigger inflammatory and non-inflammatory responses.
- Dysbiosis of the skin microflora, particularly an over abundance of *Cutibacterium acnes* (*C. acnes*), has been identified in acne pathogenesis.
- Through the gut-skin axis, dysregulation in the gut microbiota can influence the health and appearance of the skin.
- Probiotics and prebiotics are key factors that help influence the composition of the microbiota and support the diversity of the microflora.

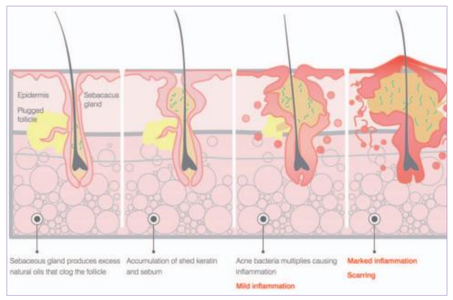

Figure 1. Pathology of acne vulgaris (Ash et al., 2015).

OBJECTIVE

- Thoroughly analyze scientific literature for the role of the skin and gut microbiota on the development of acne vulgaris and evaluate prebiotics and probiotics as preventative measures and possible treatments.

DESCRIPTION

Mechanism Linking the Skin Microbiota to Acne Vulgaris

- *C. acnes* interacts with toll-like receptors (TLRs). Patients with acne have been identified to have an overexpression of TLR-2 and TLR-4 (Kim et al., 2002 & Jugeau et al., 2005 & Graham et al., 2004).
- The cytokine, Interleukin-1α (IL-1α) overexpression results in abnormal keratinization leading to the formation of comedones (clogged pores) and acne lesions (Freedberg et al., 2001 & Tuchayi et al., 2015).

Gut Microbiome and Acne Vulgaris

- Patients (n = 86) with acne have lower gut microbiota diversity with higher abundance of *Bacteroidetes* and lower abundance of *Firmicutes* (Deng et al., 2018).
- Patients (n = 31) with moderate acne were also identified to have decreased levels of *Bifidobacterium* and *Lactobacillus* (Yan et al., 2018).

Efficacy of Topical Microbial Interventions in Treating Acne

- *Lactobacillus plantarum* as a topical probiotic was determined to target and decrease the production of IL-1α and inhibit the growth of *C. acnes* (Podrini et al., 2023).
- Patients (n = 70) treated with lotion containing *Enterococcus faecalis* cell free extract showed a 60% decrease in number of acne lesions after eight weeks (Fig. 2) (Kang et al., 2009).

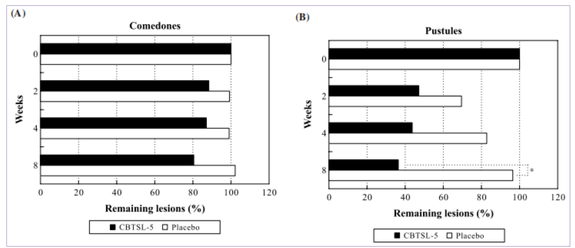

Figure 2. The therapeutic effect of lotion containing *Enterococcus faecalis* on (A) the non-inflammatory lesions (comedones) and (B) the inflammatory lesions (pustules). The number of lesions in the patients was counted over the period shown on the Y axis. *P<0.05 (Figure 7 in Kang, 2009).

Efficacy of Oral Microbial Interventions in Treating Acne Vulgaris

- After regular consumption of lactoferrin (a prebiotic protein found in milk), lesion count decreased by 28.5% with sebum levels decreased by 6.2% after twelve weeks (n = 164) (Chan et al., 2017).
- *Bifidobacterium breve*, *Lacticaseibacillus casei*, and *Ligilactobacillus* consumption showed a mean 33.33% reduction in percent global acne grading system (GAGS) (Fig. 3) (Rinaldi et al., 2022).

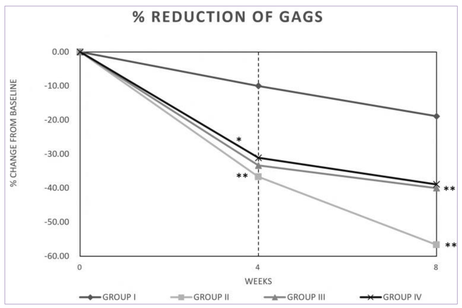

Figure 2. (n = 112) Clinical improvement of acne vulgaris expressed as GAGS score. Group (I) placebo, group (II) study agent, group (III) botanical extracts, and group (IV) probiotics. Data are expressed as % of change from baseline (Figure 1 of Rinaldi et al., 2022).

DISCUSSION

- *C. acnes* levels have been identified to be higher in acne patients stimulating the production of IL-1α, resulting in the clogging of pores, initiating the formation of acne lesions.
- Decreases in the levels of *Bifidobacterium* and *Lactobacillus* result in the production of less beneficial interleukins like IL-10.
  - ➢ IL-10 helps to promote anti-inflammatory cytokines as well as activate alternative macrophage species (M2) that help with promoting wound healing and reducing inflammation.
- Improving the balance of the skin and gut microflora helps to promote anti-inflammatory responses and prevent the formation of inflamed acne lesions.
- *Lactobacillus plantarum* was proven to decrease the number of lesions present in acne patients.
  - ➢ *L. plantarum* is effective in limiting the productions and secretion of IL-1α preventing the formation of comedones and acne lesions.
- *Enterococcus facelis* can inhibit the growth of *C. acnes* and produce bacteriocins.
  - ➢ Bacteriocins (antimicrobial peptides produced by bacteria) can prevent the colonization of microbes that mitigate the inflammation of the skin and suppress *C. acnes* growth.
- Lactoferrin helps to promote the growth of *Lactobacillus* and *Bifidobacterium*, two genera of bacteria that limit inflammatory response by promoting the production of anti-inflammatory molecules such as IL-10.
- Lactoferrin has also been identified to inhibit the overstimulation and hyperfunction of sebaceous glands.
  - ➢ Reduces inflammatory responses and decreases sebum production.

FUTURE DIRECTIONS

- Further research behind the mechanism of how microbiota dysbiosis influences acne vulgaris pathogenesis and how microbial interventions influence acne progression.
- Further research that focuses on a diverse group of participants with different skin types to fully harness the potential of microbial interventions as effective preventatives and treatments for treating acne.

REFERENCES

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