

Propionibacterium acnes (*Cutibacterium acnes*) and Acne Vulgaris: The Latest Updates of Antimicrobial Activity

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Abstract

Propionibacterium acnes is commonly recognized for its acne pathogenesis. *P. acnes* produces chemotactic substances and activates the complement system. Resistant *P. acnes* strains were explained more than 40 years ago. For that reason, new antimicrobial agents for the topical treatment of skin infections have been researched, and it has been determined that plant extracts may be an alternative treatment for acne. In this review, antimicrobial studies of *P. acnes* have been reviewed.

Keywords: Acne, antimicrobial activity, *Propionibacterium acnes*

INTRODUCTION

The microbial community is mostly formed of bacteria, which include *Corynebacteria*, *Propionibacterium* and *Staphylococci*.^[1] *P. acnes* is a gram-positive bacteria and the anaerobic form exists on the surface of the human skin.^[2] *P. acnes* colonises the sebaceous glands and the hair follicles of the human skin.^[3] If the *Propionibacterium acnes* (*P. acnes*) becomes predominant in the sebaceous region, this prevents the colonisation of other harmful microorganisms.^[4,5] Also, it can play an important role in acne vulgaris.^[6] The pathogenesis of acne vulgaris is based on multiple factors, such as increased sebum production, *P. acnes* proliferation and inflammation.^[7]

The main groups of therapeutic drugs are topical and systemic retinoids, antimicrobial agents, and systemic hormonal drugs.^[8] Clindamycin, tetracyclines, erythromycin, metronidazole, nadifloxacin, and dapsone are used for anti-*Propionibacterium acnes* therapy.^[9] A significant problem in the treatment is bacterial resistance. Currently, new retinoids are being used with antibiotics to decrease the risk of bacterial resistance.^[7] Phytotherapy may be an alternative for acne treatment due to its low side effects, usage in local areas, and low costs.^[10]

NEW DATA ON *PROPIONIBACTERIUM ACNES* TAXONOMY

P. acnes was first isolated from patients with chronic skin diseases called “acne vulgaris.”^[11] The genus *Propionibacterium*, which was described by Orla-Jensen, belongs to the phylum of Actinobacteria and to the Propionibacteriales group.^[12-14] The cutaneous group consists of *P. acnes*, *Propionibacterium avidum*, and *Propionibacterium granulosum*.^[12]

High-resolution core genome studies have reported the new genus of *Cutibacterium* gen. nov. These specific genes were indicated in these cutaneous species; however, others disappeared by deletions of cutaneous *Propionibacterium* on the human skin. As a result of the 16S rRNA gene sequences, DNA G + C content, genome size, and gene content, *P. acnes* was renamed as *Cutibacterium acnes*.^[15] *C. acnes* is predominant in the microbiota of pilosebaceous follicles of acne patients as opposed to unaffected skin.^[16] As a result of genomic analysis, cutaneous *Propionibacterium* has now been changed to the new bacterial genus *Cutibacterium*. The names used for bacteria species are *C. acnes*, *Cutibacterium avidum*,

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Cutibacterium granulosum, *Cutibacterium namnetense*, and *Cutibacterium humerusii*.^[17]

CUTIBACTERIUM ACNES FEEDBACK TO ANTIBIOTICS

Systemic and topical antibiotics have been used for acne treatments.^[18] The use of antibiotics may induce the spread of antibiotic resistance.^[19]

Propionibacterium species are intrinsically resistant to metronidazole, tinidazole and ornidazole, aminoglycosides, sulfonamides, and mupirocin. On the other hand, *C. acnes* is susceptible to many antimicrobials. However, studies have reported that *C. acnes* has high rates of resistance to erythromycin and clindamycin.^[18,20,21]

Bacterial biofilms also play an important role in antibiotic resistance and decrease the susceptibility to antibiotherapy.^[16] The ability of biofilm formation of *C. acnes* was reported in 2007.^[22] Studies have indicated that the development of *C. acnes* biofilms was higher in patients with acne than normal patients.^[23]

IN VITRO ANTIMICROBIAL EFFECTS OF NATURAL MATERIALS AGAINST PROPIONIBACTERIUM ACNES

Resistant *P. acnes* strains were explained more than 40 years ago.^[19] For that reason, new antimicrobial agents for the topical treatment of skin infections were researched, and it was found that plant extracts may be an alternative treatment for acne.^[24] Weber *et al.* reported that hop extract has a high antimicrobial activity against *P. acnes* (minimum inhibitory concentration [MIC] of 3.1 µg/mL).^[25] Furthermore, studies indicate that herbal ball extract with Kalmegh, rosmarinic acid, *Centella asiatica* extract, and *Rosa damascena* methanolic extract had antimicrobial activity against *P. acnes*.^[8,10,24,26] It has been shown that *Boswellia serrata* extract is effective at low concentrations against *P. acnes* (MIC: 1 µg/mL).^[27] Only a limited number of studies have studied the anti-*P. acnes* activities of herbal tea extracts. In terms of antimicrobial activity against *P. acnes*, duzhong extract showed the highest level, yerba mate extract showed a moderate level, and rose extract showed the least (Tsai *et al.*, 2010). Eilami *et al.* found that hydroxytyrosol has an antibacterial effect against *P. acnes*.^[28] *Angelica anomala* demonstrated effective activity against *P. acnes*.^[29] Yamaguchi *et al.* reported that *Humulus lupulus*, which contains xanthohumol and lupulones, showed very effective inhibitory activity against *P. acnes*.^[30]

CONCLUSION

Recently, cosmeceuticals and nutraceuticals are areas that are significantly increasing in popularity. The development of new botanical extracts and compounds against *P. acnes* has considerable potential.

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Conflicts of interest

There are no conflicts of interest.

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