ACNE, PROPIONIBACTERIUM ACNES AND BIOFILM

DEVELOPMENT AND FORMATION OF A BACTERIAL BIOFILM
Propionibacterium acnes demonstrates two clear modes of behaviour and can switch between them:

1. **In planktonic form**: “free” bacterial cells.

2. **within a biofilm**: a community structured by bacterial cells that are enclosed in a self produced polymeric matrix and attached to an inert or alive surface.

The microorganisms form a biofilm to protect themselves against hostile environments.
PROCESS OF FORMATION OF THE BIOFILM OF P.ACNES
P. ACNES BIOFILM: CLINICAL IMPLICATIONS

• Is structured to allow the respiration and the exchange of liquids and nutrient substances between bacterial cell, while it impedes the access to immune cells of the host, such as phagocytes.

• Impedes antibiotic ability to reach the microorganisms and exert their bactericidal action.

• The biofilm releases antigens and stimulates the immune response including the production of the antibodies but the antibodies are not effective in killing the bacteria inside the biofilm but can cause complex damage to the surrounding tissue outside the biofilm.

• The biofilm allows the creation of new singular planktonic cells, that can multiply quickly and are dispersed.
ANTI-ACNE THERAPY AGAINST P. ACNES BIOFILM
An in vitro study* evaluating multiple anti-acne agents, alone or in combination, found that only:

- 0.1% triclosan
- 5% benzoyl peroxide + 0.5% erythromycin
- 5% benzoyl peroxide + 1% clindamycin

were effective in both reducing biofilm mass and killing >99% of biofilm-associated P.acnes.

Interestingly, 5% benzoyl peroxide alone was ineffective unless combined with erythromycin or clindamycin, possibly due to the antibiotics inhibiting protein synthesis and, therefore, making p.acnes cells vulnerable to benzoyl peroxide generated radicals.

It should be noted that although 30mM azelaic acid is bactericidal, it did not reduce biofilm mass.

Minocycline was the only agent in its class that removed biofilm and displayed the greatest bactericidal effect of all the tetracyclines tested.

It has been postulated that the success of isotretinoin therapy may be related to reduction of sebaceous gland size with a subsequent decrease in sebum production, thus depleting the nutrient source for p.acnes biofilm.*

The effectiveness of photodynamic therapy may also be due to an indirect effect on biofilms mediated by decreased sebaceous gland activity.**


WHICH STRATEGY IS BEST TO AFFECT P. ACNES BIOFILM?
CHOICES: WHICH STRATEGY IS BEST TO AFFECT P. ACNES BIOFILM?

1. DESTRUCTION OF THE BIOFILM AND THE RELEASE OF P. ACNES IN PLANKTONIC FORM
   - BACTERICIDAL ACTION ON BACTERIA IN PLANKTONIC FORM

2. BACTERICIDAL ACTIVITY ON PROPIONIBACTERIUM ACNES INSIDE THE BIOFILM
   - DELAY IN FORMATION OF NEW BIOFILM
FIRST STRATEGY: MECHANISM OF ACTION

MOLECULE ABLE TO DESTROY THE BIOFILM RELEASING P. ACNES

BACTERICIDAL ACTION OF THE ANTIBIOTIC ON P. ACNES RELEASED BY BIOFILM

PLANCTONIC BACTERIA

BIOFILM

ANTIBIOTIC
FIRST STRATEGY: DISADVANTAGE

The rupture of the biofilm causes that singular free bacterial cells to multiply quickly and disperse.

It is necessary to combine the two molecules: one that causes the rupture of the biofilm to release free p acnes and a second molecule with bactericidal action that kills the bacteria released by the biofilm (antibiotics).
A NEW APPROACH:

ACTS ON THE BACTERIAL BIOFILM OF P. ACNES
WITHOUT DESTROYING IT
SECOND STRATEGY: MECHANISM OF ACTION

TRIETHYL CITRATE + GT PEPTIDE-10
BACTERICIDAL ACTION ON 92% OF *P. ACNES* PRESENT INSIDE THE BIOFILM

DELAY IN THE FORMATION OF NEW BIOFILM

BIOFILM

PLANCTONIC BACTERIA
• Doesn’t provoke the rupture of the biofilm: doesn’t create singular free cells that multiply quickly and are dispersed.
• It is thus not necessary to combine with antibiotics.

• *Triethyl citrate and GT-peptide 10 penetrate the biofilm* and exert an effective **bactericidal action** leading to the killing of 96% of *P.Acnes* contained in the biofilm and delay the formation of new biofilm

*(In vitro evaluation of the effectiveness of Triethylcitrate and GT Peptide-10 on Propionibacterium acnes, Propionibacterium granulosum, Propionibacterium avidum and on *P.acnes* biofilm formation and dispersal. Prof. Oleg Alexeyev, Researcher, Department of Medical Biosciences/Pathology, Umeå University)*
Non Antibiotic, Non Retinoid, No Benzoyl Peroxide, Non photo toxic Acne Solution