EMF AND THE MICROBIOME: BACTERIA, MOLDS, BIOFILMS

MOST OF THE CELLS ON/IN OUR BODIES BELONG NOT TO US, BUT TO MICROORGANISMS. MOST MICROORGANISMS LIVE VERY SHORT LIVES IN TINY MULTI-SPECIES ECOSYSTEMS CALLED BIOFILMS AND ARE NOT FREE-FLOATING.

INDIVIDUAL BACTERIAL SPECIES REACT DIFFERENTLY TO EMF, AND THEIR RESPONSES DEPEND UPON THE EXPOSURES AS WELL AS THE STAGE IN THEIR LIFE CYCLES.

BIOFILMS BEHAVE DIFFERENTLY THAN FREE-FLOATING ORGANISMS. BOTH HAVE BEEN SHOWN TO BE SENSITIVE TO EMF, BUT THE EFFECTS ARE DIFFERENT.

MUCH MORE IS UNKNOWN THAN KNOWN. HOWEVER, BECAUSE OF THE IMPORTANCE OF THE TOPIC, AVAILABLE LINKS ARE OFFERED.

BIOFILMS DO NOT SHOW UP IN CULTURES. CHRONIC INFECTIONS, WHICH ARE OFTEN BIOFILM RELATED, ARE CULTURE-NEGATIVE.

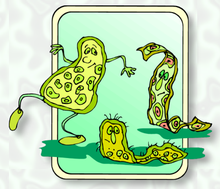
Biofilms

- Bacteria are either free-floating or in biofilms
- There must be a surface, bacteria, and water
- There are several steps from bacteria to biofilm
- Early attachment reversible, later irreversible
- Eventually a mix of organisms
  - Algae
  - Fungi
  - Bacteria
  - Archaea
  - Protozoa

Characteristics

- Resistant to antiseptics
- Enzymes may disrupt matrix
- 1500 X as much antibiotic needed
- Matrix protects against macrophages
- "Persister" organisms begin re-colonization
- Radiation may detach, deactivate organisms

Studies: EMF, Bacteria



- ELF stresses bacteria
- Species react differently
- EMF, growth, viability bacteria
- Bacterial membrane affected by MW
- AM and FM bacterial DNA broadcasts
- Pulsed MW, E. coli, membrane effects
- MW/RF might induce antibiotic resistance
- MF effects depend on exposed cell shape
- MW, bacterial death due to magnetite effects
- LF-MF, different species, different sensitivities
- ELF, growth, morphology, gram pos. and neg. bacteria
- MW, P. aeruginosa, persisters sensitized to antibiotics
- Window theory, non-linear response, EMF plus antibiotics
- Short wave-length light, smart phones, S. aureus, acne
- ELF-EMF, Salmonella, E. coli, B. subtilis, colonies, DNA
- ELF + antibiotics, E. coli, P. aeruginosa, adaptive response
- ELF, growth effects, membrane, gram pos. and neg. bacteria

Studies: EMF, Biofilms

- EMF and control of biofilms
- MF, spin direction, biofilm adhesion
- MW plus antiseptic kills MRSA biofilm
- Nanowires, cell-cell EM communication
- Electric pulse configuration, biofilm growth
- ELF, biofilm mass, adhesions, self-protection
- MW increases biofilm activity in waste recycling
- PEMF, charge in biofilm, antibiotic effectiveness
- EMF affects staph viability, not its biofilm activity
- H. pylori, EMF turns spiral rods into coccoid form
- Electric currents, biofilm detachment, inactivation
- Biofilms make electrically conductive nanowires 1
- Biofilms make electrically conductive nanowires 2
- ELF, H. pylori biofilm, phenotype, adhesion changes
- Rotating MF changes biofilm activities S. aureus, E. coli

Links

- Nanowires
- Biofilm basics
- Studying slime
- Good and bad biofilms
- Breast implant biofilms
- Toxic mold and EMF
- Biofilms: Hypertextbook
- Candida biofilm drug resistance
- Biofilms on plastic cutting boards
- 10 things about the microbiome
- Common implant persistent infections

Community behaviors

- May fossilize
- Quorum sensing behavior
- Each type of organism has its own function
- EPS facilitates protection, communication, nutrition
- Creation of sticky matrix, the exopolysaccharide (EPS)

SOME "GOOD" BIOFILM EFFECTS

Waste-water treatment
Clean-up of oil spills
Providing nutrients for plants
Helping our digestion

SOME "BAD" BIOFILM EFFECTS

Eutrophication of waterways
Clogging of drains
Infection and inflammation
Colonization of household items
Colonization of body implants

The Biofilm Primer
by J. William Costerton
Springer Series on Biofilms, 2007

Five stages of biofilm development: (1) Initial attachment, (2) Irreversible attachment, (3) Maturation I, (4) Maturation II, and (5) Dispersion. Each stage of development in the diagram is paired with a photomicrograph of a developing *P. aeruginosa* biofilm. All photomicrographs are shown to same scale. ***PLOS***

"Biofilms don't like DC current."
J. W. Costerton

"Microbes make up the majority of the living biomass on Earth and, as such, have major roles in the recycling of elements vital to life."
Biofilms Hypertextbook

"Biofilm formation represents a protected mode of growth that allows cells to survive in hostile environments and also disperse to colonize new niches."
L. Hall-Stoodley, et al

"Biofilm is a microbial derived sessile community characterized by cells that are irreversibly attached to a substratum or interface to each other, embedded in a matrix of extracellular polymeric substances that they have produced." ***J.W. Costerton***

"In a paper in Science in 1999, we said 65 percent of all diseases in the developed world are biofilms," Costerton said. "Now the NIH says 80 percent."
J. W. Costerton

Home: Oscillatorium
Newest version: this map
Date of this update: 01-11-17

See Map: Germs or Bio-Terrain

MMW or EHF, Bacteria

EMF, Various Microorganisms in Biofuel studies.

EMF Reduces Plants Anti-microbial Activity

Bacterial EMF Signaling

Bacteria on the Radio

Dr. Bill Costerton

EMF and Microbiome

Bacterial Biofilms

Microbiomes