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# Biofilms: A Policy of Microbes to Strengthen their Viability

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## Abstract

**Biofilm is a peculiar characteristic of microorganisms, in which microbial cells stick to each other on a living or non-living surfaces inside a self-delivered grid of extracellular polymeric substance. Extracellular polymeric matrix plays a vital role in structure and function of variety of microbial biofilms. Initial stage of attachment to substratum provides a confined structure, resistivity, metabolic co-operability and genetic traits in microbial community. Biofilms gets affected by some physical factors such as surface of adherence substance, flow of water, quorum sensing etc. This unique feature of microbes help them to habituate in any drastic environmental condition as well as it stimulate their viability.**

***Keywords: Biofilm; EPS; Microorganism; Quorum sensing; Adherence***

## Introduction

Biofilm can be defined as a thin but robust layer of mucilage adhering to a solid surface and containing a community of bacteria and other microorganisms. Microorganisms attach to surfaces and develop biofilms. Biofilm-associated cells can be differentiated from their suspended counterparts by generation of an extracellular polymeric substance (EPS) matrix, reduced growth rates, and the up- and down- regulation of specific genes. The microbial cells growing in a biofilm are physiologically distinct from planktonic cells of the same organism, which, by contrast, are single-cells that may float or swim in a liquid medium [1-10].

### Formation of biofilm

Biofilm might be shaped on assortment of substances including living tissues. Development of a biofilm starts with the connection of free-coasting microorganisms to a surface. While still not completely comprehended, it is suspected that the primary pilgrims of a biofilm hold fast to the surface at first through feeble, reversible attachment by means of van der Waals strengths and hydrophobic effects. If the homesteaders are not instantly isolated from the surface, they can stay themselves all

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the more for all time utilizing cell bond structures, for example, pili. Hydrophobicity likewise assumes an imperative part in deciding the capacity of microbes to frame biofilms, as those with expanded hydrophobicity have decreased shock between the extracellular network and the bacterium [11-15].

**Stages involved in biofilm formation**

These biofilm microorganisms have been shown to elicit specific mechanisms for initial attachment to a surface, development of a community structure and ecosystem, and detachment as shown in FIG. 1.

- Initial reversible connection of free swimming microorganisms to surface.
- Permanent substance connection, single layer, bugs start making sludge.
- Early vertical advancement.
- Multiple towers with channels between, developing biofilm.
- Mature biofilm with seeding dispersal of all the freer swimming miniaturized scale living beings.

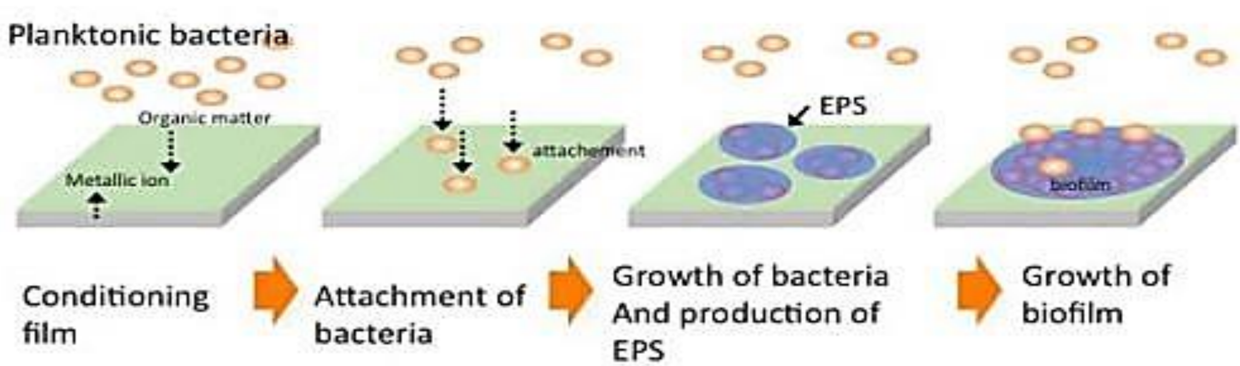


FIG. 1. **Stages involved in biofilm formation.**

**Factors affecting biofilm formation**

**Topography of surface**

The solid substratum may have a few attributes that are vital in the adherence procedure. The degree of microbial colonization seems to be high as the surface roughness is more. This is because shear strengths are reduced, and surface zone is higher on rougher surfaces. microorganisms adhere immediately to hydrophobic, nonpolar surfaces, for example, Teflon and different plastics than to hydrophilic materials, for example, glass or metals.

**Physico-chemical properties of medium**

Different attributes of the watery medium, for example, pH, supplement levels, ionic quality, and temperature, plays a vital part in the rate of microbial adherence to a substratum. Researcher found that an expansion in the centralization of a few cations (Na, Ca, La, Fe, Mg particle) influenced the connection of microorganisms to glass surfaces, apparently by lessening the appalling powers between the adversely charged bacterial cells and the glass surfaces.

### Hydrodynamics

Laminar and turbulent flow also responsible to change the morphology of biofilms. Biofilms formation under laminar flow is patchy and shows presence of rough cell aggregates while biofilms formed under turbulent flow are elongated though their morphology is similar like laminar flow biofilms. Cell size and cell motility these two are also equally important factors involved in biofilm formation.

### Horizontal gene transfer

Evolution of microbial community takes place because of adaptation of microorganisms in new environment. This adaptation is attributed by horizontal gene transfer instead of genetic mutation. Mobile genetic elements such as plasmids, transposons, bacteriophages etc. are responsible for this genetic transfer. Because of them some microbes are able to express genes responsible to a specific surface where bacteria have decided to settle.

### Quorum sensing

Quorum sensing is a process of cell signaling, in which microorganisms can communicate with each other. Here some extracellular molecules e.g. Acyl-homoserine lactone released from one cell and diffuses in environment towards the other one. Such molecules are responsible for making biofilms powerful [15-20].

## Why microorganisms form biofilms?

### Defense

EPS of biofilm gives certain level of safe house and homeostasis to the microscopic organisms dwelling in biofilm. EPS assumes different parts in structure and capacity of various biofilm groups. The EPS lattice additionally can possibly physically keep the entrance of certain antimicrobial operators into the biofilm by going about as an anion exchanger. It limits the dissemination of mixes from surroundings into the biofilm. These attributes rely upon the way of both the specialist and the EPS framework. This impact has all the earmarks of being more declared with the anti-infection agents that are hydrophilic and decidedly charged, for example, aminoglycosides. EPS has additionally been accounted for to sequester metal particles, cations and toxins and answered to give security from assortment of ecological burdens, for example, pH shift, UV radiation, osmotic stun and drying up [21-30].

### Nutrition

The water channel gives reliable method for trading supplement and metabolites in semisolid form, improving the supplement accessibility and in addition expulsion of possibly harmful metabolites. These multispecies small scale consortia can come about because of relationship between metabolically co-agent creatures. Their closeness encourages interspecies substrate trade and expulsion and circulation of metabolic items. For instance, debasement of complex natural matter into methane and carbon dioxide amid anaerobic absorption requires connection of no less than three microbes. Fermenter microbes start the catabolism creating acids and alcohols, which are then used as substrate by acetogenic microorganisms. Methanogen gets vitality by changing over acetic acid derivation, carbon dioxide and hydrogen to methane. Biofilm gives a perfect situation to the foundation of syntrophic relationship. Syntrophism is an extraordinary instance of advantageous interaction in which two metabolically particular microscopic organisms rely on upon each other to use certain substrates, commonly for vitality prerequisites. Syntrophism has been very much examined with respect to methanogenic debasement [31-40].

### Accretion of new genetic feature

Adaptation is the procedure of ecological adjustments in life forms. Microbial communities additionally experience the procedure of adaptation to adjust changing ecological conditions. To adapt up to the circumstance, they exchange their hereditary material horizontally (conjunction) bringing about hereditary varied qualities. Different microbial groups get new genetic element which, translate it to qualities taking after to frame a critical individual from biofilm. The new transferred genotype results in the expression of principle phenotype which helps to strengthen biofilm formation, e.g. Transcription of algC gene responsible for higher production of alginate as compared to planktonic cells [41-50].

### Biofilms: A major tool in waste water management

Biofilm framework is an all-around created innovation in which strong media are added to suspended development reactors to provide adherence to biofilms, in order to build the microbial fixation and in addition rates of contaminant gets decreases. So, that one can completely utilize biofilms to various evacuation means, including biodegradation, bioaccumulation, biosorption and biomineralization. The microbial groups in the biofilm separate distinctive supplements, for example, phosphorous and nitrogen-containing mixes, carbonaceous materials and in addition caught pathogens from the wastewater. When toxins are expelled, treated water of a biofilter is either discharged to nature or utilized for agribusiness and other recreational purposes. Wastewater treatment with biofilm frameworks has some benefits, including operational adaptability, low space necessities, decreased water powered maintenance time, versatility to changes in the environment, expanded biomass habitation time, high dynamic biomass focus and improved capacity to reduce stubborn mixes and a slower microbial development rate, which results in less residual formation [51-60].

### Biofilms and agriculture: A symbiotic association

Formation of fungal-bacterial biofilms by bacterial colonization on biotic fungal surface gives the biofilm enhanced metabolic activities compared to monocultures, and perhaps multi-species bacterial or fungal biofilms on abiotic surfaces. Incorporation of a $N_2$-fixing rhizobial strain to the fungal-bacterial biofilm to form fungal-rhizobial biofilms has been shown to improve potential biofilm applications in N-deficient settings and in the production of biofilm inoculum for biofertilizers and biocontrol in plants [61-70].

In addition, EPS produced by algae and cyanobacteria can improve the soil water-holding capacity and prevent erosion. Some researchers showed that some microbial biofilms are able to retain 30% of water content in the soil at 55°C while the soil without such biofilm is get dried easily [71-80].

Elevated soil salinity, which is increasing worldwide, has a major impact on soil quality and agricultural production. In many coastal areas, salinity is an inherent situation, but inefficient water management, i.e. excess recharging of groundwater and accumulation through concentration often leads to secondary salinization of farmlands. Researchers has been shown that inoculation of soil surfaces with a suspension of halotolerant cyanobacteria leads to a salinity reduction. This improvement of soil salinity is probably caused by a temporal entrapment of $Na^+$ ions in cyanobacterial EPS sheaths, resulting in a restricted

$Na^+$ influx in the plant roots. Permanent removal of $Na^+$ from the soil may not be possible, because $Na^+$ is released back into the soil after the death and decay of the cyanobacteria [81-87].

## Conclusion

Positivity and negativity go side by side. Scientific interest in biofilms has boomed in the past decade. Ability of microorganisms to adapt in their surrounding environment is remarkable, this kind of colonization is not limited to selfishly support their own survival but also it is beneficial for the betterment of territory. In addition, mechanism behind biofilm development and its commitment in biocontrol should be addressed hopefully.

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