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INTRODUCTION

Microorganisms are often viewed as simple life forms when compared with “higher” organisms. The study of microbial development however, has shown that microorganisms are capable of complex differentiation and behaviors; mostly working as communities rather than as individuals. Biofilms are defined simply and broadly as communities of microorganisms attached to a surface.

The discovery of biofilms was credited to Anton van Leeuwenhoek who discovered microbial attachment on his own tooth surface (Kokare et al., 2009). Biofilms as they occur in nature consist primarily of viable and nonviable microorganisms embedded in polyanionic extracellular polymeric substances anchored to a surface (Wimpenny, 2000). Extracellular polymeric substances (EPS) may contain polysaccharides, proteins, phospholipids, teichoic and nucleic acids, and other polymeric substances hydrated to 85 to 95% water (Sutherland, 1999). EPS provide protection to the biofilm inhabitants by concentrating nutrients, preventing access of biocides, sequestering metals and toxins, and preventing desiccation (Carpentier and Cerf, 1993). The ability of many bacteria to adhere to surfaces and to form biofilms has major implications in a diversity of industries including the food industry, where biofilms create a persistent source of contamination. Food industry biofilms in addition may also have high food residue and mineral content originating from product and process water. These constituents also provide protection to microorganisms held within the biofilm (Chmielewski and Frank, 2003).

Biofilms may also be considered as ‘The city of microbes’. There are several steps that must be taken to optimize lives in a city. The first is to choose the city in which to live, select the neighborhood in the city that best suits our needs, and finally make our home amongst the homes of many others. Occasionally, when life in the city sours, we leave. The same steps occur in the formation of a bacterial biofilm. First, the bacterium approaches the surface so closely that motility is slowed. The bacterium may then form a transient