Opinion

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Microbial Biofilms: The Challenge of Food Industry

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Abstract

Failure in the cleaning process may form a conditioned film on the food processing surfaces which allows bacterial adherence. After the initial adhesion the microorganism start to multiplicate and results in a cell mass embedded in a complex exopolysaccharide matrix known as biofilm. Microorganisms in biofilm are more resistant to antimicrobial compounds than planktonic cells. That behavior allows them to persist and to survive even after sanitization processes. Biofilms is a relevant public health problem and represents potential source of contamination. Moreover, the food industry can face serious consequences by the presence of biofilms which results in economic losses. To guarantee the quality and the safety of food product, efforts are needed to improve the cleaning and sanitizing program used to inactivate microorganisms and prevent the biofilms formation. Thus, understanding the concept of microbial biofilms, the aspects inherent to their structure and composition, as well as its mechanism of formation, are fundamental for the development of effective strategies to control and prevent them.

Keywords: Novel control strategies; Bacteriocins; Microbial biofilms; Adhesion

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Introduction

A biofilm is defined as a complex microbiological ecosystem formed by single or multiple species associated with a matrix of organic polymers. Some researchers believe that bacterial association in biofilm is one way found to protect themselves from the hostile environmental conditions and promote symbiotic relations [1-4].

In the food processing environment, the presence of biofilms can cause serious consequences to consumer health due to the risk of causing foodborne diseases and outbreaks. Moreover, it raises financial loss to the industry by reducing shelf life of the food products, increasing the product spoilage, impairing the heat transfer processes, increasing the corrosion rate of surfaces and also because products may be considered adulterated and subject to recall [1,5,6].

Microorganisms within biofilms are more resistant to antimicrobial compounds than planktonic cells. That behavior is related to the architecture and physiology in the biofilm environment which give such characteristics: reduced diffusion, anaerobic growth, physiological changes due to reduced growth rates and the production of enzymes that degrade antimicrobial substances [7,8].

The biofilms are present in various segments such as medicine, environmental bioremediation and biotechnology. The multidisciplinary approach to find the control and prevention of biofilms formation has resulted in a wide field to study and play an important role in microbiology.

Strategies for combating biofilms are basically divided into two segments: the inhibition of biofilm formation or treatment and eradication of biofilms already formed [9]. The main challenge in the food industry is to prevent the conditioning film forming in the equipments and surfaces. That usually happens because food manufacturing equipment poses many sanitary design challenges making difficult to clean and to avoid the initial adhesion of biofilm cells [1].

Lots efforts have been made to control and prevent biofilm formation in food industry. A vast variety of chemical disinfectants is used in the food industry such as acidic compounds, aldehyde-based biocides, caustic products; chlorine, hydrogen peroxide, iodine, isothiazolinones, ozone, peracetic acid, phenolics, biguanides, surfactants halogens, and quaternary ammonium compounds, however, none is enough to completely remove the biofilms [8].

Some studies have tried other strategies to control and prevent biofilm formation. Lequete et al. [10] analyzed the cleaning efficiency of polysaccharides and proteolytic enzymes against biofilms of bacterial species found in food industry. Winkelstroter et al. [11] and Winkelstroter et al. [12] evaluated the use of antimicrobial molecules known as bacteriocins and that researchers found a potential use of them to influence *Listeria monocytogenes* biofilm formation. Valeriano et al. [13] evaluated the anti-biofilm effect of with essential oils (EOs) of peppermint (*Mentha piperita*) and lemongrass (*Cymbopogon citratus*) against biofilm formation by *S. enterica* serotype Enteritidis S64.

Recently De Angelis et al. [14] investigated the relative abundance of extracellular and cell wall associated proteins (exoproteome), cytoplasmic proteins (proteome), and related phenotypic traits of *Lactobacillus plantarum* grown under planktonic and biofilm conditions. Genomics, proteomics and metabolomics are the new approach to study biofilms. Those analyses have been extensively used to screen and to identify genes, proteins and metabolites related to biofilm formation. The knowledge in that field will increase the information in the biofilms regulatory pathways and will stimulate the discovery and the development of new strategies to control microorganisms in biofilms.

Biofilms were first described by Antonie van Leeuwenhoek, however, the theory describing the biofilm process and research in bacterial biofilms have become more consistent over the past 40 years. Even so, the knowledge of the control and the prevention of biofilm is a challenge until nowadays. The complexity of biofilms can be attributed to various aspects of this form of bacterial growth such as increased resistance to antibiotics, different growth rates, interactions between species. Currently, research in biofilm field requires the interaction of different areas of knowledge which enables the development of a multidisciplinary work. That can be a manner to increase the expectations for development effective alternatives to combat them and to answer so many questions.

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