Poloxamer-Mediated Control of Biofilms on Polycarbonate Surfaces

Amina Belboul [2], Mohamed El Mohtadi [1], **Jason Ashworth** [2]

[1]*Department of Biology, Edge Hill University, Lancashire, United Kingdom*

[2] *Centre for Bioscience, Department of Life Sciences, Manchester Metropolitan University, Manchester, United Kingdom*

j.ashworth@mmu.ac.uk

Background: Polycarbonate (PC) is a type of plastic widely used in the food industry as components of food processing equipment and resusable food/water storage containers and bottles. Biofilm formation on food contact surfaces (FCS) such as reusable plastics like PC can pose an potential health risk if insufficiently controlled. Poloxamers have surfactant properties that make them useful as dispersants, detergents, emulsifiers or wetting agents. Poloxamers have been utilised as an emulsifing agent and food additive in the food industry but their application in biofilm control on FCS has not been exploited to date. In particular, the soaking of PC items in poloxamers prior to routine washing processes may present a novel biofilm control measure for reusable products made from PC. Thus, this study investigated the potential use of poloxamers to control biofilm formation on nutrient-exposed PC surfaces.

Methods: Poloxamer surfactants (P188 and P407: 0.1, 1.0 and 10.0 mg/ml) were investigated to assess their ability to disrupt biofilms of Gram-positive and Gram-negative bacteria. *Staphylococcus aureus* (Sa) & *Pseudomonas aeruginosa* (Pa) biofilms were cultured in nutrient-rich medium on PC surfaces (13mm PC discs; n=6) prior to exposure to poloxamer for 24 hours. The crystal violet (CV) assay was used to determine biofilm mass following treatment of Sa and Pa biofilms with poloxamers. The recovery of Sa or Pa from PC surfaces (n=6) following treatment of biofilms with poloxamer was assessed and biofilm disruption was visualised by confocal and scanning electron microscopy (SEM).

Results: Both poloxamer P188 and P407 significantly ($P<0.05$) reduced Sa and Pa biofilm mass on nutrient-exposed PC surfaces in a dose-dependent manner. In concordance with this finding, treatment of established biofilms of Sa or Pa with poloxamer (P188 or P407) for 24 hours significantly ($P<0.05$) reduced bacterial recovery from nutrient-exposed PC surfaces. Confocal microscopy and SEM showed extensive biofilm disruption on poloxamer-treated PC surfaces compared to untreated control PC surfaces.

Conclusions: This study showed poloxamer surfactants significantly disrupt established biofilms on PC surfaces. These findings suggest treatment of FCS with poloxamers prior to routine washing may be a novel biofilm control measure in the food industry for reusable items made from PC.

Keywords: Biofilm, Polycarbonate, Poloxamer

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