Abimbola Allison and Aliyar Cyrus Fouladkhah*

Public Health Microbiology Laboratory, Tennessee State University, Nashville, TN 37209, USA

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2900 100th Street, Suite 309, Des Moines, IA 50322-3855

Sensitivity of Planktonic Cells and Biofilm of Wild-Type and Pressure-Stressed *Cronobacter sakazakii* and *Salmonella enterica* Serovars to Sodium Hypochlorite

ABSTRACT

Aggregate cells are the predominant physiological mode of bacterial proliferation in food processing areas and clinical settings, and microbial biofilms are responsible for the vast majority of all bacterial infections. The current study was conducted to determine whether sodium hypochlorite, validated in the past against planktonic cells, is also efficacious for decontamination of biofilms of wild-type and pressure-stressed nontyphoidal *Salmonella enterica* serovars and *Cronobacter sakazakii*. A four-strain mixture of wild-type and pressure-stressed pathogens was used for biofilm formation of up to 14 days on the surface of stainless steel coupons at 7 and 25°C. Experiments were conducted in two biologically independent repetitions (blocking factors) in a randomized complete block design. Similar biofilm formation trends were observed for wild-type and pressure-stressed phenotypes of *C. sakazakii*. Treatment with sodium hypochlorite was efficacious ($P < 0.05$) only against the planktonic cells and was unable to completely eliminate 1- and 2-week-mature bacterial biofilms of the pathogens. These findings illustrate that, whereas after a typical sanitization with sodium hypochlorite up to >3-log reduction of planktonic pathogens is achievable, >6 log of viable pathogens per cm^2 of an abiotic surface may survive if bacteria had the opportunity to anchor onto the surface and form biofilm prior to treatment.

INTRODUCTION

As one of the leading causes of foodborne bacterial infections in American adults, various nontyphoidal *Salmonella enterica* serovars are an important public health microbiology challenge. Various nontyphoidal serovars of the pathogen are the leading cause of foodborne hospitalizations and death episodes in the United States. In a typical year, over one million Americans are estimated to contract salmonellosis, with 27.2 and 0.5% hospitalization and death rates, respectively *(10, 26)*. This burden is expected to be augmented in the landscape of changing climate because every 1°C increase in environmental temperature above 5°C could be associated with a 5 to 10% annual increase in cases of salmonellosis *(13)*. The bacterium is also the

*Author for correspondence: Phone: +1 970.690.7392; Email: afouladk@tnstate.edu