

Efficiency of Detergents against Microbial Biofilm Growth in Kuching, Sarawak

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Abstract

Biofilms formed on these surfaces are the main cause of contamination in the final product. The attachment of bacteria to food product or the product contact surfaces leads to serious hygienic problems and economic losses due to food spoilage. Detergent is commonly used as cleaning product to mitigate the growth of microbial on the food product surface and in any food supply chain process. In this study, the efficiency of commercial detergent was analyzed against single cell of foodborne pathogens to biofilm form; *Klebsiella pneumoniae*, *Bacillus cereus* and *Staphylococcus aureus*. The antibacterial activity of three detergent; Detergent 1, Detergent 2 and Detergent 3, were evaluated by measuring the diameter zone of inhibition using disc diffusion test. *S. aureus* showed the highest zone inhibition which is 27.67 ± 0.577 mm (mean \pm standard deviation) whereas *K. pneumoniae* showed the lowest zone of inhibition which is 19.97 ± 0.577 mm against Detergent 4. Minimum inhibitory concentration (MIC) and minimal bactericidal concentration (MBC) were determined using 96-well microtiter plates. All detergents exhibited inhibitory activity against bacteria tested. D3 showed the lowest MIC and MBC of *S. aureus* at 0.390 mg/ml and 0.781 mg/ml respectively, whereas *K. pneumoniae* has the highest MIC and MBC at 3.125 mg/ml and 6.25 mg/ml. The studies have been further done to test minimum bactericidal eradication concentration (MBEC) in related to biofilm eradication capacity. The MBEC result showed Detergent 3 could eradicate biofilm of *S. aureus* at 3.125 mg/ml. Thus, the appropriate detergent can be incorporated into food product surfaces and processing lines to mitigate the biofilm growth that potentially cause disease outbreak in future.

Keywords: Biofilm; Detergent; *Klebsiella pneumoniae*; *Bacillus cereus*; *Staphylococcus aureus*

Introduction

Detergent is important in daily life because it assists in cleaning and removing dust, dirt and germs that attach on contaminated surface. In response to the increasing concern about food preparation by food handlers due to cross contaminating of bacteria that may be pathogenic, thus the use of detergent is necessary in cleaning phase [1]. The goal of detergent is to totally eradicate food poisoning microorganisms in any food surfaces such as utensils, facilities or equipment in the food processing line [2].

In the food industry, the use of detergents is an important part of the manufacturing practices to prevent any aggregation regime and subsequent microbial biofilm formation. The failure in removing the bacteria from food contact surfaces may lead to the transmission of foodborne illness. Food residue on the food product surfaces may provide nutrient and encourage the microorganism to grow and form biofilm. Adhesions of microorganism to equipment surface such as unsanitized utensils enable to direct or indirectly transmit into food, food processing lines [3] and domestic environment [4]. Food contaminated with pathogenic bacteria such as *Bacillus cereus* and *Staphylococcus aureus* can cause severe risk to human being. *Bacillus cereus* is a spore forming bacterium and mainly known as causative agent in foodborne disease. Transmission disease is through consumption of contaminated food, improper food handling, cooking, storage and heating [5].

According to Maris [6], the exact mechanism of action of a detergent is not easy to determine. The notion of 'target' in the bacterial

cell, frequently toward the antibiotics, is not clear for detergents. Hence, it can be difficult to distinguish the primary stage which is characteristic of the mode of action and the secondary stage of the consequence of the action of the detergents. In the food industry, the use of detergents is an important part of the manufacturing practices to prevent aggregation regime and subsequent microbial biofilm formation. However, various detergents which are extensively used in food industries may not be really effective against some microorganisms especially in biofilm form. Bacterial colonization of food processing equipment and facilities is the main concern and is a potential source of contamination of foods that may lead to spoilage or transmission of food borne pathogens. Therefore, this study investigated the effects of detergents on the growth biofilm of *Klebsiella pneumoniae*, *Bacillus cereus* and *Staphylococcus aureus* in Kuching, Sarawak.

Methodology

Preparation of detergents

K. pneumoniae, *B. cereus* and *S. aureus* isolates were collected from Microbiology Laboratory, Faculty of Resources Science and Technology, UNIMAS. Then, three types of commercial detergents were purchased from supermarket in Kota Samarahan, Kuching Sarawak. Namely Detergent 1, Sodium tripolyphosphate (STPP) based, Detergent 2 Alkylpolyglucoside (APG) based and Detergent 3 Linear alkylbenzene sulphonate (LAS) based.

The stock solution was prepared according to Rukayadi et al. [7] with some modifications. The detergents (0.1 g) were diluted in DMSO (10%) to obtain the final 10% of stock solution as it is the minimum