RESEARCH, DISCOVERY & INNOVATION

Water & Energy Sustainable Technology Center

HOTEL PERSONAL CARE PRODUCT RESEARCH STUDY – ARIZONA PILOT PHASE

Conducted on behalf of: Clean the World

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Executive Summary - Technical Report

Objective

The objective of this study was to assess levels of bacterial contamination in refillable dispensers (also referred to as "open systems" or "bulk systems") for shampoos, conditioners, body washes, and hand soaps provided for guest use in the rooms of hotel establishments.

Sample Collection Methodology

To accomplish this, the University of Arizona (UA) conducted a pilot study in the state of Arizona. Forty rooms were booked in twenty hotels (2 rooms per hotel). UA researchers stayed at the hotels as guests, and collected the samples aseptically by dispensing 20 – 25 mL of the respective sample type into sterile 50-mL conical tubes. The samples were placed into a cooler, and held under refrigeration conditions (4 °C – 10 °C) until assaying for heterotrophic plate count bacteria (within 48 hours of sample collection). A total of 108 samples were collected from refillable dispensers during the Arizona pilot study. Table 1 below provides details on type, and number of brands and samples collected.

Table 1. Sample Types Collected from Refillable Dispensers

	Product Type	# Brands per Product Type	# of Samples Collected
1	Shampoo	7	28
2	Shampoo plus Conditioner	2	10
3	Conditioner	7	28
4	Shampoo plus Body Wash	1	2
5	Body Wash	8	36
6	Hand Soap	1	2
7	Lotion	1	2
		Total # of Samples =	**108**

Testing Methodology

Samples were tested using culture-based and molecular methodologies. The testing protocol included:

- Heterotrophic plate counts (HPCs) of culturable bacteria on Tryptic Soy Agar (TSA) in triplicate per dilution
- DNA extraction and identification of culturable bacterial isolates using conventional polymerase chain reaction (PCR) of the 16S rRNA gene
- Evaluation of resistance to five classes of antibiotic agents
- Preservative neutralization validations using reference bacterial organisms

Results

HPC counts were determined for product brands/sample types for which neutralization could be validated (82 samples out of 108 total samples collected). Of the 82 samples, 63 (76%) yielded bacterial numbers greater than 1,000 colony-forming units per gram of product (CFU per gram), and 40 samples (49%) exceeded 10,000 CFU per gram.

Table 2. Mean Heterotrophic Plate Counts (CFU/g) and Ranges Detected for Each Sample Type

	Shampoo (n=26)	Shampoo + Conditioner (n=8)	Conditioner (n=26)	Shampoo + Body Wash (n=2)	Body Wash (n=18)	Hand Soap (n=2)
Mean (CFU / g)	2.98×10^4	1.71×10^4	1.93×10^5	8.32×10^3	5.86×10^3	3.33×10^3
Range of CFUs / g Detected	$< 3.33 \times 10^1$ – 3.50×10^5	$< 3.33 \times 10^3$ – 7.67×10^4	3.33×10^3 – 2.13×10^6	$< 3.33 \times 10^3$ – 1.33×10^4	$< 3.33 \times 10^2$ – 3.33×10^4	$< 3.33 \times 10^3$ – 3.33×10^3

The unopened bulk products that were shipped to UA WEST Center for assessment of product neutralization demonstrated low levels of background heterotrophic plate count bacteria (< 10 CFU per g of product) compared to samples collected from hotel sites.

Discussion

According to the Food and Drug Administration (FDA) Compliance Program Guidance Manual[1], "Cosmetic products are not expected to be aseptic; however, they must be completely free of high-virulence microbial pathogens, and the total number of microorganisms per gram must be low." The Center for Food Safety and Applied Nutrition (CFSAN)[2] currently adheres to the following aerobic plate counts (APCs) requirements:

- For eye-area products, counts should not be greater than 500 CFU per g or mL
- For non-eye-area products, counts should not be greater than 1,000 CFU per g or mL.

[1] FDA Compliance Program Guidance Manual (2016). Color and cosmetics technology. Page 25. Retrieved on August 10, from: https://www.fda.gov/media/78441/download

[2] CFSAN stands for Center for Food Safety and Applied Nutrition, and it is one of six product-oriented centers that carry out the mission of FDA. CFSAN, in conjunction with the Agency's field staff, is responsible for promoting and protecting the public's health by ensuring that the nation's food supply is safe, sanitary, wholesome, and honestly labeled, and that cosmetic products are safe and properly labeled.

Based on the results of the Arizona pilot study and with regards to the FDA manufacturing guidelines, the following can be concluded:

1- Culturable bacterial levels of the order of 10^3 to 10^5 in 77% of the samples demonstrates the vulnerability of refillable dispensers to bacterial growth, and potentially to cross-contamination during the refilling process. Bulk soap-refillable dispensers are prone to bacterial contamination, as supported by several reported outbreaks linked to the use of contaminated soap in health care settings.[3]

2- Once bacteria colonize the refillable dispensers, it is extremely difficult and challenging to completely cleanse a contaminated dispenser and to inhibit the future growth of bacteria. According to a Montana State University research study[4], bacterial counts in bulk soap dispensers returned to pre-wash contaminated levels within two weeks, regardless of the washing procedure. In addition, the labor and costs required to properly clean refillable dispensers may be prohibitive. Implementation of a periodic cleaning regimen for refillable dispensers would also require ongoing testing and audit procedures to ensure compliance with the internal standard operating procedures.

3- The World Health Organization (WHO)[5] and Center for Disease Control (CDC)[6] have recommended against the addition of soap to partially-empty containers in their guidelines on hand hygiene. This practice, referred to as "topping off", can lead to bacterial contamination of refillable soap dispensers.

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3 **Archibald, L. K., et al.** 1997. *Serratia marcescens* outbreak associated with extrinsic contamination of 1% chloroxylenol soap. Infect. Control Hosp. Epi- demiol. **18:**704–709.; **Barry, M. A., D. E. Craven, T. A. Goularte, and D. A. Lichtenberg.** 1984. *Serratia marcescens* contamination of antiseptic soap containing triclosan— implications for nosocomial infection. Infect. Control Hosp. Epidemiol. **5:**427–430.; **Buffet-Bataillon, S., et al.** 2009. Outbreak of *Serratia marcescens* in a neo- natal intensive care unit: contaminated unmedicated liquid soap and risk factors. J. Hosp. Infect. **72:**17–22.; **McNaughton, M., N. Mazinke, and E. Thomas.** 1995. Newborn conjunctivitis associated with triclosan 0.5% antiseptic intrinsically contaminated with *Ser- ratia marcescens.* Can. J. Infect. Control **10:**7–8.; **Sartor, C., et al.** 2000. Nosocomial *Serratia marcescens* infections associated with extrinsic contamination of a liquid nonmedicated soap. Infect. Control Hosp. Epidemiol. **21:**196–199.; **Spainhour, S., et al.** 1998. *Serratia marcescens* outbreak associated with extrinsic contamination of 1% chloroxylenol soap. Infect. Control Hosp. Epidemiol. **19:**476–479.; **Weber, D. J., W. A. Rutala, and E. E. Sickbert-Bennett.** 2007. Outbreaks associated with contaminated antiseptics and disinfectants. Antimicrob. Agents Chemother. **51:**4217–4224.

4 Lorenz et al. (2009). Evaluation of Contaminated Bulk Soap Dispensers for Biofilm Bacteria: Comparison of Two Methods of Analysis and Effectiveness of Dispenser Washing Procedures. Retrieved on August 10, from: https://pdfs.semanticscholar.org/d3ab/e4231eb27c20ad2ad8850bce32812bc867c5.pdf

5 WHO Guidelines on Hand Hygiene in Health Care: a Summary. Rep. no. WHO/IER/PSP/2009.07. 2009 ed. Geneva, Switzerland: WHO Press, 2009. Retrieved on August 10, from: https://apps.who.int/iris/bitstream/handle/10665/44102/9789241597906_eng.pdf;jsessionid=4A1EC8E09831580EEC402CADDF10B38F?sequence=1

6Boyce, John M., and Didier Pittet. "Guideline for Hand Hygiene in Health-Care Settings." Guideline for Hand Hygiene in Health-Care Settings Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. CDC, 22 Oct. 2002. Retrieved on August 10, from: https://www.cdc.gov/mmwr/preview/mmwrhtml/rr5116a1.htm

Conclusions

Unsafe levels of contamination were found in ~77% of the samples collected from refillable dispensers in the Arizona pilot study. In contrast, no bacterial contamination was observed in the unopened bulk product samples of shampoo, conditioner, body wash, and hand soap evaluated for product neutralization.

In the hospitality industry, housekeepers and related personnel are generally well-trained on the best and most proper sanitation practices that will ensure guest safety and thereby protect the image of the hotel brand. The heavy levels of bacterial contamination observed within the refillable dispensers at the hotels sampled in this study reinforce the rationale and recommendations of the CDC and WHO against adding product to partially-filled dispensers due to the potential for bacterial re-growth.

It is therefore recommended that all open and refillable dispensers be switched to dispensers with sealed disposable refills to ensure user access to safe product, and to avoid unnecessary public health risks.