Foam soaps are aerosolized liquid soaps dispensed through a special pump mechanism. Currently there are no studies comparing liquid soap with foam soap in regard to efficacy of reducing hand microbial burden. In 3 separate experiments and with 2 different brands of foam soap, it was observed that nonantimicrobial foam soap was not as effective in reducing hand bacterial load as the liquid soap.

Key Words

- Bacteria
- Antimicrobial
- Hygiene

Hand hygiene has been shown to prevent the spread of infectious microorganisms, including those that are resistant to antimicrobial agents, in multiple settings, including hospitals.
[1]
There have been multiple studies on the effectiveness of various types of cleansers, including plain soap, alcohol-based handrubs, and antibacterial soaps.
[2]
There have been concerns over antibacterial soaps and emergence of resistant bacteria,
[3]
and the US Food and Drug Administration has recently issued a final rule that banned over-the-counter consumer antiseptic wash products containing triclosan and triclocarban to be marketed.
[4]

Foam soaps are aerosolized liquid soaps dispensed through a special pump mechanism that mixes the liquid soap with air.
[5]
Because the soap is diluted with air,
[5]
foam soaps appear to be more cost-effective. They have recently become more popular, and are commonly used in health care, in the food industry, and in school settings where appropriate decontamination of the hands is critical. Currently there are no data comparing the effectiveness of liquid soap with foam soap in reducing hand microbial burden.

Methods

Foam and liquid versions of Method (San Francisco, CA) nonantimicrobial soap were compared. According to the products' Safety Data Sheets, the detergent in both the foam and liquid soaps are sodium lauryl sulfate at different concentrations; that is, 5%-10% in the foam soap [6] and 1%-5% in the liquid soap. [7] In the first set of experiments, 10 healthy subjects (age range, 13-60 years) were enrolled and randomly assigned to Group A (n = 5, foam soap) or Group B (n = 5, liquid soap). Prior data have shown that the flora is different between the right palm and the left palm in the same individual and changes over time during the course of the day [8]; consequently, we swabbed both hands of the individual subjects between the fingers, on the fingertips, and across the palm and the dorsum of the hands before and after the handwashing using BBL CultureSwab with Stuart Medium (Becton, Dickinson and Company, Franklin Lakes, NJ). All of the sampling occurred at the same time of day and after the subjects had just come from home.

Based on data from a previously published observational study, [9] subjects wet their hands with water, dispensed 1 pump of soap onto the palm of 1 hand, washed for 6 seconds, and dried with paper towel for 4 seconds. The handwashing and drying was timed by an investigator.

Each swab was rolled 360° onto the first quadrant of a 5% sheep's blood agar plate. The inoculum was streaked into 4 quadrants using a culture loop, heating the loop completely between each quadrant. The swab was placed in a tryptic soy broth tube to detect low numbers of organisms; that is, there was no growth on the agar plate. All culture media were incubated in a room air incubator at 35°C for 48 hours. The growth on the agar plates was enumerated using a semiquantitative method, determining the number of colonies in each quadrant and assigning a number of 1 + , 2 + , 3 +, or 4 + growth. The designation “1+” indicates <10 colonies in the first quadrant and the designation “4 +” indicates >10 colonies in the first quadrant and >5 colonies in the second and third quadrants.

Hand bacterial load was assessed on sheep-blood agar plates by using semiquantitative method (0 +-4+). The experiment was repeated on a separate occasion using foam soap and with a different set of subjects (10 prewash and 10 postwash swabs). In a third set of experiments, liquid soap was tested among 6 subjects (6 prewash and 6 postwash samples) and using a different brand of foam soap (J. R. Watkins, Winona, MN) in 4 subjects to determine whether the observations were brand-related. Two-tailed Student *t* test was used for comparisons.

Results

In the first set of experiments, washing hands with the liquid soap led to a significant reduction in the mean hand bacteria load (from baseline 3.8 ± 0.4 to 1.2 ± 0.9; $P = .01$) (Table 1), whereas foam soap was ineffective (baseline colony count was 3.6 ± 0.5 vs 2.6 ± 1.7 postwash; $P = .16$) (Table 1). In repeat experiments, washing hands with foam soap had no influence on bacterial

colony counts (mean prewash count, 4 ± 0.0 vs mean postwash count, 3.4 ± 0.8; $P = .1$), whereas washing with liquid soap led to a significant decrease in bacterial load (mean prewash count, 3.9 ± 0.4 vs mean postwash count, 2.3 ± 1.2; $P = .02$). The results were consistent when a different brand of foam soap was used in the experiments (mean postwash count, 3.0 ± 0.9).

Table 1Bacterial growth on agar plates was enumerated using semiquantitative method, determining the number of colonies in each quadrant, and assigning a number of 1+, 2+, 3+, or 4+ growth

Soap form	Baseline colony count	Postwash colony count	Pre vs Post *P* value
Foam (n = 5)	3.6 ± 0.4	2.6 ± 1.4	.3
Liquid (n = 5)	3.8 ± 0.4	1.2 ± 0.9	.01

NOTE. Values are presented as mean ± standard deviation.

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Conclusions

In these pilot experiments, foam soap was not as effective as liquid soap in eliminating hand bacterial load. This may be due to the fact that one must build up lather with liquid soap, whereas foam soap is already dispensed as lather. In addition, the amount of soap dispensed per pump is less with foam soap compared with liquid soap: The initial foam density may be from about 0.01 g/cm^3 to about 0.25 g/cm^3.
[10]

Our data suggest that the use of foam soaps for handwashing may give a false sense of hand decontamination and potentially lead to the spread of resistant bacteria. This study needs to be repeated with larger sample sizes and at different public settings like hospitals, schools, and airports. In addition, studies that compare the effectiveness of foam alcohol hand sanitizers with the gel versions are needed.