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Short report

# Microbicidal effects of plain soap vs triclocarban-based antibacterial soap

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SUMMARY

The aim of this study was to determine the bactericidal effects of plain and antibacterial soap. The bactericidal effects of plain and antibacterial soap containing 0.3% triclocarban were examined against 10 Gram-positive and 10 Gram-negative bacterial strains after exposure at 22°C and 40°C for 20 s. Gram-negative bacteria were more susceptible to both soaps than Gram-positive bacteria. However, with one exception (*Enterococcus faecalis* ATCC 19433 at 40°C), there was no significant difference between the effects of medicated and non-medicated soap at either temperature. Triclocarban in soap does not lead to a meaningful reduction in bacterial levels during use.



## Introduction

Handwashing is one of the most simple and cost-effective ways of protecting people from pathogens and infections. The number of soaps labelled as 'antibacterial' or 'antimicrobial' is expected to grow, and a wide range of commercial soaps are available across all industrial markets.[1] Antibacterial soap refers to soap that contains antiseptic active ingredients, whereas plain soap refers to soap that does not contain antiseptic active ingredients (or only contains low concentrations).[1]

Triclocarban (TCC) is an antiseptic ingredient that has a broad-spectrum antibacterial effect and is often added to a wide variety of personal care products.[2] It is particularly common in commercial bar soaps; one study reported that 84% of antimicrobial bar soaps in the USA contain TCC as the antiseptic agent.[3] However, TCC has several adverse health and environmental effects. For example, it could contribute to bacterial resistance, it may contain carcinogenic impurities, it can be acutely/chronically toxic, it can disrupt the endocrine system, it is an allergen, and it is a persistent environmental pollutant.[2] Thus, there is concern that antibacterial soaps or TCC may pose a greater risk than benefit to health. Therefore, in December 2013, the US Food and Drug Administration (FDA) issued a proposed rule stating that there were insufficient clinical data that antibacterial soap is more effective at preventing illness than

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regular soap.[4] Also, TCC was classified within the IIISE group in this proposed rule, meaning that additional data regarding its effectiveness and safety are required.

The antibacterial activity of antiseptic ingredients is generally tested by determination of minimum inhibitory concentrations (MICs); however, the FDA stated that MICs are not relevant in this case because consumers are exposed to antiseptic products for a very short time, whereas MIC tests require a long exposure time (at least one day).[4] Thus, the contact time and concentration should represent real-life exposure scenarios. Moreover, the test for assessment of the activities of antiseptic ingredients should be performed using 20 reference strains or representative clinical isolates. The 20 strains should comprise 10 Gram-positive and 10 Gram-negative bacteria (Tables I and II).[4]

To date, no studies have compared the bactericidal effects of antibacterial soap containing TCC with those of plain soap by the approved method using 20 different bacterial strains. Hence, the aim of this study was to examine the bactericidal effects of plain soap and antibacterial soap (bar soaps) containing 0.3% TCC against 20 bacterial strains after a short exposure at room temperature (22°C) and warm water temperature (40°C) for 20 s (recommended handwashing procedures and consumer habits).

## Methods

The antibacterial activity of the soaps was examined using the time-kill assay officially proposed by the Clinical and Laboratory Standards Institute (M26-A, Methods for determining bactericidal activity of antimicrobial agents), with some minor modifications.

### *Culture and cell suspensions*

The 20 bacterial strains proposed by the FDA were used (Tables I and II). Each strain was activated separately via the transference of inoculating loops into 10 mL of Mueller-Hinton broth (Difco Becton Dickinson, Sparks, MD, USA) in screw-cap tubes and incubated under optimal growth conditions as follows: 30°C for 24 h for *Listeria monocytogenes*, 42°C for 24 h for *Campylobacter jejuni*, and 37°C for 24 h for all other strains. *C. jejuni* was incubated under micro-aerobic conditions containing 5–12% carbon dioxide using CampyPak Plus (Difco). The other strains were incubated under aerobic conditions. Ten-millilitre cultures of each strain were placed in plastic centrifuge tubes and harvested by centrifugation (Centra-CL2, IEC, Needham Heights, MA, USA) for 15 min at 3000 × *g*. After the supernatant

**Table I**
Initial bacterial populations and recovered bacterial counts after exposure to plain or antibacterial soap containing triclocarban (0.3%) at 22°C for 20 s (20 bacterial strains proposed by the US Food and Drug Administration)

| Bacterial strain | | ATCC number | Recovered bacterial population (log cfu/mL) | | |
|---|---|---|---|---|---|
| | | | Before exposure | Exposure to plain soap | Exposure to antibacterial soap |
| Gram-positive | *Enterococcus faecalis* | 19433 | 6.6 ± 0.1[a] | 5.5 ± 0.6[b] | 5.0 ± 0.2[b] |
| | *Enterococcus faecalis* | 29212 | 6.5 ± 0.1[a] | 5.7 ± 0.4[b] | 5.2 ± 0.9[b] |
| | *Staphylococcus aureus* | 6538 | 6.8 ± 0.2[a] | 3.8 ± 0.2[b] | 3.3 ± 0.3[b] |
| | *Staphylococcus aureus* | 29213 | 6.5 ± 0.3[a] | 3.3 ± 0.1[b] | 3.7 ± 0.5[b] |
| | Meticillin-resistant *Staphylococcus aureus* | 33591 | 6.6 ± 0.2[a] | 4.8 ± 0.3[b] | 4.8 ± 0.2[b] |
| | Meticillin-resistant *Staphylococcus aureus* | 33592 | 6.7 ± 0.3[a] | 4.2 ± 0.4[b] | 3.8 ± 0.1[b] |
| | *Streptococcus pyogenes* | 14289 | 6.7 ± 0.1[a] | 4.8 ± 0.3[b] | 4.7 ± 0.3[b] |
| | *Streptococcus pyogenes* | 19615 | 6.4 ± 0.2[a] | 4.8 ± 0.6[b] | 5.2 ± 0.3[b] |
| | *Listeria monocytogenes* | 7644 | 6.3 ± 0.2[a] | 4.6 ± 0.2[b] | 4.4 ± 0.5[b] |
| | *Listeria monocytogenes* | 19115 | 6.3 ± 0.1[a] | 4.5 ± 0.6[b] | 5.0 ± 0.2[b] |
| Average | | | 6.5 ± 0.2 | 4.6 ± 0.7 | 4.5 ± 0.7 |
| Gram-negative | *Campylobacter jejuni* | 33291 | 6.9 ± 0.1[a] | 6.2 ± 0.2[b] | 6.1 ± 0.2[b] |
| | *Campylobacter jejuni* | 49943 | 6.8 ± 0.2[a] | 6.1 ± 0.1[b] | 6.3 ± 0.1[b] |
| | *Escherichia coli* | 11775 | 6.7 ± 0.1[a] | 6.1 ± 0.2[b] | 6.3 ± 0.1[b] |
| | *Escherichia coli* | 25922 | 6.9 ± 0.2[a] | 5.8 ± 0.3[b] | 6.0 ± 0.2[b] |
| | *Pseudomonas aeruginosa* | 15442 | 6.8 ± 0.2[a] | 4.5 ± 0.5[b] | 5.2 ± 0.1[b] |
| | *Pseudomonas aeruginosa* | 27853 | 6.6 ± 0.1[a] | 4.5 ± 0.8[b] | 5.1 ± 0.4[b] |
| | *Salmonella enterica* serovar Enteritidis | 13076 | 6.8 ± 0.0[a] | 5.9 ± 0.2[b] | 5.8 ± 0.1[b] |
| | *Salmonella enterica* serovar Typhimurium | 14028 | 6.7 ± 0.2[a] | 6.2 ± 0.3[b] | 6.1 ± 0.2[b] |
| | *Shigella sonnei* | 9290 | 6.3 ± 0.0[a] | 6.5 ± 0.1[b] | 6.5 ± 0.1[b] |
| | *Shigella sonnei* | 25931 | 6.4 ± 0.1[a] | 6.0 ± 0.5[b] | 6.1 ± 0.4[b] |
| Average | | | 6.7 ± 0.2 | 5.8 ± 0.7 | 5.9 ± 0.5 |

cfu, colony-forming units.
[a] and [b] denote statistically significant differences between values in the same row ($P<0.05$).