Food Control 20 (2009) 310–313

Contents lists available at ScienceDirect

Food Control

journal homepage: www.elsevier.com/locate/foodcont

Short Communication

Effective household disinfection methods of kitchen sponges

Manan Sharma *, Janet Eastridge, Cheryl Mudd

Food Safety Laboratory, USDA-ARS, Animal and Natural Resources Institute, Building 201, 10300 Baltimore Avenue, Beltsville, MD 20705, USA

ARTICLE INFO

Article history:
Received 31 December 2007
Received in revised form 27 May 2008
Accepted 30 May 2008

Keywords:
Sponges
Disinfection
Kitchen
Household
Bacteria
Spoilage
Foodborne illness

ABSTRACT

Several household disinfecting treatments to reduce bacteria, yeasts and molds on kitchen sponges were evaluated. Sponges were soaked in 10% bleach solution for 3 min, lemon juice (pH 2.9) for 1 min, or deionized water for 1 min, placed in a microwave oven for 1 min at full power, or placed in a dishwasher for full wash and drying cycles, or left untreated (control). Microwaving and dishwashing treatments significantly lowered ($P < 0.05$) aerobic bacterial counts (<0.4 log and 1.6 log CFU/sponge, respectively) more than any chemical treatment or control (7.5 CFU/sponge). Counts of yeasts and molds recovered from sponges receiving microwave (<0.4 log CFU/sponge) or dishwashing (0.4 log CFU/sponge) treatments were significantly lower than those recovered from sponges immersed in chemical treatments. Our study shows that microwaving and dishwashing treatments may kill foodborne pathogens in a household kitchen environment.

Published by Elsevier Ltd.

1. Introduction

Cross contamination of foodborne pathogens in the household kitchen may contribute to the estimated 76,000,000 cases of foodborne illness in the US, each year (Mead et al., 1999). Improper domestic food handling and unhygienic practices are thought to be a major factor in sporadic cases of foodborne illness. It is estimated that up to 87% of foodborne disease outbreaks that occurred in the United Kingdom, Europe, Australia, New Zealand, the United States, and Canada originated from food prepared or consumed in the home (Redmon & Griffith, 2003).

Kitchen sponges deserve attention in the household because they can remain wet and serve as a reservoir and vehicle for foodborne pathogens to cause illness. Kitchen sponges used to wash dishes containing foodborne pathogens transferred *Escherichia coli* O157:H7 to surfaces more frequently than *Salmonella* spp. (Mattick et al., 2003). Sponges contaminated with *Staphylococcus aureus, Salmonella enteritidis*, and *Campylobacter jejuni* were able to transfer pathogens to stainless steel surfaces, where *S. aureus* survived for up to 4 days. Similarly, pathogens transferred by sponges to stainless steel surfaces were subsequently transferred to cut vegetables at varying rates (Kusumaningrum, Riboldi, Hazeleger, & Beumer, 2003). In a study of ten kitchens in the US, 33% and 67% of sponges tested positive for *E. coli* and fecal coliforms, respectively (Josephson, Rubino, & Pepper, 1997).

Limiting the ability of sponges to disseminate pathogens is crucial to food safety as several studies have shown the presence of these pathogens in household kitchens. Gram positive pathogens (*S. aureus, Bacillus cereus*) have been more frequently isolated from dry surfaces in households than Gram negative bacteria (Beumer & Kusumaningrum, 2003). *Listeria monocytogenes* was found in 21% of households in the Netherlands, with the most common source identified as wet dish cloths (Beumer, Te Giffel, Spoorenberg, & Rombouts, 1996). An examination of 342 household refrigerators in Ireland determined total viable and total coliform counts as high as 8.8 and 6 log CFU/cm^2, respectively (Jackson, Blair, McDowell, Kennedy, & Bolton, 2007). This same study also reported low incidences of the psychrotrophic pathogens *L. monocytogenes* and *Yersinia enterocolitica*. Other studies have established that areas that were moist or frequently touched by human hands (sponges, dishcloths, kitchen faucet handles, and kitchen sink drains) had higher numbers of fecal coliform, coliform, and heterotrophic bacteria than other areas in the kitchen (Rusin, Orosz-Coughlin, & Gerba, 1998). Norovirus, the leading cause of viral foodborne illness in the US, inoculated on a variety of surfaces persists for up to 7 days and was transferred to lettuce leaves at levels that may cause illness (D'Souza et al., 2006). Foodborne pathogens can persist in a kitchen environment, and they may be spread using kitchen sponges unless properly disinfected.

S. aureus and *C. jejuni* were isolated from the preparers' hands, oven handles, counter-tops, and cutting boards, while *Salmonella* spp. were isolated in 25 different households from used dishcloths after the preparation of chickens for cooking (Gorman, Bloomfield, & Adley, 2002). In a controlled study in the United Kingdom, up to

* Corresponding author. Tel.: +1 301 504 9198; fax: +1 301 504 8438.
E-mail address: manan.sharma@ars.usda.gov (M. Sharma).

0956-7135/$ - see front matter Published by Elsevier Ltd.
doi:10.1016/j.foodcont.2008.05.020

35% of chickens purchased at retail were contaminated with both *Salmonella* and *C. jejuni* (Cogan, Bloomfield, & Humphrey, 1999), providing another route that foodborne pathogens can enter household kitchens. In two studies, *Salmonella spp.* were isolated from 13.8% of dishcloths and 15.4% of sponges taken from US households (Enriquez, Eniquez-Gordillo, & Gerba, 1997), while *S. aureus* was found in 4% of sponge-type dishcloths (Hilton & Austin, 2000). Inconsistent hand washing between handling meat and non-meat items was associated with higher risk of sporadic salmonellosis (Kohl, Rietberg, Wilson, & Farley, 2002). Other work has shown that a targeted disinfection program may reduce foodborne illnesses and costs due to medical treatment and lost productivity (Duff et al., 2003). Disinfection of sponges may prevent the survival and spread of pathogens in the kitchen. As lifestyles change, individuals spend less time in the kitchen preparing meals and subsequently give less attention to proper food handling and sanitation practices that can reduce foodborne illness and spoilage of food. Simple, fast, and effective methods to disinfect kitchen sponges may prevent the spread of spoilage and pathogenic microorganisms in household kitchens, and may lead to better food preservation and fewer cases of foodborne illness.

The purpose of this experiment was to determine the most effective and rapid method available to a household to disinfect a heavily contaminated kitchen sponge.

2. Methods

2.1. Preparation and inoculation of sponges

Commercial sponges (119 mm × 76 mm × 15 mm) without scrub pads were purchased, removed from the original packaging and cut with sterile scissors so each sponge measured 60 mm × 38 mm × 15 mm. Lean (90%) ground beef (454 g), purchased at a local grocery store, was mixed with 1300 ml of tryptic soy broth (TSB, Becton Dickinson) in a stomacher (Interscience) for 2 min to create a ground beef slurry. Using sterile forceps, sponges were placed in a sterile test tube rack in a sterile plastic tub. The test tube rack was used to hold the sponges apart for uniform inoculation. The ground beef slurry was then poured evenly over the sponges in the test tube rack, after which 2700 ml of TSB was added. The tub was covered with aluminum foil and sponges were incubated in this slurry for 48 h at room temperature (22 °C).

2.2. Disinfection of sponges with chemical treatments

After incubation, sponges were removed from the ground beef slurry with sterile forceps, and excess slurry was allowed to drip off sponges before being fully immersed without agitation or squeezing into a sterile beaker containing 500 ml of either sterile deionized water, single strength lemon juice (Real Lemon, pH 2.9), or a 10% solution of household bleach (Clorox, 5.25% sodium hypochlorite). Sponges in lemon juice or water were exposed for 1 min to the treatment, while sponges in 10% bleach were exposed for 3 min. Sponges were then placed in 40 ml of 1 X Dey Engley (DE) broth (Becton Dickinson) contained in a stomacher bag and squeezed to neutralize the effects of residual disinfecting solutions and distribute the DE throughout the sponge. Untreated (control) sponges receiving no chemical treatments were placed directly into DE broth.

2.3. Disinfection of sponges by microwave and dishwashing treatment

Inoculated sponges in a sterile beaker were placed on the turntable of a household microwave oven (Emerson, model MW8780SB) with a frequency of 2,450 MHz and 1.30 kW for 1 min at full power and then immediately transferred to DE broth. For dishwashing treatments, inoculated sponges were placed in the top rack of a household dishwasher (portable-convertible model, General Electric) and a normal cycle with the water temperature boost feature and heated drying cycle was executed. No dishwashing detergent was added during this treatment. Immediately after the cycle ended, the sponges were placed into DE broth.

2.4. Microbiological analysis

Sponges transferred to the DE broth were stomached for 2 min to agitate microorganisms from sponges into the broth. Undiluted suspensions or serial dilutions (0.1 ml, in duplicate) of DE broth in 0.1% peptone water were spiral-plated (Don Whitley Scientific) on tryptic soy agar (TSA, Becton Dickinson) to determine aerobic bacterial populations. Suspensions and serial dilutions were plated on Dichloran Rose Bengal Chloramphenicol agar (DRBC, Becton Dickinson) to determine counts of yeasts and molds. TSA plates were incubated at 37 °C for 24 h before enumeration; DRBC plates were incubated at 25 °C for 5 days before enumeration.

2.5. Statistical analysis

Three replicates of each experiment were performed. Statistical Analysis Software version 9.1 (SAS,) was used to conduct an analysis of variance and least significant difference mean separation tests ($P \leqslant 0.05$).

3. Results

Untreated (control) sponges receiving no disinfecting treatment had total counts of 7.5 CFU (colony forming units) of aerobic bacteria/sponge and 7.3 CFU of yeasts and mold/sponge. Microwave treatment of heavily contaminated kitchen sponges was the most effective method to kill bacteria, with less than 0.4 log CFU/sponge surviving 1 min of exposure, significantly ($P < 0.05$) less than any other treatment evaluated (Fig. 1). Dishwashing treatment was significantly more effective than 10% bleach, lemon juice or water applied to sponges, with 1.8 log CFU/sponge surviving after treatment. Among chemical treatments, sponges soaked in 10% bleach had populations only 0.3 and 0.5 log CFU/sponge lower than those soaked in water or lemon juice, respectively.

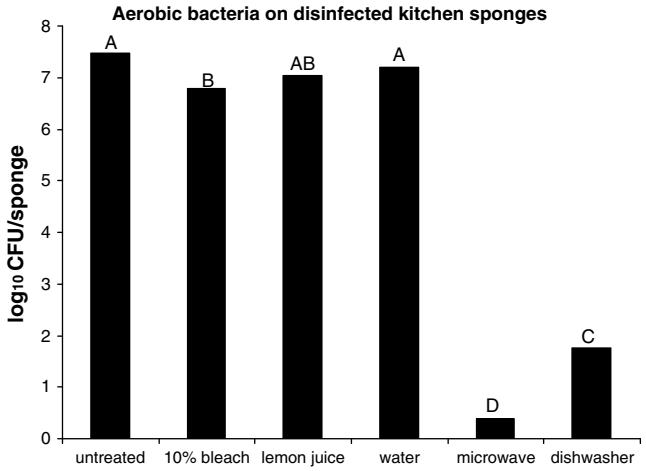

Fig. 1. Recovery of aerobic bacteria (log CFU/sponge) following disinfection treatments of kitchen sponges. Different letters above bars indicate statistically significant differences ($P < 0.05$) in populations of aerobic bacteria as affected by household disinfection treatment.