Cross-Contamination Risks in Reusable Grocery Shopping Bags and Potential Risks to Patrons: A Model Applied to Leafy Greens e coli O157:H7

Ships toxin-producing E. coli (STECs) are estimated to cause 63,000 illnesses, 2,100 hospitalizations, and 20 deaths in the United States annually (Scalcan et al., 2011). Food sources of E. coli O157:H7 are common of these pathogens include beef products, leafy greens, unpasteurized milk and cheese, unpasteurized apple juice/cider, sprouts, fruits, and nuts. The U.S. Food and Drug Administration (FDA) reports that 28 foodborne illness outbreaks were associated with the consumption of leafy greens from 1996 to 2008 (FDA, July 2009).

Because of its complexity, cross-contamination is likely underreported and the potential as source of pathogens is greater than epidemiological data implies (Chaiyakunapruk et al., 2005; Redmond et al., 2004; Griffins et al., 2002 and Chapman et al., 2011). Reusable grocery shopping bags have increased in popularity as a method to reduce environmental impact of plastic one-use bags. Although not heavily studied, previous work has shown a risk of cross-contamination of reusable grocery bags. First, this study considered the potential of pathogen transfer from contaminated leafy greens to a reusable bag and survival on a reusable bag. In order to explore practices carried out by patrons with their reusable bags, 107 patrons participated in a convenience sample.

Leafy greens were inoculated with 106 CFU/ml tetracycline and chloramphenicol resistant E. coli O157:H7. Inoculated and non-inoculated leafy greens were placed in reusable bags (21 bags per treatment) and 30-minute transport was simulated using a large sample mixer. The microbial load of the reusable bags was measured and all bags were stored at 21°C. Three bags per treatment were tested on Day 1, 3, 5, 8, 10, 12, and 14. Bags were sampled in five locations (10 x 10 cm), one on the bottom and four at varying levels on the side-pans of the bag using wet swabs (Figure 1). The microbial load of three new reusable bags was tested to provide the microbial baseline prior to the transportation simulation. To investigate initial transfer, the microbial load of the reusable bags was measured two hours after simulation and all bags were stored at 21°C. Each treatment was tested in triplicate. To investigate survival, the microbial load of the reusable bags were sampled on Day 1, 3, 5, 8, 10, 12, and 14.

Figure 1: Swab locations on reusable bag (bags were cut along seams and laid flat)

Results

Survey of handling, storage, and cleaning of reusable grocery bags by patrons

Survey of handling, storage, and cleaning of reusable grocery bags by patrons revealed that 24.3% of patrons did not clean their reusable bags before use. The microbial load was less than 102 colony forming units (CFU)/g of E. coli O157:H7 on the reusable bags. The least amount of pathogens resulting in tetracycline and chloramphenicol resistant E. coli O157:H7 to Lennox Broth (LB) based on methods established by Neal et al. (2012). Non-inoculated leafy greens (25 gbag) were treated with 2.5 ml LB to provide equal nutrient as inoculated leafy greens. Inoculated and non-inoculated leafy greens placed in reusable bags (21 bags per treatment). Once leafy greens were placed in the bags, a 30-minute transport (based on the mean transport time reported from self-reported surveys) was simulated using a large sample mixer. Reusable bags were measured for aerobic bacteria, coliform, and tetracycline and chloramphenicol resistant E. coli O157:H7.

Cross-contamination of reusable grocery bags with Leafy Greens e coli O157:H7

To assess the potential for cross-contamination and survival, leafy greens were purchased from a local grocery store and held at 4°C for 24 hours prior to treatment (Delaequis et al., 2002). Inoculated leafy greens (25 gbag) were treated with 2.5 milliliters of chloramphenicol and tetracycline resistant bacteria E. coli O157:H7 in Lennox Broth (LB) based on the methods established by Neal et al. (2012). Non-inoculated leafy greens (25 gbag) were treated with 2.5 ml LB to provide equal nutrient as inoculated leafy greens. Inoculated and non-inoculated leafy greens placed in reusable bags (21 bags per treatment).


Materials & Methods

Survey of handling, storage, and cleaning of reusable grocery bags by patrons

Survey (n=107) were collected at three different sites (grocery store, farmers’ market, and university community). Users were asked about reusable grocery bag use, average length of transport (after purchase and prior to use or storage) of reusable grocery bags, and storage of reusable grocery bags. The aim of the structured question on length of transport was incorporated to provide a rough estimate of time for food contamination exposure of the reusable bags during cross-contamination testing.

Cross-contamination of reusable grocery bags with Leafy Greens e coli O157:H7

Inoculated leafy greens (25 g/bag) were treated with 2.5 milliliters of chloramphenicol and tetracycline resistant bacteria E. coli O157:H7 on the reusable grocery bags. The microbial load of the reusable bags was measured and all bags were stored at 21°C. Three bags per treatment were tested on Day 1, 3, 5, 8, 10, 12, and 14. Bags were sampled in five locations (10 x 10 cm), one on the bottom and four at varying levels on the side-pans of the bag using wet swabs. Results indicate that 34.69% of patrons who claimed to have cleaned their reusable bags did not separate food products. The 34.69% of patrons who claimed to have cleaned their reusable bags was unexpected based on the lower numbers reported by Williams et al. survey responses (2011). The low number of patrons who knew risk actions for meat spills on reusable grocery bags and the low number of patrons who separate food products based on type also displays a potential lacking of food safety knowledge and behaviors by the surveyed patrons.

Cross-contamination of reusable grocery bags with Leafy Greens e coli O157:H7

Cross-contamination of reusable grocery bags with Leafy Greens e coli O157:H7 was recovered. The microbial loads from Day 3 to Day 14 were minimal, 106 CFU/ml E. coli O157:H7 was consistently recovered. Counts were similar regardless of sampling location on the bag but were highest on the bottom location. Non-pathogenic microorganisms were recovered at low concentrations. It is important to consider potential pathogens available for transfer to reusable bags and further to food products that come in contact with contaminated bags. The data generated helps with the development of a better model for assessing microbial movement within reusable bags. The results of this study convey the potential for survival and cross-contamination of foodborne pathogens on reusable bags.

Figure 6: Persistence of bacteria on reusable grocery bags due to leafy greens (PTTC, live to count)