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Bacterial Contamination of Shopping Carts and Approaches to Control

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SUMMARY

Placing children in grocery shopping carts has been implicated recently as a source of infection with *Salmonella* and *Campylobacter* in young children. This study was conducted to assess the occurrence total bacteria, coliform bacteria and *Escherichia coli* on grocery shopping cart handles and seats. A total of 85 shopping carts in parking lots of grocery stores were tested in five major metropolitan areas across the United States. The total numbers of heterotrophic bacteria were as great as 1.1×10^7 on the handle and seat. Coliforms were detected on 72% (62) of the carts. *E. coli* was identified on 18 of 35 carts (51%) on which coliform identification was conducted. The results of this study suggest the need for improved sanitation of shopping cards/baskets to reduce exposure to pathogens and potential transmission of microbial infections among shoppers.

INTRODUCTION

Contamination of raw meat products with bacterial enteric pathogens, such as *Salmonella*, *Campylobacter* and *Escherichia coli,* occurs on a regular basis *(1)*. Recent studies have shown that children are at increased risk of both *Salmonella* and *Camplyobacter* infections if they ride in shopping carts carrying meat products *(4, 6, 9)*. This suggests that exposure of children to enteric bacterial pathogens in shopping carts occurs on a regular basis. Mizumachi et al. *(7)* also reported frequent exposure to pathogenic *Staphylococcus aureus* on shopping cart handles and suggested that this was a hidden reservoir of this organism that points to a need for shopping basket sanitation. Contamination of shopping carts may occur from direct handling of raw food products or contamination of the cart by previous users.

The goal of this project was to determine the general sanitation of shopping carts with regard to bacteria.

MATERIAL AND METHODS

Cart sampling

Grocery store shopping carts were selected at random in grocery store parking lots in Sioux City, IA, San Francisco, CA, Los Angeles, CA, Portland, OR, and Atlanta, GA. A total of 85 carts were sampled, with 50 carts tested in the greater Los Angeles area, eight from San Francisco and nine from each of the other cities. These cities were selected to represent varying regions and outdoor climates in the United States. Because of the practice of leaving shopping carts outdoors in front of the store or in parking lots, climate might affect the survival of bacteria on their surfaces. For example, relative humidity and temperature will affect the survival of bacteria on surfaces *(5)*. The cart handle and seat were swabbed using the same Sponge-Stick containing a neutralizing buffer (3M Corporation, St. Paul, MN) and delivered overnight packed in ice to the University of Arizona, where the samples were processed. The estimated surface area sampled was 668 sq. cm. Three ml of fluid was extracted from the Sponge-Stick by squeezing it from the sponge in a plastic bag. One ml of this extract was used to test for coliforms/*E. coli*.

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TABLE1. Arithmetic averages of bacteria detected on shopping carts

Bacteria	Average	Minimum	Maximum	Average per sq. cm
Total*	3.43×10^5	110	1.1×10^7	513
Coliforms	≥ 767	< 3	> 7,259	≥ 1.1

*colony forming units

**most probable number

TABLE 2. Enteric bacteria detected on shopping carts*

Bacteria isolated	Number of Carts
Escherichia coli	18
Klebsiella pneumoniae	7
Cronobacter sakazakii	6
Enterobacter cloacae	2
Klebsiella oxytoca	1
Yersinia pseudotuberculosis	1

*Coliform bacteria isolated from 35 carts were identified with APIE 20 biochemical strip

Bacterial assays and identification

Total heterotrophic plate counts were determined by dilution of samples in buffered peptone water and spread plating on R2A media (Difco, Sparks, MD), a medium designed to enhance the recovery of stressed bacteria. The plates were incubated for five days at room temperature and colonies were counted. Coliforms and *Escherichia coli* were identified by placing one ml of the Sponge-Stick extract into 99 ml of Colilert media (IDDEX, Westbrook, ME), which was placed in a Quanti-Tray system and incubated overnight at 37°C. Coliforms were then determined using a most probable number (MPN) table provided by the manufacturer. The results were then multiplied by the dilution factor (1:100) and the total volume of fluid recovered from the Sponge-Stick to determine the total number of coliform bacteria in the sample.

Identification was conducted by diluting positive Quanti-Tray samples in phosphate buffered saline (0.01 M) and then spread plating the diluted samples onto MacConkey's agar (Difco) to confirm the presence of coliform bacteria, since the Colilert media is not specifically designed for isolation of coliform bacteria from fomites colonies of different morphology were randomly selected and subcultured on Trypticase Soy Agar (Difco). The bacteria were then identified by use of APIE20 strips (bioMérieux, Durham, NC).

RESULTS

Table 1 shows the total number of bacteria isolated per cart collected from store parking lots, reported as colony forming units (CFU)/cart. The number of bacteria detected on the shopping carts ranged from 110 to 11,000,000, and coliform bacteria from < 3 to > 7,259. Coliforms were detected on 72% (61/85) of the carts sampled. No *E. coli* were detected directly by the Colilert assay, but *E. coli* was identified as one of the coliforms detected in colonies on which coliform identification was conducted (35 of 61 carts were positive for coliforms). *E. coli* was the most common coliform identified on 18 of the 35 carts on which identification of coliform bacteria was conducted (Table 2). The Colilert assay is primarily designed to detect *E. coli* bacteria from water sources and not fomites, although it has been used for that purpose in other studies *(8, 11)*. However, *E. coli* was identified by APIE 20 strips biochemical tests as one of the coliforms detected by Colilert. Why the Colilert did not detect it as *E. coli* directly may be due to low numbers present in the samples, interferences from the other coliform bacteria, or other unknown factors.

DISCUSSION

The common occurrence of coliform and *E. coli* bacteria on shopping carts indicates that the consumer is exposed to enteric bacteria on a regular basis when using grocery shopping carts. Total bacterial levels are far greater than those found in public restrooms and other public places and objects that are commonly touched in these environments (airports, bus stations, public bathroom, shopping malls, etc.). Reynolds et al. *(10)* found the geometric mean of HPC bacteria on these objects ranged from 5 to 41.5 per sq. cm. with the higher average found in public restrooms. Coliforms and *E. coli* also appear to be present in greater numbers on shopping cart handles than on other common surfaces with which consumers may come into contact. In testing of diaper changing tables, chair arm rests, playground equipment, ATM buttons, restaurant tabletops, escalators, and restaurant condiment containers, coliforms were detected only on 7% (16/200 samples) *(10)*, vs. 72% (61/85) on shopping carts in the present study. Coliform bacteria often originate from feces and are associated with poor sanitary conditions. Coliform bacteria and *E. coli* detected on the carts may have originated from contact with raw foods, birds (while the carts were sitting in the parking lots between use), other sources of animal feces, and contact with fecally contaminated hands or other body parts (diaper aged infants).

The high numbers of HPC bacteria and coliform bacteria indicate unsanitary conditions of the carts compared with other public places and surfaces that the general public comes into contact. This increases the risk of coming into contact with a disease-causing organism. Results of epidemiological studies have shown that a risk of infection from common enteric bacteria is related to placing of small children in shopping carts *(4, 6, 9)*. The results of this study suggest the need for improved sanitation of shopping carts/baskets to reduce exposure to pathogens and transmission of bacterial infections among shoppers.

Two solutions to reduce exposure of consumers are to provide consumers with a disinfectant contained in a wipe or the use of disposable barriers. In Arkansas, legislation has passed that encourages grocers to offer complimentary sanitary wipes *(3)*. Most disinfecting wipes provided today contain quaternary ammonium compounds effective against many types of enteric bacteria *(2)*. Disposable plastic barriers are designed to fit over the hand contact area, such as the handle of the cart, and then be discarded in a recycling bin after use.

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