



Bacterial Contamination of Shopping Carts and Baskets Used in the Major Shopping Malls in Owerri, Imo State, Nigeria

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Abstract

Shopping malls have recently gained a lot of popularity in Nigeria. This is due to changes in government policies, population makeup and increasingly sophisticated consumers. However, shopping carts and baskets used in these malls have become a source of transmission of potential pathogens. This study examined the bacterial contamination of shopping carts and baskets used in the four major shopping malls in Owerri, Imo state, Nigeria. A total of 85 swab samples were collected from shopping carts and baskets from the four major shopping malls in Owerri, Imo state and analyzed using standard microbiological procedures. The result indicates that shopping carts and baskets were contaminated with bacteria in all shopping malls. Shopping mall B recorded the highest count for both total heterotrophic (7.8×10^5 CFU/cm²) and coliform count (4.5×10^5 CFU/cm²). A total of 64 isolates comprising 25(39%) gram-positive and 38(61%) gram-negative bacteria were isolated. *Staphylococcus aureus*, *Klebsiella* spp, *Escherichia coli* *Enterobacter* spp, *Bacillus* spp, *Citrobacter* spp, *Proteus* spp and *Pseudomonas* were identified. *Staphylococcus aureus* (29.7%) was the most predominant while *Pseudomonas* spp was the least predominant (4.7%) organism. The study has revealed the contamination of shopping carts and baskets in these shopping malls by potential bacterial pathogens. The study therefore recommends adequate cleaning and periodic disinfection of shopping carts and baskets to prevent the spread of these infectious agents.

Keywords: Shopping Malls; Carts; Basket; Bacteria; Contamination

Introduction

A shopping mall is a group of retail establishments established in a location that is planned, developed, owned, and administered as a unit [1]. A shopping mall, also known as a shopping centre, arcade, precinct, or simply mall, is an indoor, modernized version of the traditional marketplace made up of one or more buildings that house a collection of stores. Visitors can easily walk from one unit to the next thanks to interconnecting walkways. These huge retail enterprises are a collection of several retail shops integrated in a single, specific plan and are typically found in the suburbs away from the city centre and potentially the traffic congestion [2].

Previously, the informal retail sector of the economy in Nigeria was only comprised of tiny local storekeepers and traditional open marketplaces. The continuous shift in government policies, changes in population makeup, rising income levels, and the increasingly sophisticated Nigerian consumer have all contributed to the decline of the old or traditional retail system, Families are now more likely to shop together, and organized stores that cater to their needs are drawing more customers. As a result, the new structure of retail continues to replace the old or traditional structure [3]. However, Inanimate objects (fomites) such as shopping trolley handles, carts and baskets, faucets, door knobs, lift buttons, countertops, handrails, etc, often used in public places including shopping malls, are a source of contamination of potential pathogenic microorganisms. They come into contact either directly by

surface-to-mouth contact or indirectly by contaminated fingers and subsequent hand-to-mouth contact [4,5]. Other routes of exposure include the eyes, nose, and cut or abraded skin [6,7]. Post-infection, pathogenic organisms, i.e., viruses, bacteria and protozoa, may be excreted in large numbers in biological substances including blood, mucus, saliva, faeces and urine [8-12]. Numerous studies have reported exposure to pathogenic organisms such as *Staphylococcus aureus*, *Salmonella* and *Campylobacter* on shopping carts and trolley handles [4,13]. It is opined that shopping baskets/trolleys serve as a reservoir for transmission of pathogenic microorganisms and thus requires periodic cleaning and sanitation. Cross-contamination in a shopping trolley and baskets occurs when disease-causing microorganisms are transferred from one food type to surfaces or when dirty hands transfer microorganisms to trolley handles or baskets. For example, raw meat products are often contaminated with foodborne bacteria, such as *Salmonella* and *Campylobacter* which may be transferred to surfaces [14]. It is believed that up to 80% of common infections can spread through coming into contact with contaminated surfaces [15]. Several authors have reported bacterial contamination of fomites on surfaces in public places [15-21]. There is a report of assessment on Cross Contamination by Shopping Carts and Baskets in Akure, South-West, Nigeria during the pandemic period [22]. However, there are no reports on the assessment of contamination of shopping carts and baskets in shopping malls in Owerri. This work was therefore carried out to assess the bacterial contamination of shopping carts and baskets in major shopping malls in Owerri, Imo State, Nigeria.

Materials and Methods

Study design and sampling technique

This study was conducted from March to August 2019 in Imo State, Nigeria. A total of 85 swab samples were randomly collected from shopping carts and baskets from the four major shopping malls in Owerri designated as A, B, C, D. The shopping carts and baskets were swabbed with sterile cotton wool swabs moistened in sterile normal saline. Each sterile swab was wiped firmly over the entire surface of each shopping cart and baskets. The were placed in well-labelled swab caps kept in a cold box containing ice and transported to the microbiology laboratory at Imo State University Owerri within 30 minutes for microbiological analysis.

Isolation and Enumeration of bacteria

Isolation of bacteria contaminants were done using the standard techniques of [23]. The swabs were spread on the surface of already prepared plate count and McConkey agar. Inoculated plates were incubated aerobically for 24 h at 37 °C. The resulting colonies were enumerated for each plate and the number of colonies in each plate was then converted to CFU/cm².

Identification of bacteria isolates

Single colonies were streaked on fresh plate count agar plates to obtain pure cultures. Pure cultures were maintained in nutrient agar slants at -4°C. Isolate were identified based on colony morphology, gram staining reaction and biochemical characteristics such as, motility test, indole test, coagulase, urease test, oxidase test, coagulase test, indole test and carbohydrate utilization tests.

Result and Discussion

Enumeration of bacterial from shopping carts and baskets

This study sampled 85 swabs from the four major shopping malls in Owerri. The result indicates that shopping carts and baskets were contaminated with bacteria in all locations. The total heterotrophic bacteria count ranged from 4.6×10^5 - 7.8×10^5 CFU/cm² while the coliform count ranged from 2.0×10^5 to 4.5×10^5 CFU/cm². Shopping Mall B recorded the highest count for both total heterotrophic and coliform counts. On the other hand, shopping mall C recorded the lowest count (Figure 1).

There are several reports on microbial contamination of shopping carts and baskets [4,5,12,13, 22,24,25].

4 reported a higher heterotrophic count ranging from as 1.1×10^7 cfu/cn². However other studies have reported a lower bacteria count from shopping carts and baskets [13,22]. The variations in the bacteria counts might be attributed to the degree of exposure, contact time and relative humidity From this study, the high bacteria count obtained in shopping mall B corresponds with the low level of cleaning and sanitary conditions observed during the sampling. The abundance of microorganisms observed in the shopping carts could be due to the high rate of individual activities with dif-

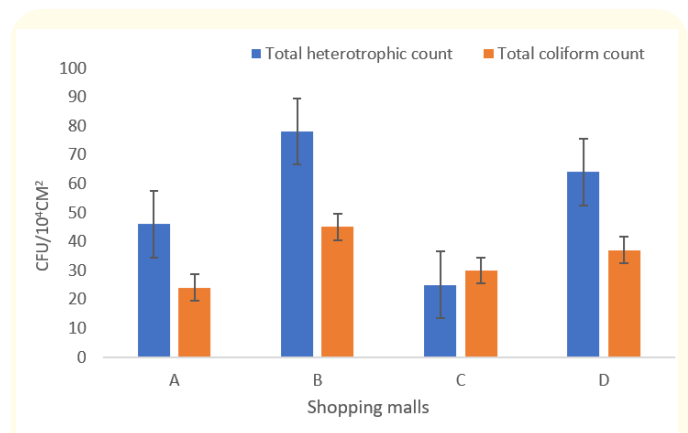


Figure 1: Enumeration of bacteria from Shopping malls. (a) a plate and (b) under a digital microscope.

ferent hygienic practices. According to 4, the presence of coliform bacteria on the carts could have been caused by contact with raw food, animal excrement, and hands or other body parts contaminated by faeces Shopping carts and baskets must be kept clean for the convenience of users, but when not cleaned regularly, they are critical sources of microbial transmission and disease [19,25].

Identification and distribution of bacterial isolates

Samples from Shopping Mall B were the most contaminated (43.2%) while shopping carts and baskets from Shopping Mall C were the least contaminated (7.8%) (Figure 2).

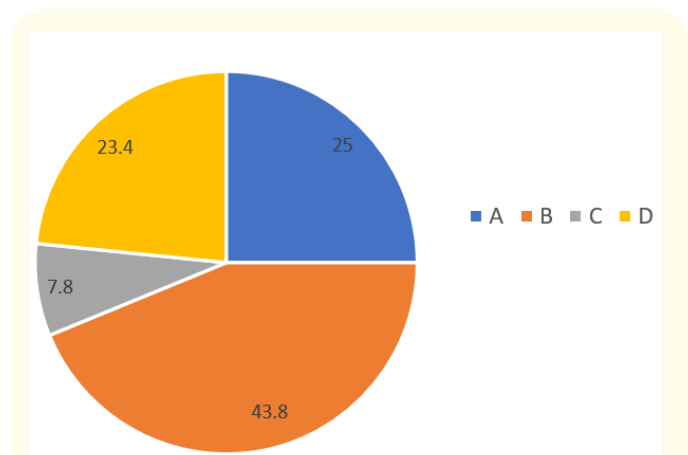


Figure 2: Percentage distribution of bacteria in shopping carts and baskets from different shopping malls.

This result was, however, expected judging from the condition of these shopping carts and baskets at the time of sampling. Shopping carts and baskets from Shopping Mall C were clean and better maintained than those used at Shopping Mall B. It was also observed that Shopping Mall B was the biggest and busiest with a lot of shoppers. According to 17), the rate of contamination levels in common fomites used in public facilities is directly proportional to the frequency of usage A total of 64 bacterial isolates comprising 25(39%) gram-positive bacteria, and 38(61%) gram-negative bacteria were identified from the shopping carts and baskets in all

shopping malls (Figure 3). Gram-negative bacteria have been reported to persist longer than gram-positive bacteria on surfaces, indicating that the persistence of bacteria on surfaces might vary depending on intrinsic variables from microorganisms [26].

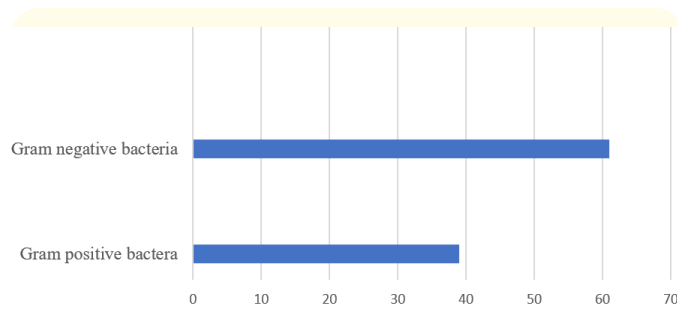


Figure 3: Percentage distribution of gram positive and gram negative bacteria isolated from the shopping carts and baskets.

A total of eight bacteria genera were identified and include, *Staphylococcus* 19(30%) *Klebsiella* spp. 10(16%), *Escherichia coli* 10(16%), *Enterobacter* spp. 6(10%), *Bacillus* spp. 6(10%), *Citrobacter* spp. 5(8%), *Proteus* spp. 4(6%) and *Pseudomonas* spp 3(4%). *Staphylococcus aureus* predominated in this study with *Klebsiella* spp and *E. coli* following (Figure 4). 22 and 25 also reported a high preponderance of *Staphylococcus aureus* in their studies.

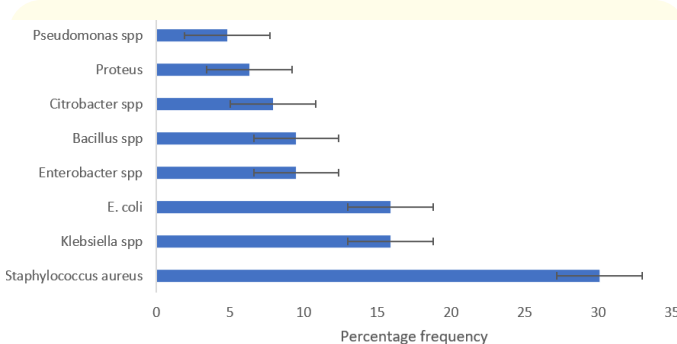


Figure 4: Percentage dominance of bacteria isolated from shopping carts and baskets in all super markets.

Numerous researchers have also implicated similar organisms in shopping carts and baskets in different facilities [12,13,22,25,27]. *Staphylococcus* sp is a microflora of the nasal and skin mucosa in healthy individuals. This may be responsible for its predominance as it can easily contaminate shopping carts and baskets through contact with humans. According to [28,29], *Staphylococcus aureus* is the most significant potential pathogen causing burns, abscesses, wound infection and toxic shock syndrome. The presence of coliform on shopping carts suggests that consumers are regularly exposed to enteric bacteria when utilizing grocery shopping carts and baskets. Coliform bacteria found on the carts may have resulted from contact with raw foods and contact with feacally contaminated hands or other body parts. *Escherichia coli*, *Klebsiella* spp, *Proteus* spp, *Citrobacter* sp, *Proteus* sp and *Enterobacter*

are indicators of fecal pollution. They are predominant in the environment and thrive as commensals of the gastrointestinal tract of humans. These organisms can cause diverse diseases in humans ranging from urinary tract infections to pneumonia [36]. *Bacillus* is a gram-positive spore-forming organism which predominates in the environment. Their presence in this study may be attributed to their sporulating ability which causes them to spread into the air and hence settle on the surface of shopping carts and baskets [30].

Conclusion

This study assessed bacterial contamination of shopping carts and baskets from major shopping malls in Owerri and reported significant contamination with all the shopping carts and baskets in the shopping malls. The study also identified potential pathogens such as *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella* spp, *Proteus* spp, *Citrobacter* sp, *Proteus* sp, *Enterobacter* and *Pseudomonas* from the shopping carts with *Staphylococcus* being the most predominant. The study, therefore, recommends adequate cleaning and periodic disinfection of shopping carts and baskets to prevent the spread of infectious agents. The study also advocates improvement in the personal hygiene of shoppers to prevent the transmission of these potential pathogens to the shopping carts and baskets.

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