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Samantha McMichael
Midway College, smcmichael@midway.edu

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Cover Page Footnote

I would like acknowledge Mrs. Juett for helping and guiding me through this project, along with ordering all of my supplies

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THE PREVALENCE OF *ESCHERICHIA COLI* AND FECAL COLIFORMS ON BACKPACKS OF COLLEGE STUDENTS IN CENTRAL KENTUCKY

SAMANTHA MCMICHAEL, MIDWAY COLLEGE
MENTOR: BEVERLY JUETT

Abstract

Escherichia coli (*E. coli*) is a gram negative, rod-shaped, facultative anaerobic bacterium, it is normally found in the lower intestines of warm-blooded animals and humans. *E. coli* and/or fecal coliforms have been used as fecal indicators in water, food, and contact surfaces. The purpose of this experiment is to identify the prevalence of *E. coli* and fecal coliforms on the bottom of backpacks belonging to college students in central Kentucky. Forty samples were taken from bottoms of college students' backpacks in central Kentucky. Sterile swabs were used to collect the samples from the backpacks. The swabs were placed in Stuart's transport medium and arrived at the lab within 2 hours. Upon arrival the samples were streaked for isolation on Coliscan Easygel© plates under a laminar air flow hood. The inoculated plates were placed in an incubator at 35º C and read for presence or absence of *E. coli* and/or fecal coliforms at 24 and 48 hours. *E. coli* was isolated from four samples (10%), fecal coliforms were isolated from nine samples (22.5%), and both *E. coli* and fecal coliforms were isolated from two samples (5%) out of the forty total samples collected. *E. coli* and fecal coliforms found on the backpacks may be a possible source of secondary infections in the communities.

Introduction

Escherichia coli (*E. coli*) is a gram negative, non-spore forming, rod-shaped, facultative anaerobic bacterium. It is normally found in the lower intestines of warm-blooded animals and humans. Examination of water for coliform bacilli such as *E. coli* can be used to determine fecal pollution in the water (Smith, 1984).

Previous studies of the prevalence of fecal and total coliforms found 20% of public surfaces were positive for coliform bacteria and 7% were positive for presence of fecal coliforms (Reynolds *et al.*, 2005). This study sampled many

different places such as the airport, bus station, public bathroom, home, children's playground equipment, and shopping mall (Reynolds *et al*., 2005). They found the highest amount of fecal coliforms on children's playground equipment. Since there was such a high frequency in this area, they suggested further evaluation of the playground. Trindade *et al*. (2014) assessed the biological qualities and food safety practices in municipal schools in Jequitinhonha Valley, Brazil. In the food samples they collected, coliforms were found (52.9%), *E. coli* (1.5%) and *Staphylococcus aureus* (*S. aureus*) (32.4%) and on the food contact surfaces: coliforms (40.7%), *E. coli* (3.3%), and *S. aureus* (22.0%).

Sinclaire and Gerba (2010) completed a study in the homes of a Cambodian village. This study was designed to survey the levels of microbial contamination on the kitchen and bathroom surfaces in the homes that had improved latrines. They compared their results to a study of the homes in the United States. Their findings indicated a high fecal coliform contamination on the ladle for sink water while the floor surfaces around the base of the toilet had a lower count for fecal contamination (Sinclaire and Gerba, 2010). Rusin *et al*. (1998) determined which sites in a household kitchen and bathroom were heavily contaminated with fecal coliforms. Their findings demonstrated high levels of contamination among: the sponge/dish cloth, the kitchen sink drain area, the bath sink drain area, the kitchen faucet handle(s), the flush handle, the shower drain area, the bathroom sink faucet handle(s), the cutting board, the refrigerator handle, and the kitchen counter top. Most places that had the high amount of coliforms were the moist areas. The kitchen was more heavily contaminated than the bathroom, particularly the sponge/dishcloth (Rusin *et al*., 1998).

Rusin *et al*. (2002) compared surface-to-hand and fingertip-to-mouth transfer efficiency of gram positive bacteria, gram negative bacteria, and phage. They used three microorganisms: *Serratia rubidea* (*S. rubidea*), *Micrococcus luteus* (*M. luteus*), and PDR-1 phage, and placed them on fomites and touching their lip. The study found that fomite to hand *M. luteus* was transferred more efficiently than the virus or phage, PDR-1 and the gram negative bacterium, *S. rubidea*, from all but two cases. Percent transfer was higher from porous surfaces than from non-porous surfaces; the contaminations of the hands were often high after handling porous fomites (Rusin *et al*., 2002). The fingertip-to-lip transfer had *M. luteus* showing the highest percent transfer from the fingertip to the lower lip (40.99%). Gram positive bacteria were transmitted readily from environmental surfaces followed by viruses and gram negative bacteria (Rusin *et al*., 2002).

Rinaldi *et al.* (2006) evaluated the extent of both fecal contamination and canine parasitic elements in Naples, Italy. They knew that the fecal matter was a public health problem for humans directly and indirectly (Rinaldi *et al.*, 2006). Their results showed a widespread distribution of canine feces throughout the city of Naples and even higher in residential neighborhoods in the southwestern part of the city (Rinaldi *et al.*, 2006).

Singh *et al.* (2011) did a study of nosocomial infection (bacterial pathogen) from library books. One hundred samples were collected from Himachal Institute of Life Sciences Library at Paonta Sahib in India. A total of 225 isolates were recovered from the 100 samples; *Staphylococcus sp.* (35.5%), *E. coli* (28.8%), and *Bacillus sp.* (22.2%). *Staphylococcus sp.* and *E. coli* were the most numerous organisms isolated from the library books (Singh *et at.*, 2011).

The purpose of this experiment is to identify the prevalence of *E. coli* and fecal coliforms on the bottom of backpacks belonging to college students in central Kentucky.

Hypotheses

H_o1= *E. coli* will not found on the bottom of backpacks belonging to college students in central Kentucky.

H_a1= *E. coli* will be found on the bottom of backpacks belonging to college students in central Kentucky.

H_o2= Fecal coliforms will not be found on the bottom belonging to backpacks of college students in central Kentucky

H_a2= Fecal coliforms will be found on the bottom of backpacks belonging to college students in central Kentucky

Materials and Methods

The bottom of approximately 40 student backpacks on a campus was sampled with a sterile swab, placed into Stuart's transport medium, and taken to the lab. The samples were streaked for isolation under a laminar airflow hood within 2 hours of collection on Coliscan Easygel© plates (Micrology Laboratories). They were placed in an incubator at 35° C and read for the presence or absence of *E. coli* and coliforms at 28-30 hours. The media controls were *E. coli*, *Klebsiella pneumonia* (*K. pneumonia* - a coliform other

than *E. coli*) and *Alcalignes fecalis* (*A. fecalis* - another bacterium) with the expected results after 24-48 hours, incubation at 35º C. *E. coli* grew with a blue/dark purple color, *K. pneumonia* grew with a reddish color, and *A. fecalis* grew with a whitish/cream color. These colors indicated satisfactory results for the control organisms on the Coliscan Easygel© plates (Micrology, 2008).

Results

Four out of forty (10%) of the samples tested positive for *E. coli* from all the backpacks. From the total number of samples, thirty-six (90%) tested negative for *E. coli*. Nine out of the forty samples (22.5%) collected tested positive for fecal coliforms. Thirty-one samples from the total forty (77.5%) tested negative for fecal coliforms. Two out of the forty (5%) of the samples tested positive for both *E. coli* and fecal coliforms. Thirty-eight out of the forty (95%) tested negative for both *E. coli* and fecal coliforms (**Table 1**).

	Number (%) Positive	Number (%) Negative
Fecal coliforms	9 (22.5%)	31 (77.5%)
E. coli	4 (10%)	36 (90%)
E. coli & fecal coliforms	2 (5%)	38 (95%)
Total: 40		

Table 1. Total number/percentage of *E.coli* and fecal coliforms from the bottom of college students backpacks in central Kentucky. Study conducted during Fall 2014.

Discussion

Four out of forty samples tested positive for the presence of *E. coli*. Nine out of the forty samples tested positive for the presence of fecal coliforms. Two out of the forty samples tested were positive for both the presence of *E. coli* and fecal coliforms. The results did not support the first null hypothesis that stated *E. coli* would not be found on the bottom of backpacks of college

students in central Kentucky. The results did support the first alternative hypothesis that *E. coli* would be found on the bottom of backpacks of college students in central Kentucky. The results did not support the second null hypothesis that fecal coliforms would not be found on the bottom of backpacks of college students in central Kentucky. The results did support the second alternative hypothesis that fecal coliforms would be found on the bottom of backpacks of college students in central Kentucky.

No research studies were found that tested backpacks. However, some studies had similarities because fomites were sampled. Reynolds *et al*. (2005) sampled various places such as public bathrooms, homes, and children's playground equipment. Their results demonstrated that the prevalence of fecal and total coliforms found on 20% of the public surfaces was positive for coliform bacteria and 7% was positive for presence of fecal coliforms. The present study sampled backpacks (fomites) with results of *E. coli* (10%), fecal coliforms (22.5%), and both *E. coli* and fecal coliforms (5%). Another study similar to the present study was a study in India that sampled library books. Singh *et al*. (2011) sampled library books for nosocomial infection (bacterial pathogen). Out of the 100 samples taken 225 isolates were recovered. *Staphylococcus sp*. (35.5%), *E. coli* (28.8%), and *Bacillus sp*. (22.2%) were found on the samples. *Staphylococcus sp*. and *E. coli* were the most numerous organisms isolated from the books. The present study showed results of *E. coli* (10%), fecal coliforms (22.5%), and both *E. coli* and fecal coliforms (5%). These fomites could contribute to secondary infections in the communities.

This study had some limitations including small sample size, restricted location, and only testing backpacks of college students. A larger samples size and more locations could possibly find different result. If owners of backpacks were of different age groups the results might be different especially with children included.

In future studies, researchers may want to test backpacks outside of central Kentucky, backpacks of different age group of people (elementary, middle school, high school children) and have a larger sample size. This would possibly find different results.

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