Bacterial Contamination in the Kitchen: Could It Be Pathogenic?

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Bacterial Contamination in the Kitchen: Could It Be Pathogenic?

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Abstract

Background: Food borne infection is a serious health problem that results from improper food preparation or cross-contamination. Cross-contamination is produced by contaminated raw foods during further processing, preparation of food by infected person or due to inadequate cleaning of kitchen. Present study is carried out to identify various contaminated spots in the kitchen that may harbour pathogenic bacteria.

Methods: Ten kitchens were randomly selected for the study. Samples were collected using sterile cotton swabs from five specific sites which included stove knob, kitchen towel, refrigerator handle, and water tap and kitchen sponge used for washing vessels. Samples collected were processed for isolation and identification of bacteria using blood agar and MacConkey’s agar followed by biochemical tests. Antibiotic susceptibility testing was done using Kirby-Bauer disc diffusion test.

Results: Fifty samples collected out of which 32 were found to harbour pathogenic bacteria which included 12 samples of Klebsiella pneumoniae, 7 each with Proteus species & Staphylococcus epidermidis, 3 with Escherichia coli, 2 with Staphylococcus aureus and one with Enterobacter species.

Conclusions: This study demonstrated that cross-contamination from the various sites in the kitchen that harbour pathogenic bacteria may contribute to food associated infections. Therefore, frequent cleaning of commonly contaminated areas in the kitchen is essential to prevent vulnerable people from developing food poisoning.

Introduction

Illness resulting from consumption of contaminated food is a serious public health problem in the world. Foodborne infection results from consumption of food which is improperly cooked, handled or stored. Increased incidence of foodborne illness has renewed our interest in the hygiene and cleanliness at home. Good hygiene practices at the kitchen are important for the prevention of infections originating from there, very often because of improper cooking practices including cross-contamination. Biological contaminants such as bacteria, viruses, fungi, protozoa and helminths are the major cause of food poisoning which ranges from mild to chronic, sometimes life-threatening conditions such as cholera, campylobacteriosis, Escherichia coli gastroenteritis, salmonellosis, shigellosis, typhoid fever, brucellosis & amoebiasis.

Cross-contamination is produced by contaminated raw foods during further processing and preparation. Pathogenic organisms contaminate the food or water, through food cooked at home by an infected person (person-to-person spread), through the air, by insects or via pets. These are considered as primary sources of potential harmful microorganism in the house.

Everyone is prone to develop foodborne illness on consuming unhygienic food. However, the very young, older adults and immune-compromised people are at greater risk. Most suffer from mild symptoms like vomiting, nausea, and diarrhoea that usually last from several hours to several days. But some types of foodborne illness can be more deadly. Recent evidence suggests that foodborne illness can even lead to long-term health problems such as arthritis [1]. Foodborne illness is nearly 100% preventable if food is handled safely from the time of preparation to ingestion.

Methods

Objectives: To assess the level of hygiene at various places in kitchen belonging to the staff and students of Melaka Manipal Medical College (MMMC), Manipal, India

Methodology: This study was taken up as a part of the mentored student project which was a mandatory requirement for the completion of second year MBBS programme at MMMC in Manipal, India. Number of kitchens selected was ten, which belonged to the staff & students of MMMC. They were randomly selected for the study. Participants in the study were asked to follow their usual kitchen practices and sample collection was carried out after that day’s cooking was completed. Samples were collected from 5 specific sites from the kitchen. Samples included swabbing from kitchen towel, cooking gas stove knob, refrigerator handle, water tap and kitchen sponge used for washing utensils by using sterile cotton swabs.
Specimen collected in brain heart infusion broth was incubated at 37 °C overnight. Turbidity of the broth indicated the growth of organisms. Subculture was done on blood agar & MacConkey’s agar streaked using streak culture. Plates were incubated at 37 °C for 24 hours. Bacteria were identified according to the conventional biochemical methods as described by Weaver & colleagues [2].

Results: Table 1 and Table 2.

Discussion

Out of 50 samples collected from our study, i.e., five each from ten kitchens, 32 samples (64% of sample collected) were found to harbour pathogenic microorganisms. They included 12 samples with Klebsiella pneumoniae, 7 samples each with Proteus species and Staphylococcus epidermidis, 3 with Escherichia coli, 2 with Staphylococcus aureus and one with Enterobacter species. Among the 10 kitchens studied, only one showed contamination with Enterobacter organisms which was found on the surface of refrigerator handle (Illustration 3). Several strains are pathogenic and cause opportunistic infections in immunocompromised (usually hospitalized) hosts and in those who were on mechanical ventilation. The presence of enteric bacteria such as Escherichia coli indicated a low level of hygiene among the kitchen users. Among 10 kitchens, 3 were positive with its contamination on stove knob and sponge used for washing vessels (Illustration 1 & 5). Along with different species of Enterobacter, E. coli form the faecal coliforms. These two species in the kitchen indicated the low level of hygiene there. E. coli was an indicator of faecal contamination and might be introduced into the kitchen by raw foods, mainly of animal origin, people, pets and insects [3,4]. Klebsiella pneumoniae was the major bacteria that contaminated the kitchen and it was reported from all the five sites in the kitchen with preponderance towards kitchen towel (Illustrations 1 to 5). Klebsiella pneumoniae is ubiquitous in nature. Frequent human pathogens, these organisms can lead to a wide range of disease states, notably pneumonia, urinary tract infections, septicemia, ankylosing spondylitis, and soft tissue infections [5].

This was followed by Proteus species and Staphylococcus epidermidis in seven samples each. Proteus was isolated from all kitchen surfaces except from refrigerator handle & its pattern of distribution was same as Klebsiella which showed more liking towards kitchen towel with three positive samples isolated from them. It was also present on water tap, kitchen stove and sponge (Illustrations 1 to 5). Proteus species frequently cause infections of the urinary tract and lower respiratory tract [6].

Staphylococcus epidermidis on the other hand, was mostly found on the water tap with their presence on four samples (Illustration 4). It typically lives on the human skin and mucosa [7]. Staphylococcus aureus was isolated from two kitchens and was found on kitchen stove and water tap (Illustration 1 & 4). S. aureus is widely distributed in nature and carried by 25-33% of normal individuals in the anterior nares and skin. Its presence was an indicator of poor personal hygiene practices such as poor hand washing technique or wiping the nose, touching the hair, mouth and smoking with no hand washing before preparing foods or after cleaning the kitchen [8].

Among the different places in the kitchen, water taps were found to be most contaminated followed by stove knob, towel & refrigerator handle. Kitchen sponge was least contaminated. Water taps and stove knobs were often touched with unwashed hands during cleaning of raw food. Hence, the high incidence of pathogens on them. The high incidence of bacteria on kitchen towels was certainly due to the frequency that towels were needed to wipe up raw food juices or to dry hands. Contaminated kitchen towel will spread bacteria when used to clean equipment and surfaces and probably results in high incidence of contamination in most of the kitchens. In fact, Speirs et al. [9] have demonstrated that bacteria were transferred from dishes onto food more frequently when the dish had been towel dried instead of air-dried. In case of continuous or repeated contamination, e.g. on the water tap, development of biofilm particularly by S. aureus and S. epidermidis could be seen. Increased number of bacteria collected from water taps was not a surprise as the moisture created an ideal environment for bacterial growth. Cleaning of these spots of the kitchen with household cleaning products with disinfectants was required, especially in a house with people vulnerable for food poisoning like very young babies, older adults and immuno-compromised patients. Kitchen towels should be changed frequently, and on washing they need to be dried under sunlight regularly to control the cross-contamination as sunlight is known to kill bacteria [10]. Sponges used for cleaning vessels have to be cleaned in antibacterial dish washing liquid and dried after each use and should be kept in boiling water for 5 minutes to decontaminate them as suggested by Erdogru & Erbilir [11].
Conclusion

This study demonstrated that various places in the kitchen harbour pathogenic organisms, thus being a possible source of food poisoning, possibly through cross contamination. Maintaining strict hygiene in the kitchen during handling of raw food and its processing is a must to protect vulnerable people at home from food poisoning or food associated infections. Regular cleaning of various commonly contaminated areas or “hotspots” in the kitchen with soap, water and disinfectants is needed to prevent food borne contamination.

References

1. www.foodborneillness.com/salmonella_food_poisoning
4. fycs.ifas.ufl.edu/foodsafety/HTML/il114.htm Bacteria on cutting boards
7. microbewiki.kenyon.edu/index.php/Staphylococcus_epidermidis
Bacteria isolated from the samples collected from different places in the kitchen.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Area</th>
<th>Bacteria isolated</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Kitchen Stove</td>
<td>Escherichia coli, Klebsiella pneumoniae, Proteus species, Staphylococcus aureus, Staphylococcus epidermidis</td>
</tr>
<tr>
<td>B</td>
<td>Kitchen Towel</td>
<td>Klebsiella pneumoniae, Proteus species</td>
</tr>
<tr>
<td>C</td>
<td>Fridge Handle</td>
<td>Enterobacter species, Klebsiella pneumoniae, Staphylococcus epidermidis</td>
</tr>
<tr>
<td>D</td>
<td>Water Tap</td>
<td>Klebsiella pneumoniae, Proteus species, Staphylococcus aureus, Staphylococcus epidermidis</td>
</tr>
<tr>
<td>E</td>
<td>Kitchen Sponges</td>
<td>Escherichia coli, Klebsiella pneumoniae, Proteus species</td>
</tr>
</tbody>
</table>
### Illustration 2

#### Table 2

Frequency of different bacteria isolated out of 50 (10 X 5) samples.

<table>
<thead>
<tr>
<th>Bacterial Isolates</th>
<th>Frequency</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enterobacter spps</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td>3.1%</td>
</tr>
<tr>
<td>Escherichia coli</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>9.4%</td>
</tr>
<tr>
<td>Klebsiella pneumonia</td>
<td>12</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>37.5%</td>
</tr>
<tr>
<td>Proteus spps</td>
<td>7</td>
<td>1</td>
<td>3</td>
<td></td>
<td>2</td>
<td>1</td>
<td>21.9%</td>
</tr>
<tr>
<td>Staphylococcus aureus</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>6.3%</td>
</tr>
<tr>
<td>Staphylococcus epidermidis</td>
<td>7</td>
<td>2</td>
<td></td>
<td>1</td>
<td>4</td>
<td></td>
<td>21.9%</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>32</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A= Stove knob, B=Kitchen towel, C=Refrigerator handle, D=Water tap, E=Kitchen sponge
Illustration 3

Microorganisms isolated from kitchen stove knob

A: Microorganisms isolated from kitchen stove knob

- S. aureus: 20%
- Proteus spp.: 10%
- S. epidermidis: 20%
- Klebsiella spp.: 20%
- E. coli: 20%
- Non pathogenic microorganism: 10%
Illustration 4

Microorganisms isolated from kitchen towel

B: Microorganisms isolated from kitchen towel

- Proteus spp.: 30%
- Klebsiella spp.: 30%
- Non-pathogenic microorganism: 40%
Illustration 5

Microorganisms isolated from refrigerator handle

C: Microorganisms isolated from refrigerator handle

- Enterobacter: 10%
- S. epidermidis: 10%
- Klebsiella spp.: 30%
- Non pathogenic microorganism: 50%
Illustration 6

Microorganisms isolated from water tap
Illustration 7

Microorganisms isolated from kitchen sponge

![Microorganisms isolated from kitchen sponge](image-url)
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