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Bacteria Associated with Kitchen Surface in Some Selected Areas in Sokoto State, Nigeria

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ABSTRACT

Contamination of kitchen utensils and their role as a source or microbial reservoir is now becoming a major concern in addressing food hygiene and safety. This study was carried out to isolate and identify bacteria associated with kitchen surfaces in some selected areas in Sokoto State, Nigeria. The swab sticks were collected from the Kitchen surface in Arkilla, Lowcoast, Mabera, Minnanata and Runjin Sambo. Samples collected were isolated and characterized using microscopy and biochemical tests. The most frequently isolated bacteria were *Citrobacter freundi* with (16%), followed by *Staphylococcus cohnii* with (12%). *Clostridium fallax*, *Bacillus cereus, Salmonella* sp., *Staphylococcus saccharolyticus, Clostridium botulinum and vibrio cholera,* had (8%) each. *Clostridium septicum, Staphylococcus haemolyticus, Lactobacillus acidophilus, Staphylococcus intermedius, Salmonella para typhi A, Shigella specie, Staphylococcus xerosis, Clostridium butyricum* had (4%) each. Also, the highest mean count of $1.18x10^5$cfu/ml/50cm^2 was observed from bacteria isolated in Arkilla area. The implication of this finding is that potentially pathogenic bacteria like *Staphylococcus, Salmonella, Shigella and Vibrio species* may be of public health concern. The need for disinfection of kitchen and covering the utensils use in kitchen is now very important.

Keywords: kitchen surface, hygiene, food borne illness, disinfection.

INTRODUCTION

Kitchen is considered as one of the most important parts of a home and a place where families tend to display their courage and professionalism. It is a room where families display various types of food and where the most delicious activities related to what we eat are made. It serves as the main point of view of the house due to the fact that we need to eat in order to survive. Despite the importance attach to the kitchen, it is also associated with the presence of bacteria and other related germs due to the presence of food and other related materials (Wolde& Bacha, 2016). Pathogenic organisms enter the home on a continuous basis through foods (foodborne) or water (waterborne), or prepared in the home by an infected person (person-to-person infection), through the air (airborne), by insects, or through house pets (Beumer et al.1999; Scott, 2000; Mattick et al., 2003; Medrano-Felix et al., 2011). These are the most common sources of potentially harmful microorganisms in the home.

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Germs can be found on any kitchen surface, so the growth of unwanted contaminating bacteria not only deteriorates the sensory and organoleptic characteristics of food, but it can also cause illness. As a result, food handlers are frequently the primary cause of contamination, and cross contamination bacteria are easily transferred from a wide range of food items to kitchen surfaces (Othman, 2015).

Othman (2015)examines the link between pathogenic bacteria in various types of food found in the kitchen. Using sterile cotton swabs, samples were collected before and after disinfection from refrigerator handles, kitchen towels, water taps, cooking gas stove knobs, and kitchen sponges used for washing utensils. The results revealed that the most abundant bacteria in the isolates were *Escherichia coli, Klebsiella* sp*.,* and *Staphylococcus aureus*. The samples were free of bacterial contamination after disinfection with sodium perborate and sodium silicate (detergent), sodium hypochlorite (Clorox), 5% amphoteric surfactant and chlorine (dishwashing powder), and Dettol. This demonstrates a link between food contamination and bacteria isolated from the kitchens.

Sea food, particularly oysters, and other shellfish can be contaminated with *Vibrio* specie of bacteria that cause diarrheal or with hepatitis A virus. Unpasteurized cheese and some meat can be contaminated with *Listeria monocytogens,* a strain of bacteria that can cause disease in people and miscarriage or damage to the foetus in pregnant women. Contaminated vegetables or fruit can carry a variety of organisms and parasite depending on where they were grown and how they were processed. Other than that, Centre for Disease Control and Prevention argued that harmful microorganisms can be transferred by hand or dish towels (Byrd-Bredbenner, Berning, Martin-Biggers, & Quick, 2013). Items in the kitchen become contaminated by contact with contaminated people, food items like poultry, raw or under cooked meat, raw foods (veggies, fruits, eggs, meats) damaged can goods or other environment sources. The first and famous suspected kitchen gadget is the human hand, too often people don't wash their hand before preparing food, more often people don't wash their hand between handling possibly contaminated food like meat and other food that are most likely to be contaminated like vegetables. The cross contamination is a leading cause of food borne diseases (Edward, 2009). The study was performed to ascertain whether there was a relationship between pathogenic bacteria and kitchen surfaces and to identify the type of bacteria present which is necessary for the maintenance of good health. Kitchen is regarded as safe after cleaning but there are some bacteria that are resistant to detergent. The research was designed to monitor the type of bacteria present on the kitchen surfaces.

MATERIALS AND METHODS

Sample Collection

Twenty-five kitchen surface samples were collected from five locations in Sokoto metropolis (Mabera, Arkilla, Minanata, Runjin Sambo, and Lowcoast) within Sokoto. Samples were collected using a moistened sterile swab stick and an area of 50cm^2 surface was swabbed. The swab sticks were immediately transported to the microbiology laboratory in Usmanu Danfodiyo University Sokoto for further analysis.

Isolation of the organism

The swab sticks were directly inoculated into tubes containing 5ml sterile nutrient broth and incubated at 37^0C for 2hrs. After two hours, the sample was serially diluted by pipetting 1ml from the 5ml sterile nutrient broth to a test tube containing 9ml of sterile distilled water 3 times, and it was inoculated into a prepared nutrient Agar medium using the spread plate method and incubated at 37^0C for 24 hours.

Biochemical Test

Biochemical test used to identify the isolated colonies are Catalase Test, Urease Test, Indole Test, Coagulase Test, Citrate Test, Methyl red and VogasProskaeur (MRVP), Triple Sugar Iron agar (TSI), and Motility test.

RESULTS

Bacteria associated with kitchen surfaces were isolated and identified. The total viable count of bacteria from each site is shown in Table 4.1. The highest mean count of $1.18x10^5$ cfu/ml/$50cm^2$ was obtained from Arkilla.

Table 4.2 shows a biochemical test result used in identifying the bacteria. Sixteen bacteria identified in this study are Clostridium botulinum, Staphylococcus cohnii, Staphylococcus haemolyticus, Corynebacterium xerosis, Lactobacillus acidophilus, Citrobacter freundii, Staphylococcus intermedius, Bacillus cereus, Shigella specie, Vibriocholerae, Clostridium septicum, Clostridium fallax, Clostridium butyricum, Salmonella, Salmonella paratyphi A and Staphylococcus scharolyticus.

Table 4.3 shows the frequency distribution of the entire identified bacteria the result in Table 4.4 shows thatcitrobacterfreundii has the highest percentage of (16%) and Clostrdium botulinum, Clostridium septicum, Staphylococcus haemolyticus, Lactobacillus acidophilus, Staphylococcus intermedius, Salmonella para typhi A, Shigella specie, Vibrio cholerea, Staphylococcus xerosis, Clostridium butyricum have the lowest frequency of (4%)

Table 4.1: Bacterial count from various kitchens within Sokoto

Sample	Bacterial count in cfu/ml/$50cm^2$		
	Total	Range	Mean (SD)
A	5.90×10^5	3.9×10^4-2.05×10^5	1.18×10^5
R	4.43×10^5	$2.3 \times 10^4 - 1.8 \times 10^5$	8.86×10^4
M	2.57×10^5	$1.9 \times 10^4 - 8.1 \times 10^4$	5.14×10^4
L	3.52×10^5	$2.7 \times 10^4 - 8.8 \times 10^4$	$7.0\ 4x\ 10^4$
Mn	3.21×10^5	$2.9 \times 10^4 - 9.2 \times 10^4$	$6.4\ 2x\ 10^4$

Keys: A= Arkilla R= Runjin sambo M= Mabera L= Lowcoast Mn= Minannata

Table 4.2: Results of Biochemical Characteristics of the Bacteria Isolated from Kitchen Surface.

	Glucose	Lactose	Sucrose	H_2S	Gas	Motility	Indole	Mr	Vp	Ureas	Catalase	Citrate	Organism
1	+	-	-	+	-	+	-	-	+	-	+	+	*Clostrodium botulinum(CDE$^+$)*
2	+	-	-	-	-	-	+	-	+	-	+	+	*Staphylococcus cohnii*
3	+	-	+	-	-	-	-	-	+	-	-	+	*Staphylococcus haemolyticus*
4	+	-	+	+	-	+	-	-	+	-	+	+	*Corynebacterium xerosis*
5	+	+	+	-	-	+	-	+	-	-	-	-	*Lactobacillus acidophilus*
6	+	+	-	+	-	+	-	-	+	+	-	+	*Citrobacter freundii*
7	+	+	+	-	-	+	+	+	-	+	-	-	*Staphylococcus intermedius*
8	+	+	-	-	-	+	-	+	-	+	-	-	*Bacillus cereus*
9	-	-	-	-	-	-	-	+	-	-	+	-	*Shigella specie*
10	+	-	-	-	+	+	-	+	-	-	-	+	*Vibriocholerae*
11	+	+	-	+	+	+	+	-	+	-	+	+	*Clostridium speticum*
12	+	+	+	+	+	+	-	+	-	+	+	+	*Salmonella paratyphi A*
13	+	+	-	+	-	+	-	+	-	-	+	-	*Clostridium fallax*
14	+	-	-	+	-	+	-	+	-	-	-	-	*Salmonella*
15	+	+	-	+	-	+	-	+	-	+	+	-	*Staphylococcus*
16	+	+	+	-	+	+	-	-	+	-	+	+	*saccharolyticus*
													Clostridium butyricum

Table 4.3: Frequency distribution of bacterial contaminant on the kitchen surfaces

Bacteria	Number Isolated	Percentage%
Clostridium botulinum	1	4%
Clostridium septicum	1	4%
Clostridium butyricum	1	4%
Clostridium fallax	2	8%
Staphylococcus cohnii	3	12%
Staphylococcus saccharolyticus	2	8%
Staphylococcus xerosis	1	4%
Staphylococcus intermedius	1	4%
Salmonella para typhi A	1	4%
Salmonella	2	8%
Bacillus cereus	2	8%
Shigella specie	2	8%
Vibrio cholera	2	8%
Citrobacter freundii	4	16%
Total	**25**	**100%**

DISCUSSION

Fourteen (14) bacteria were identified from this study. The result generated from the bacteriological analysis of the kitchen surface shows that kitchen surfaces contain bacterial contaminants.

From the bacterial count carried out the total count reveal the highest mean count of $1.18x10^5$cfu/ml/$50cm^2$ in (Table 4.1), these could be due to the differences in survival that depend on the moisture or temperature of surfaces and the frequency of transmission. And some kitchen surfaces are not clean frequently (Jeon, Chun, & Kim, 2013). According to (Flores *et al.,* 2013) bacteria readily colonize kitchen surfaces, and the exchange of microbes between humans and the kitchen environment can impact human health.

The second objective of this study is to isolate and identified the type of bacteria found on the kitchen surfaces, hence, kitchen surfaces are found to be contaminated with both gram positive and gram-negative bacteria. In table 4.2 the bacteria isolated were in line with the work of (Kumar, Rishu, & Osborne, 2012) that the most important sources of bacteria across all surfaces was clearly human skin with relatively larger contribution to those surfaces routinely touch with our hands. This is similar to what has previously been observed in public restrooms where skin was also the principal source of bacteria (Flores et al., 2011). *Citrobacter freundii* is isolated on kitchen surfaces, it is an opportunistic bacterium that causes infection in immune compromise patient. It tends to infect the urinary track, respiratory track, and blood, pancreatic and hepatic disease are also common causes of *Citrobacter freundii.*

Salmonella specie follows a cyclic life style in which host colonization is altered with period of survival outside the host (Boyd, Wang, Whittam, & Selander, 1996).*Salmonella spp* can survive outside the host by the formation of biofilm. *Salmonella* biofilms are encountered on man and biotic and abiotic surfaces. *Salmonella* can survive on stainless steel for a period of time (Burmølle, Bahl, Jensen, Sørensen, & Hansen, 2008). Salmonellosis is a type of disease cause by *Salmonella* due to eating food contaminated with *Salmonella.*

Clostridium botulinum bacteria grows on food and produces toxin that when ingested cause paralysis botulism poisoning is extremely rare, but so dangerous that each case is considered a public health emergency. Infant botulisms is the most common form of botulism. Most of botulism cases reported each year come from foods that are not canned properly at home but botulism from commercial canned food is rare.

Vibrio cholerea causes cholera which is an acute diarrheal disease the infection is usually mild or without symptoms in most healthy adults but sometimes can be severe. This disease is characterised by profuse watery diarrheal, vomiting and leg cramps. These symptoms result from rapid loss of body fluid leading to dehydration and shock.

Many species have been described; relatively few are responsible for human diseases. *Staphylococcus haemolyticus (S.haemolyticus)* is the most prevalent species isolated from different clinical specimen next to *Staphylococcus epidermidis (S.epidermidis)* observed in many studies. *haemolyticus* frequently colonizes the skin, mucous membranes of hospitalized person. *S.haemolyticus* along with the *S. epidermidis* is well documented cause of blood stream infection in all ages, wound infection, skin and soft tissue infection.

CONCLUSION

The highest mean count of 1.18x105cfu/ml/50cm2 was observed from Arkilla area. Similarly, the bacteria identified, and their frequency of isolation are *Citrobacter freundii* was determined to be the most frequently isolated bacteria in the kitchen surfaces with (16%). This was followed by *Staphylococcus cohnii* with (12%), *Clostridium fallax, Bacillus cereus, Salmonella, Staphylococcus saccharolyticus, Shigella specie, Vibrio cholera* had (8%) each, *Clostridium botulinum, Clostridium septicum, Clostridium butyricum, Staphylococcus intermedius, Salmonella para typhi A, Staphylococcus xerosis*, had (4%) each. It is necessary to ensure proper cleaning method and sanitation of kitchen surfaces. Proper hand washing and use of sanitizer is necessary before and during preparation of food as well as the act of covering kitchen utensils is highly important and needed in order to ensure food hygiene and safety. Ensuring proper maintenance of kitchen towels and sponges is also needed for the maintenance of hygienic kitchen.

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