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Assessment of Bacteria Contamination of Ready-To-Use Cutlery in The Cafeteria of A Tertiary Institution in Nigeria

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Abstract

The domestic kitchen is increasingly being recognized as the most important area in relation to the incidence of food-borne disease. Incidence of food- borne disease highlights the issue of food hygiene preparation, which includes factors which include kitchen utensils and equipment. Every tertiary institution has its own canteen. Food-borne infections in cafeterias can result from utensils carrying pathogens. These microorganisms have the ability to attach to surfaces and with high cell density with biofilms. That is, bacteria can be present in large numbers even on kitchen equipment that looks clean. This study was undertaken to determine bacteriological quality of cutlery of ten restaurants in a University in Ondo state, Nigeria. A descriptive designed study was undertaken where one hundred and fifty (150) cutlery samples were collected using swab sticks and cultured in appropriate media and the bacteria isolated were identified according to their morphological and biochemical characteristics. A profile of four (4) different bacterial species, including *Staphylococcus aureus* (40%), *Klebsiella spp* (60%), *Escherichia coli* (60%), and *Pseudomonas spp.* (30%) were isolated. The result suggests high levels of bacterial contaminants in the cafeteria and calls for improved personal and environmental hygiene.

Keywords: cutlery, swab sticks, bacterial contaminants, cafeteria, personal hygiene

Introduction

Food Microbiology involves the study of microorganisms that colonize, modify, and process, or contaminate and spoil food. It is one of the most diverse research areas within Microbiology. It comprises a wide variety of microorganisms including spoilage, probiotic, fermentative, and pathogenic bacteria, moulds, yeasts, viruses, prions, and parasites. It deals with foods and beverages of diverse composition, combining a broad spectrum of environmental factors, which may influence microbial survival and growth. Food microbiology includes microorganisms that have beneficial or deleterious effects on food quality and safety and may therefore be of concern to public health (Laranjo *et al*., 2019). The first and foremost suspect "gadget" in the kitchen is the human hand. Too often, people do not wash their hands before preparing food. More often, people do not wash their hands between handling possibly contaminated foods like meat and other foods that are less likely to be contaminated like vegetables. This "cross-contamination" is a leading cause of food-borne disease (Nwakanma & Chidobi, 2016). The intention of food safety is to prevent food poisoning (the transmission of disease through food) and to maintain the wholesomeness of the food products through all stages of processing, until it is finally served. Therefore, one important task is to make sure dishes, spoons and other cutlery are kept clean.

The need for urgent improvement in the hygienic condition of the restaurant cannot be over emphasized. Towels provide an ideal environment for bacteria to grow and habour them. Wet towels can habour potentially harmful

organisms and become breeding grounds for bacteria. The use of towels in a kitchen can cause the spread of bacteria to hands, equipment, crockery and cutlery. Harmful organisms can not only survive but continue to grow in contaminated towels which remain damp. *Escherichia coli, Proteus vulgaris, Klebsiella sp.* and *Shigella sp*. are bacteria that were most frequently isolated from the restaurants with no or poor hygiene. Some of them like *Klebsiella sp* and *Proteus vulgaris* are frequent causes of urinary tract infections, though they are usually associated with some underlying predisposing factors in the urinary tract (Maori & De, 2010).

Some schools, regardless of whether it is primary, secondary or tertiary, have their canteen. It is commonly known that during the cleaning process of kitchen utensils and equipment, sponges are used to eliminate food residues. However, food residues will stick to the sponge surfaces and if stored in favorable environment for the microbial growth, kitchen sponge will turn into a medium that promotes bacterial growth and therefore a source of contamination to other utensils. It was reported that 74% of cloths used in cleaning dishes and cutting equipment surfaces were contaminated with one or more of the following organisms, *Escherichia coli, Staphylococcus aureus, Streptococcus faecalis* and *Clostridium perfringens* (Maori & De, 2010). It is clear that wiping kitchen equipment with cloths may result in the contamination of equipment. Microbial attachment and biofilm formation to solid surface of crockery and cutlery provide some protection of the cells against physical removal of the cells by washing and cleaning of crockery (Maori & De, 2010). These cells seem to have greater resistance against sanitizers and heat due to reduced exposure time.

It was also reported that microbial cells attached to equipment surfaces, especially those that come in contact with food, may not be easily killed by chemical sanitizers or heat designed to be effective against unattached microbial cells; and thus, they can contaminate food. The washing of hands, utensils and dishes is often done in buckets or bowls (WHO, 2002). It also has been reported that several species and strains of *Pseudomonas* were found to attach to stainless steel surface within 30 minutes of contact. *Listeria monocytogenes* was found to attach to stainless steel surface, glass and rubber surfaces within 20 minutes of contact and some of the microorganisms found are *Staphylococcus* specie, *Escherichia coli*, Bacillus specie and *Pseudomonas* specie.

Food hygiene is an important factor in food preparation. This is because biological food contamination can easily occur if proper hygiene is not practiced. Biological contamination such as bacteria, viruses, fungi, protozoa and Helminthes are major causes of food-borne diseases, all of which with severity that range from mild to chronic, or life threatening, or both (Ramii *et al*., 2020). In this study, the school canteen was selected because it generally produces a large quantity of meals for the students. The contamination of food by pathogen at school canteen will result in the occurrence of food-borne disease amongst a large number of people. Surface and equipment used in kitchen may look sparkling clean, yet bacteria may be present in large numbers (Barron, 2022). The intention of food safety is to prevent food poisoning, (the transmission of disease through food) and to maintain the wholesomeness of the food product through all stages of processing, until it is finally served.

Bacteria readily colonize the hands of food vendors, the counters from where the food is served, table surfaces on which the consumers take their meals and the utensils (FSIC, 2016). Poor personal hygiene practices amongst some food vendors further accelerate the rate of contamination. It is also observed that most of the cafeterias run a “pay as you eat system” where the students pay for their meals at the point of serving (Afunwa *et al*., 2019). Exchange of money between the “buyers” and the “sellers” with unprotected hands and minimal sanitary precautions are other predisposing factors (Anyanwu *et al*., 2016)

The incidence of food borne- disease such as diarrhea and abdominal pains, which are mostly reported by the students after eating at the school are presumed as microbial food poisoning

(Ramii *et al*., 2020). Incidence of food- borne disease highlights the issue of food hygiene preparation, which includes factors such as food handler hygiene, equipment, utensils, storage and raw material preparation. Even preparing meals too early and stored at incorrect temperature will allow microbial growth. This study evaluated the microbiological quality of different kitchen equipment at school canteens. This study determined the bacterial profile on cutlery used in restaurants and the densities of bacteria on plates, spoons, and forks used in the restaurants under study in Ondo state, Nigeria. The work included the isolation and identification of bacteria in kitchen and canteen and investigating the storage of the cutlery.

Statement of the Problem

Presumably, food-borne diseases sometimes acquired in hotels and restaurants are through dishes, cutlery, plates and other kitchen equipment (Maori and De, 2010). The cafeteria is a place where food is prepared and sold. It is a means of livelihood for a significant number of people in developing countries but the poor hygiene conditions in some of these cafeterias raise worries on microbiological safety. In most cases, an increase in the volume of patronage results in poor hygiene as adequate sanitation is compromised. This is the usual occurrence in a student's environment. Thorough washing between one user of cutlery and another is a challenge. Food-borne infections in cafeterias can result from utensils carrying pathogens (Majlesi *et al*., 2014). These microorganisms have the ability to attach to surfaces and with high cell density form biofilms. Epidemiological data on the incidence of food-borne diseases show that recurrent episodes of food borne diseases with symptoms ranging from diarrhoea, abdominal cramps and vomiting are a major cause of morbidity in the populace (Afunwa *et al*., 2019).

Rationale of the Study

The school canteen generally produces a large quantity of meals for the students. Food hygiene is an important factor in food preparation. This is because biological food contamination can easily occur if proper hygiene is not practiced. Adequate cleaning of utensils such as spoons forks and knives is a difficult task because of the high volume of patronage. Microbiological contamination with bacteria, viruses, fungi, protozoa and helminths are major causes of food-borne diseases, all of which with severity ranging from mild to chronic, or life threatening, or both (Ramii *et al*., 2020).

Aims and Objectives

The aim of this study is to determine the bacterial load on ready-to-use cutlery used in the cafeterias of a University in Ondo state, Nigeria.

The objectives of the study are to:

1. Determine the bacterial profile of cutlery in cafeterias of the institution.
2. Determine antibiotic susceptibility pattern of bacteria isolated.
3. Evaluate the sanitation pattern of the cafeterias.

Hypothesis

The following hypothesis was tested:

Null Hypothesis:

H_0 There is low occurrence rate of bacteria on ready-to-use cutlery in cafeterias of the university.

H_0 Bacterial isolates are not susceptible to common antibiotics.

H_0 Sanitation practice in the cafeteria is adequate.

Significance of the Study

Food poisoning is a critical public health concern, and the hygienic conditions of the cutlery used in restaurants play a role in the ultimate outcome of food-related health status quo. This study reveals the importance of ensuring food hygiene, reducing food-borne diseases to the minimum by, amongst other things, paying attention to the satisfactory sanitation of ready-to-use cutlery.

Materials and Methods

Study Area

The study was carried out in a University in Ondo state, Nigeria.

Study Design

A descriptive study was undertaken for this research purpose.

Sample Population
This study was conducted in the cafeterias of the University. There are about 12 cafeterias located in the general market and student building of the University. The restaurants were selected based on the availability and consent of the operators of the restaurants and the samples were selected based on random selection.

Sample Size Determination
Using the prevalence of 93% of bacterial contamination of cutlery used in kitchens (Ejechi & Ochei, 2017) as the hypothesized value (P) and a standard deviation of 1.96 (Z) while the level of inaccuracy at 95% confidence level is 0.05 (D).

$$n = \frac{Z^2 p(1-p)}{d^2}$$

Where n = the minimum sample size required
P = prevalence of bacterial load on cutlery in university cafeterias in Nigeria 89% (Ejechi & Ochei, 2017)
Z = corresponds to significance level (1.96 for 0.05)
d = absolute error or precision= 5% (0.05)
n = 1.96^2x0.89 (1-0.89)/$(0.05)^2$
n = 150

Thus, the minimum sample size for this study is 150 to prevent absolute error during sampling.

Sample Collection
A total of 150 samples of swabs were obtained from randomly selected cutlery from 10 cafeterias in the university. Forks, spoons, knives, and plates were swabbed with swab sticks. The swab sticks were temporarily preserved with normal saline before transported to the microbiology laboratory for analysis purposes.

Sample duration
The study period was between May and June 2023.

Materials
Petri dishes, incubator, autoclave, weighing balance, hot air oven, bunsen burner, wireloop, hand gloves, slides, coverslip, measuring cylinder, sterile pasteur pipettes, appropriate stains, conical flasks, normal saline, nutrient agar, Chocolate agar and MacConkey agar.

Microbial Analysis of Samples
Isolation of Microorganisms
The swab stick was used to make an inoculum on Blood, Chocolate and MacConkey agar plates and streaked out using a sterilized wire loop, and then incubated overnight at 37°C.

Bacterial Analysis of Samples
Colonies of growth were identified by standard bacteriological procedures as described by Cowan and Steel (Afunwa et al., 2019). Pure colonies of bacteria were obtained by picking discrete colonies using a sterile wire loop.

Colonial Morphology
The shape, size, colour, pigmentation, elevation, edges and odour of the bacterial species were examined on the agar plates after appropriate incubation period.

Microscopic Examination

Gram staining
Gram staining was done, and all the gram-positive bacteria were subjected to coagulase and catalase tests for biochemical confirmation.

Biochemical Test
Gram-negative rods and Gram-positive cocci were identified by performing a series of biochemical tests. Biochemical test was done for the identification of the isolates to the species level. Some of the biochemical tests done included: Citrate utilization test, Coagulase test, Urease test, Indole test, Oxidase test, Urease test and catalase test.

Antimicrobial Susceptibility Testing
Antimicrobial susceptibility testing was done for bacterial isolates by using disc diffusion method on Nutrient agar. Bacterial inoculum was prepared by suspending the freshly grown bacteria in 4-5 mL sterile nutrient broth and the turbidity was adjusted to that of a 0.5 McFarland standard. It was then inoculated on the plate, and the antibiotic disc was placed on it. After overnight incubation, the diameter of the zone of inhibition around the disc was measured and interpreted as susceptible and resistant according to National Committee for Clinical Laboratory Standards and the isolates showing resistance to two or more different

classes of antibiotics was considered as multi-drug resistant (MDR) strains.

Data Analysis

Data was analyzed using SPSS version 20 statistical software. Descriptive statistics were also used to present the result in tables and in charts.

Results

General Description

A total of ten restaurants took part in this study and a total of 100 samples of plates, spoons, forks, and knives were collected from the restaurants. A total of four bacteria were isolated from all the samples collected; three Gram Negative (GN), namely *Klebsiella spp, E. coli* (which are lactose fermenters) and *Pseudomonas spp* (a non-lactose fermenter), and one Gram Positive (GP), *Staphylococcus aureus.*

Figure 1 shows the distribution of bacterial isolates across the restaurants, with *Klebsiella spp* and *Escherichia coli* showing the highest prevalence at 60%; *Staphylococcus aureus* showing a prevalence of 40% and *Pseudomonas spp* showing a prevalence of 30%.

Figure 2 shows the distribution of these isolates in individual restaurants. That is, 40% of restaurants had a single bacterial isolate; another 40% had two bacterial isolates; 10% had three bacterial isolates, and another 10% were shown to have all four bacterial isolates. It is important to note here that *Pseudomonas* and *Staphylococcus aureus* were not specific as the only isolate in any of the restaurants as shown in table 1. Furthermore, spoon was the only cutlery with mixed growth after culture.

Table 1: Restaurants and their isolates

Restaurants	Cutlery	Isolate
1	All cutlery	*Escherichia. coli*
2	Spoon Other cutlery	*Klebsiella spp & S. aureus* *Klebsiella spp*
3	All cutlery	*Klebsiella spp*
4	Spoon Other cutlery	*Escherichia. coli & S. aureus* *Escherichia. coli*
5	All cutlery	*Escherichia. coli*
6	All cutlery	*Klebsiella spp*
7	Spoon Knife Plate and Fork	*Staphylococcus. aureus* *Pseudomonas spp* *Klebsiella spp*
8	Plate and Spoon Fork and Knife	*Escherichia. coli* *Klebsiella spp*
9	Plate and Spoon Fork and Knife	*Escherichia. coli* *Pseudomonas spp*
10	Plate Spoon Fork Knife	*Escherichia coli* *Pseudomonas spp & S. aureus* *Klebsiella spp* *Pseudomonas spp*

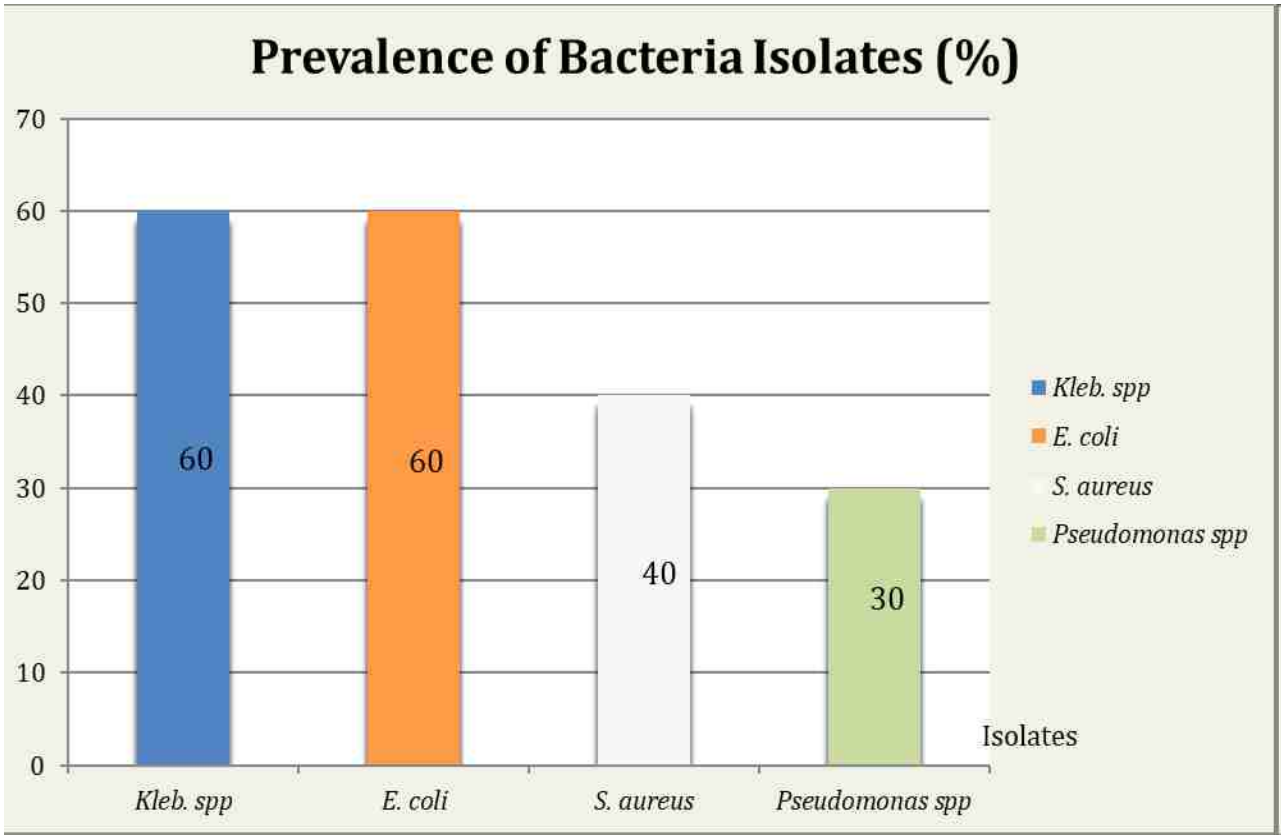

Figure 1: Bacterial Distribution across the Restaurants

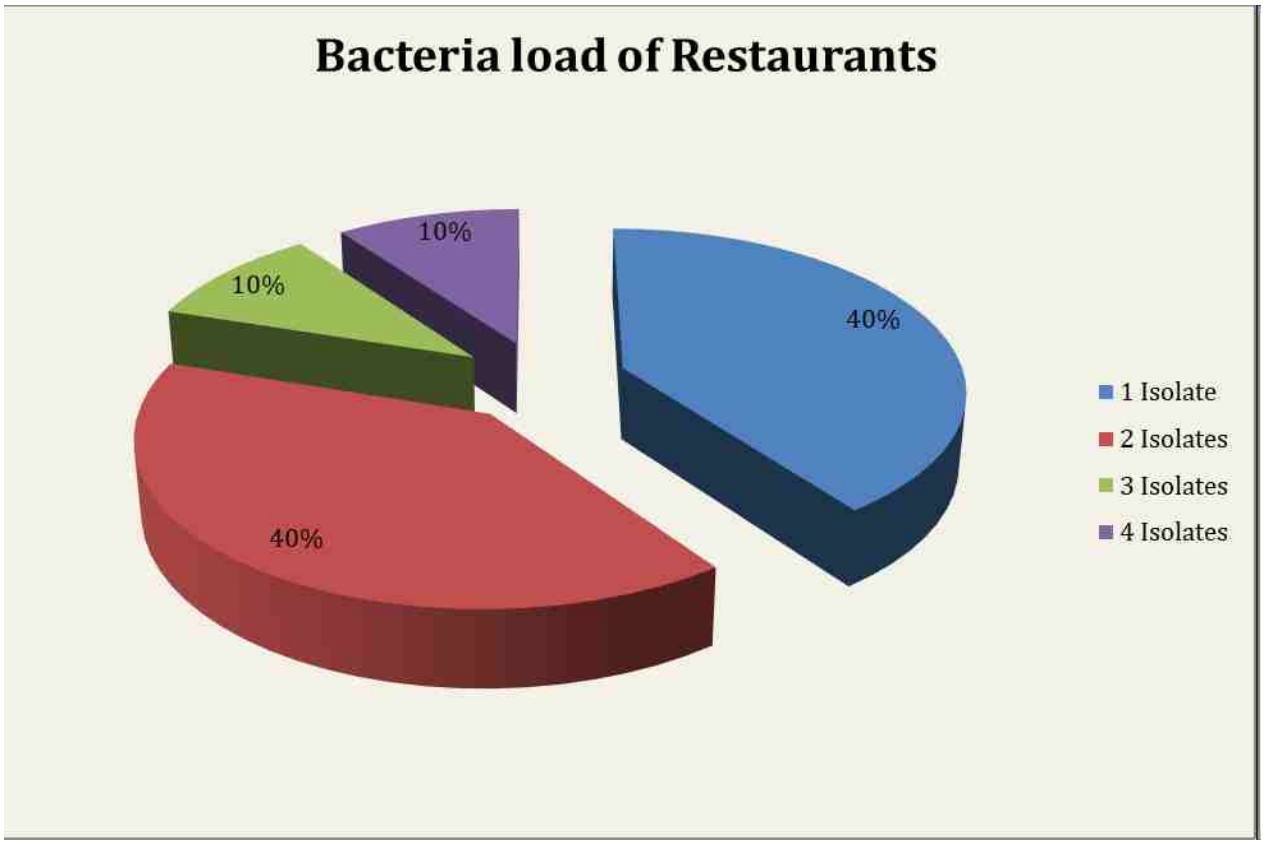

Figure 2: Bacterial Distribution in each Restaurant in relation to Number of Isolate

Data on Isolates in Relation to the Samples

Figure 3 shows the distribution of isolates as they were recovered from each group of cutleries. Generally, the groups of plates and spoons were shown to be mostly contaminated with *E. coli* at 60% and 50% respectively; *Staphylococcus aureus* coming in close second for spoon contamination at 40%. The groups of forks and knives were mostly contaminated with *Klebsiella spp* at 60% and 40% respectively; *Pseudomonas spp* and *E. coli* coming in close second at 30% each for knife contamination.

The groups of plates and forks were shown to have the highest prevalence of contamination at 60% each with *Escherichia coli* and *Klebsiella spp* respectively. Only the group of plates showed no contamination with the non-lactose fermenting (NLF) GN isolate. Only the group of spoons showed contamination with the GP isolate at 40% prevalence compared to contamination from other isolates. Knives were shown to have the highest prevalence of contamination from *Pseudomonas* spp; at all points that the NLF GN was isolated (30%) the group of knives were found to be contaminated. While the general bacterial distribution across the restaurants (as shown in figure 1) showed that the two-lactose fermenting (LF) GN isolates shared a prevalence of 60% each, figure 2 shows that in relation to sample contamination, *Klebsiella spp* was shown to have a slightly higher prevalence across the groups of cutleries.

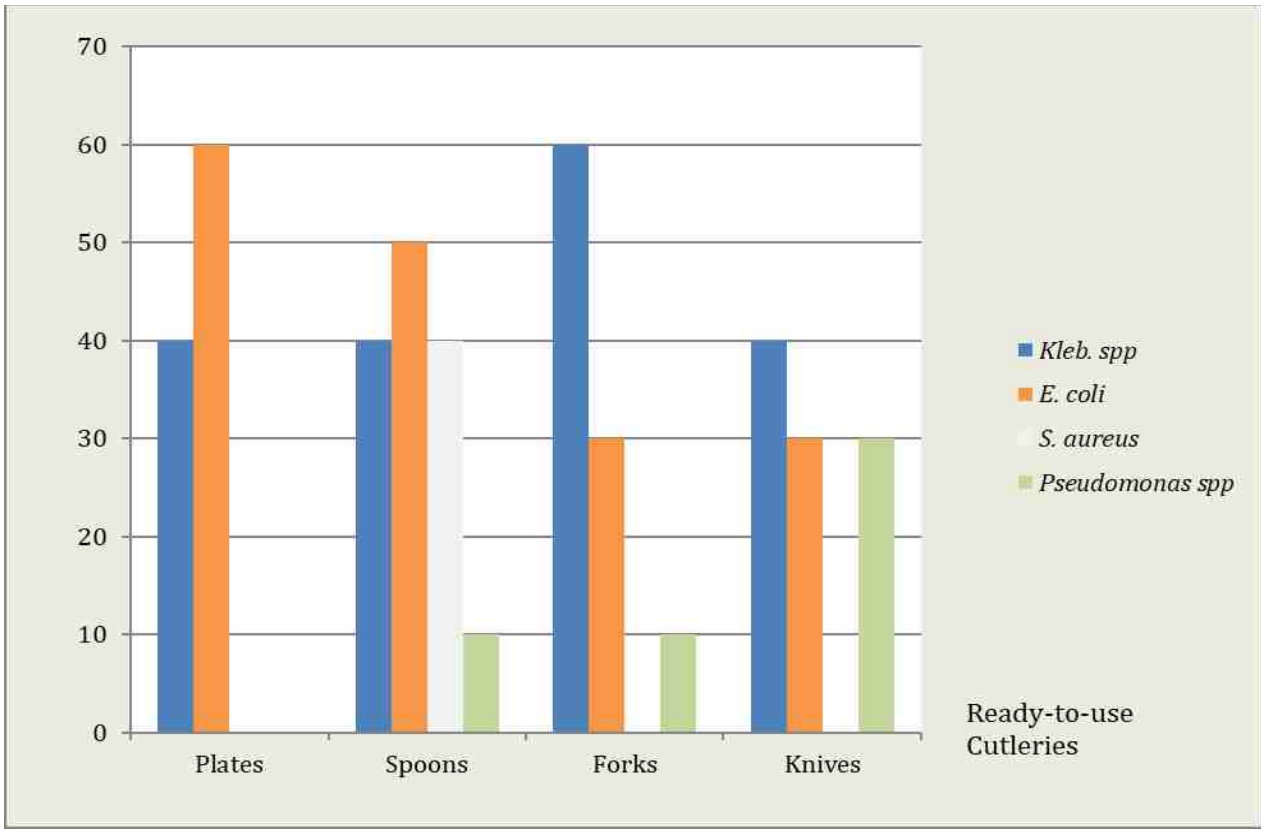

Figure 3: Distribution of Isolates on each Cutlery

Data on Isolates in Relation to Antibiotics

Antibiotics used for antibiotic susceptibility test of the GN isolates are septrin (SXT), chloramphenicol (CH), sparfloxacin (SP), ciprofloxacin (CPX), amoxicillin (AM), augmentin (AU), gentamycin (CN), pefloxacin (PEF), ofloxacin (OXF), and streptomycin (S). Table 2 shows the antibiogram of the GN isolates.

Table 2: Antibiogram of the isolates

Isolates	Sensitivity	Resistance
S. aureus	CPX, CN	SXT, AM, PEF
E. coli	CPX, OFX, PEF	SXT, CH, AM, AU, S
Kleb spp	CPX, OFX, PEF	SXT, CH, AM, AU, S
Pseudomonas spp	SP, CPX, OFX, PEF	CH, AM, S

Figure 4 shows the distribution of antimicrobial resistance of the Gram-Negative isolates.

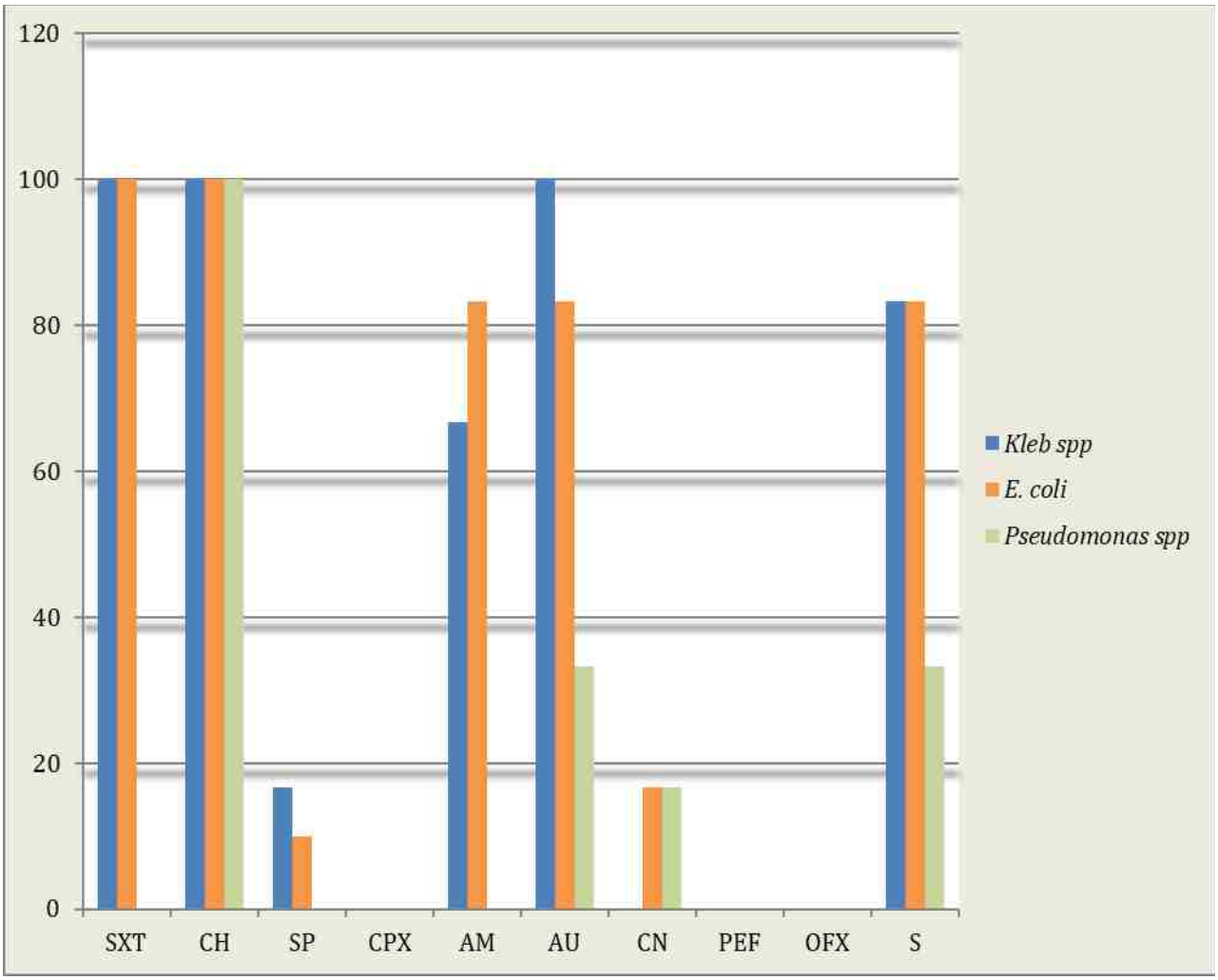

Figure 4: Distribution of Antimicrobial Resistance of the GN Isolates

PEF, OFX and CPX were seen to top effectiveness in antibiotic susceptibility of all isolates whereas SXT, CH, AU, AM, and S proved to be most ineffective with the highest prevalence of antibiotic resistance among all isolates. (Noteworthy is that CH was resistant across board). CN and SP were across board averagely effective. Specific to the isolates, *Pseudomonas spp* was in all cases resistant to CH, AU, and S while *E. coli* and *Kleb spp* were mostly resistant to CH, AU, AM, SXT, and S.

The distribution of antimicrobial susceptibility and resistance of the GP isolate (*S. aureus*). The antibiotics of interest with large zones of inhibition are Ciprofloxacin (CPX) and Gentamycin (CN). The distribution of antibiotic resistance by the organism was prevalent against Septrin (SXT), Amoxicillin (AM), Erythromycin (E), and Doxycycline/Amplicox (APX).

Data on Restaurants' Sanitation

A close attention was paid to the sanitation of the restaurants' waiters and waitresses in handling cutlery from their used state to their ready-to-use state. The observation was done in three stages, which are the washing processes of used cutlery, the storage of cleaned cutlery, and the usage of ready-to-use cutlery.

Used cutleries were found lying around for a while before they were picked up for cleaning in 80% of the restaurants. All the restaurants use the same body of water to wash their used cutlery at different times for a considerable while before having to change it. All the restaurants use the same body of water for rinsing their washed cutlery for a considerable while before changing it. None of the restaurants take the measure of drying the plates after cleaning. All restaurants have their waiters and waitresses pick the plates themselves and serve the food. Only about 30% of restaurants keep their ready-to-use spoons and forks in clean water available to customers to pick from and use. Out of the remaining 70%, 40% of the restaurants have their workers offer the spoons and forks themselves, while 30% have the spoons and knives gathered in a container from which customers pick and use.

Discussion, Recommendations and Conclusion

Discussion

During preparation and serving of foods in the cafeterias, hygienic conditions must strictly be followed (Dermesonluoglu *et al*., 2016); otherwise, chances of food-borne disease increase to consumers (Mir *et al*., 2018). The result of the gram staining, the cultural and morphological characteristics of isolates revealed that *Staphylococcus aureus, Pseudomonas*, *Esherichia coli,* and *Klebsiella spp* were the bacterial species present in the samples assessed. The presence of these isolates from cutlery could create health hazard when they are ingested or when they come in contact with the human skin. This exposed students to eating in these cafeterias to the risk of food–borne infections.

The number of food–borne disease outbreaks due to bacteria has increased in recent years. Several potential causes of these outbreaks include storage temperature, inadequate thermal treatment, cross contamination, poor hygiene conditions of processing facilities and contaminated food contact surfaces (Orogu *et al*., 2017).

It is always safer and easier to prevent the contamination of these cutleries. It is more difficult to make the cutlery safe again. Infection by food poisoning organisms is a threat requiring constant vigilance unless cutlery that comes in contact with food are adequately, cleaned and sanitized; it may still be an important source of contamination of food. Not only may organism persist on cutlery (kitchen equipment), but they may increase in numbers when treatment has been inadequate (Orogu *et al*., 2017).

In the earlier referenced Enugu University study, the results of the sensitivity testing show that most of the isolates were not susceptible to most of the antibiotics tested (Afunwa *et al*., 2019). The isolates, however, had varying sensitivity levels to gentamicin, ciprofloxacin, ampicillin and levofloxacin. The investigation carried out in Godfrey Okoye university (Nwakanma & Chidobi, 2016) showed a trend of increasing resistance rate in some patterns of treatment of kitchen utensil. This was in line with findings from CISI (2013), that there may be a clearly artificial change of susceptibility rates of species/drugs combination due to changes in AST guidelines. Two species drug combination were also used on *Staphylococcus* and *Bacillus*; the implication indicates that there is a certain level of resistance of bacteria which limits must not be exceeded. However, there should be a choice of antibiotic therapy for each infection from usage of such contaminated utensils.

The results of this study are in concordance with those of other authors demonstrating that susceptibility rates differ between species and environment. In addition, it was observed that gentamycin susceptibility on *Staphylococcus aureus* isolates collected from the kitchen utensil decreased significantly unlike other antibiotics.The human hand is a major source of contamination because it may serve as a reservoir for microorganisms. Most food vendors handle vegetables and other food items with bare hands, which may encourage the transfer of pathogens in foods especially with

those prepared and served uncooked like vegetable salad (Anyanwu *et al* 2016). In this study, 40% of all isolates was *S. aureus* and were all from spoon samples; the analysis further revealed that this prevalence was restricted to restaurants that have their waiters and waitresses handle out spoons for eating. Staphylococci are widely distributed in the environment and are found as commensals of the skin, mucous membranes and other body sites. This cross contamination of *S. aureus* is an important cause of food poisoning. The enterotoxin produced is a protein that resists boiling for 30 minutes and the action of gut enzymes and belongs to one of four antigenic types (A-D). Enterotoxin is produced when it grows in carbohydrate and protein containing foods. Enterotoxin types B results in vomiting and diarrhea in human and monkeys, the emetic effect of enterotoxin is probably the result of CNS stimuli (on vomiting centre) after the toxin acts on neural receptor in the gut. Many trains of *S aureus* produce toxins that generate powerful immune responses by binding to MHC molecules on APCs and T-cells receptors. These super antigenic toxins are potent stimulators produced by myriads of microbes that cause a variety of human diseases from transient food poisoning to lethal toxic shock.

Other organisms isolated are similar to those identified from other studies (Rakhshkhorshid, *et al*., 2016). Some of these isolates identified could cause health hazard if ingested in food and this puts students and other consumers at risk of infection. This also confirms similar sources of food borne outbreaks which were reported in other university cafeterias (Rakhshkhorshid, 2016).

A common practice in the cafeteria is that the cooks dried their hands with their aprons; these garments could also serve as a source of further contamination. Isolation of *Staphylococcus aureus* is an indication of poor sanitary conditions and use of dirty towels (Afunwa *et al*., 2019). The organism is pathogenic and survives for longer periods in water than the coliforms, indicating that those who keep their cutlery in water, however clean, may not necessarily be safe from contamination of the organism. The use of towels in the kitchen can cause the spread of bacteria to hands, equipment, cookery, and cutlery. Towel provides an ideal environment for bacteria to grow and labour. Wet towels can harbour potentially harmful organisms and become breeding grounds for bacteria (Orogu *et al*., 2017). *Klebsiella spp* was also isolated, which is not far-fetched compared to Lynn and Nandita (2010) study, showing that harmful organisms can not only survive, but continue to grow in contaminated towels which remain damp. *E. coli, P. vulgaris, Klebseilla sp*. and *Shigella sp*. are bacteria that were most frequently isolated from the restaurants with no or low hygiene, some of them like *Klebseilla sp* and *Proteus vulgaris* are frequent causes of urinary tract infections, though they are usually associated with some underlying predisposing factors in the urinary tract.

Although *E. coli* is a normal flora of the gut and is not harmful, its presence suggests faecal contamination of the cutlery. Spoons and plates also had high levels of contamination which may be due to methods of washing; insufficient and inappropriate washing methods such bulk washing, lack of disinfection and use of undrinkable water may also be a contributing factor (Gholammostafaei *et al*., 2014). The *E. coli* high prevalence of 60% may also be due to the lack of thorough disinfection that should be done on surfaces before meals are served to the students and the use of same napkins for cleaning between servings.

It was also found that the knives from all the restaurants were highly contaminated with *Pseudomonas spp*, and this is consistent with Abdulmoseen *et al.* (2021) study where the knife, cutting board, preparation surface, washing area, and refrigerator handle were having *Pseudomonas spp.*

The kitchen sponge has been described as a conductive environment enabling the growth and survival of microorganisms (Barron, 2022). This is due to the adherence of food residues/organic matter to the sponge during washing up and wiping down of surfaces together with moisture retention creating an ideal environment for microorganisms to flourish once contamination occurs. Hassan and ElBagoury (2018) in their study note the predominance of *Enterobacter spp.* among other

enterobacteria such as *Klebsiella pneumoniae* and *Escherichia coli* and identified *Pseudomonas aeruginosa* as the most common pseudomonad isolated which supports the prevalence of *Pseudomonas spp* and *Enterobacteriaceae* observed in the sponge sample in the study. To further support this finding, a bacteriological investigation looking at used cellulose sponges and cotton dishcloths in domestic kitchens identified *Pseudomonas spp*. as the most common species isolated from cleaning materials (Hassan & ElBagoury, 2018). The same knife was used for cutting different food products, ranging from fish to vegetables, onions, etc. In-between each usage, the knives are cleaned, subjecting the knives to constant contact with the kitchen sponge, which is most likely the reason for the high Pseudomonas contamination across all knife samples.

It is always safer and easier to prevent the contamination of these cutleries. It is more difficult to make the cutlery safe again. Infection by food poisoning organisms is a threat requiring constant vigilance unless cutleries that come in contact with food are adequately, cleaned and sanitized; it may still be an important source of contamination of food. Not only may organism persist on cutleries (kitchen equipment), but they may increase in numbers when treatment has been inadequate.

Conclusion

The study has shown that the ranges of the bacterial isolates found in ready-to-use cutlery used in the cafeterias of this University under study in Ondo state, Nigeria suggests that the sources were inadequately removed during routine cleaning. This is worrying because food handlers are not able to see the growth of bacteria on their kitchen equipment. Sources of contamination included contaminated hands, towels and sponges in the kitchen. The presence of these isolates suggests poor personal hygiene and general neglect of food safety procedures which can pose a health hazard to consumers. Proper sanitary practices during food processing can reduce microbial contamination to safe levels.

It has been identified that water serves a role in hygiene; it is suggested to use clean water, preferably filtered for all sorts of processing and preparation of food materials. Washing of all associated food, preparing and serving items should be conducted with great care. Properly cleaned utensils would minimize the risk of cross-contamination. The cleaning cloth should be used once every time and should not be reused, since it cannot attain a level of sterility after washing. Washing of hands after every step of processing should be promoted and hands should be properly sanitized to reduce the chances of contamination in the food chain. . Students are quite susceptible to food -borne illness because of their age and immune system that are still developing. Some of the students may also have an allergic reaction to certain products or food. As students also did not have many options in choosing their food at the canteen, it is important to take proper steps in ensuring all food is safe to consume.

The bacteriology of associated factors contributing to the bacterial load of these ready-to-use cutlery was not conducted. This would have provided specific and detailed information as to the actual cause of the problem, thereby providing information on the appropriate solution. This will be a subject for further research.

Recommendations

The following should be taken into consideration to help stop microbial contamination of cutlery use in homes, hotels, or restaurants:

1. The best way to protect public health is to enhance sanitation control.
2. Chefs, hoteliers, and hotel waiters should never use any cutlery (Kitchen equipment) without 'sterilization'. Utensils should undergo a sterilizing rinse for at least 1–2 minutes. One of the methods used in sanitizing kitchen equipment is the dishwasher. The modem and advanced dishwashers start functioning by spreading a mixture of hot water and detergent to remove the dirt from the messy items. This is followed by rinsing which is obviously done with clean water. Some of the branded models are enhanced with a heating stage which efficiently dries the wet plates and utensils efficiently.
3. Enlightenment on food safety and cafeteria hygiene should be put in place with periodic supervision to ensure adherence to the guidelines.

4. Personal and environmental hygiene should also be emphasized. Hand washing techniques and the use of alcohol base hand sanitizers should also be adopted.
5. Students could also be advised to go with their food containers to purchase food from the cafeterias and make use of their own cutleries.
6. The use of sterilized disposables should be introduced in the cafeteria and other eateries to combat the menace of food-borne infections.

Conflict of interest: None

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