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Bacteriological Assessment of Restaurants Environment in Abraka, South-South, Nigeria

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ABSTRACT

This study investigated the prevalence and distribution of bacterial contamination in five different restaurants in Abraka, Delta State, Nigeria. Samples were collected randomly from various surfaces, including the hands and aprons of food handlers,Floor, and doorknobs. Standard microbiological methods was used for the examination of the specimens in the laboratory to identify the bacterial species. The results showed that *Staphylococcus aureus* was the most common bacterial isolate, comprising 36.14% of all isolates. *Escherichia coli* followed closely behind at *20.18%,* while *Streptococcus spp* accounted for 10.84%. *Pseudomonas aeruginosa* and Bacillus sp were present at 10.24% and 7.23%, respectively. *Salmonella sp* and *Klebsiella spp* were found at 4.52% each, while *Proetus sp* and *Enterobacter sp* made up 3.31% and 3.01% of the isolates, respectively. The restaurant environment with the highest percentage of isolated contamination was Restaurant C, with a recorded value of 27.11%. Following closely behind were Restaurant B with 23.80%, Restaurant D with 18.07%, and Restaurant A with 16.27%. On the other hand, the restaurant with the least contamination was Restaurant E, with a recorded value of 14.76%. This study therefore indicates some level of bacterial contamination in the restaurants which could have significant implications for public health and food safety. We therefore recommends regular monitoring of bacterial contamination in food outlets in addition to the implementation of effective hygiene protocols to minimize the risk of foodborne illness in Abraka environment.

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1. INTRODUCTION

Due to the enormous population growth in urban areas, restaurants have seen significant growth (Jones et al., 2004). Restaurants, on the other hand, are likely to be a potential source of public health risk due to outbreaks

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of food-borne illness, which may be linked to unsuitable environments for food preparations , poor sanitary practices in food service establishments, poor personal hygiene, and other environmental factors, as well as improper holding temperatures (Korukire et al., 2018).

Foodborne diseases are a major public health concern worldwide, causing significant morbidity and mortality. According to recent estimates by the World Health Organization (2022), foodborne diseases result in approximately 600 million illnesses and 420,000 death each year globally. The burden of foodborne diseases is particularly high in low- and middle-income countries, where inadequate food safety practices and limited access to safe water and sanitation contribute to the spread of foodborne pathogens(World Health Organization, 2015). In addition to causing human suffering, foodborne diseases also impose a substantial economic burden. A recent report by the World Bank estimated that the global economic cost of foodborne diseases is at least US$110 billion annually(Jaffee et al., 2019) .This cost includes direct medical expenses, lost productivity due to illness, and costs associated with food recalls and other interventions aimed at preventing the spread of foodborne pathogens.

Some studies also suggest that burden of foodborne diseases may be increasing in some regions. For example, a study published in The Lancet in 2018 found that the incidence of foodborne illness in sub-Saharan Africa increased by 37% between 2010 and 2015 (Troeger et al., 2018). The study attributed this increase to population growth, changes in dietary habits, and inadequate food safety practices.

Foodborne diseases are generally contagious and are caused by a variety of pathogenic bacteria, viruses, or parasites.Foodborne disease outbreaks are significant challenges for health authorities, especially in frequently visited areas with high demand for restaurants and catering establishments(Newell et al., 2010; A. Bukhari et al., 2021).

Microbiological contamination of foods served in restaurants can occur at any stage during storage and processing, or even at the serving stage. It can be originated by contaminated raw materials or cross-contamination from the air, water, dust, human and animal wastes, and many other sources(Osimani et al., 2013).Out brakes of food-borne illness have been attributed to substandard practices in food handling and processing. Hence the assessment of hygiene standards, appliances and food-processing environment becomes a mandatory tool for control and prevention of foodborne diseases. Microbiological assessment of food should rely, not only on food analysis but it is fundamental investigating the types of food-contact surfaces employed in food processing and preparation. Food safety is a critical issue that affects the health of consumers and the reputation of food establishments, making it essential to conduct regular assessments of the microbiological quality of food served in restaurants. In this study, we aimed at evaluating the bacteriological environment of five restaurants in Abraka, Nigeria.

2. MATERIALS AND METHOD

Ethical considerations: Informed consent was obtained from all food handlers and the participating food establishments. The study complied with all ethical guidelines for human subject research and approved by the Institutional Review Board.

Study design: A randomized sample collection was conducted in five restaurantsin

Abraka. The five establishments were randomly assigned identification asRestaurant A,Restaurant B, Restaurant C,Restaurant D and Restaurant E.

Sample collection: Duplicates swabs samples were collected from the hands of food handlers, Aprons, Floor and Doorknobs of the five restaurants at random intervals. The samples were transported to Microbiology laboratory of the Delta State University, Abraka for Analysis.

Microbiological Analysis:

Appropriate samples were cultured in Blood agar, mannitol salt agar, MacConkey agar and Chocolate agar. The Chocolate agar was incubated under micro-aerophilic environment in a carbon dioxide extinction jar at 37^{o}C. Standard bacteriological methods including gram stain, motility, indole, oxidase, and other biochemical test were done according to Cheesbrough (2006) and (Cowan & Steel (1994)

3. RESULTS AND DISCUSSION

3.1.Results Presentation

The total number of isolates obtained in this study was 332 from 125 samples collected from the five (5) Restaurants. Overall, Restaurant C was the most contaminated with 90 isolates,While Restaurant B 79, Restaurant D 60, Restaurant A 59, and Restaurant E recorded 49 isolates in descending order respectively. Nine (9) species of bacteria were isolated from the restaurants including S*taphylococcus aureus* (120). *Escherichia coli* (67) *Streptococcus spp* (36), *Pseudomonas aeruginosa (*34), *Bacillus sp* (24), *Salmonella spp* (15) *Klebsiella spp (15*), *Proetus sp* (11), *Enterobacter spp (*10) (Figure I)

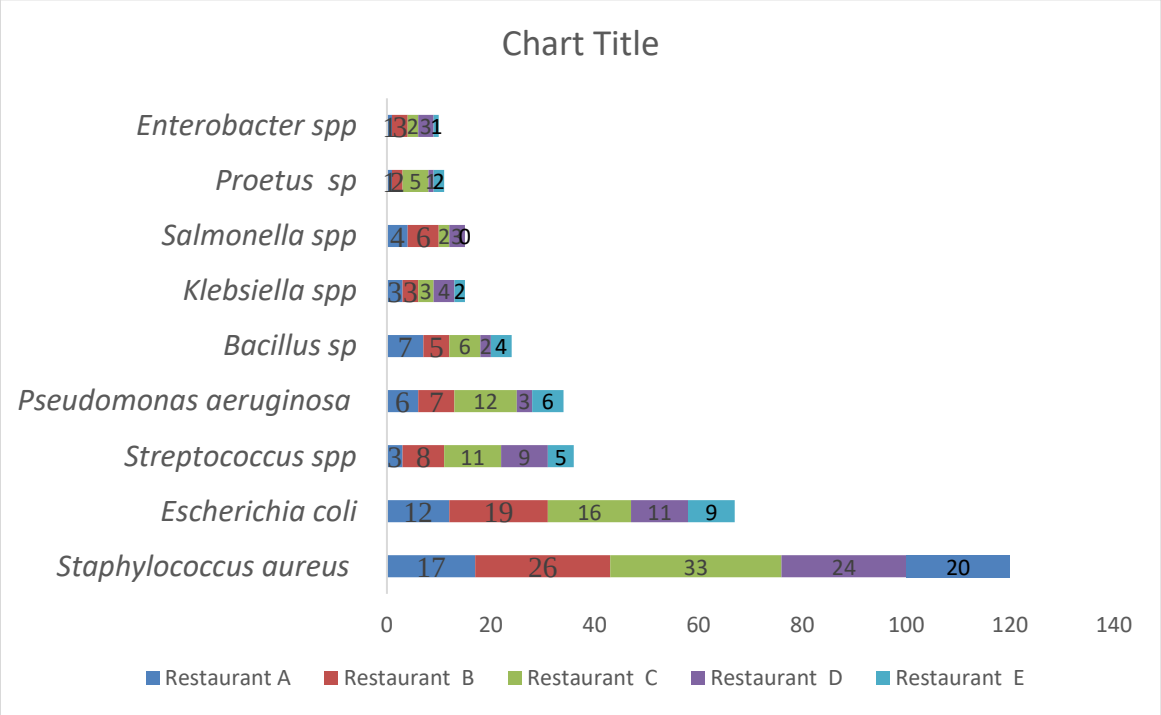

Figure 1: Bacterial isolates from the Restaurants

In this study it was observed that *Staphylococcus aureus* (38.3%) had the highest percentage prevalence of bacterial isolates from the hands of food handlers, and this was followed by *Streptococcus* sp. 20.8%), *Escherichia coli* (12.5%), *Bacillus sp* (8.3%),while *Pseudomonas aeruginosa* and *Proetus spp* recorded 5.8% each ; while *Klebsiella spp* accounted for 5.0% and .the least organism was *Enterobacter spp* 3.3%.

The prevalence of the bacterial isolates from the aprons of the food handlers indicated that *Staphylococcus aureus* had the highest percentage of 42.1% , followed by *Escherichia coli* (27.4%), *Streptococcus* sp. (11.6%),*P. aeruginosa* (8.4%%), *Bacillus sp* (6.3%),while the least was *Klebsiella sp (4.2%)*.

The Door knobs revealed *Staphylococcus aureus* as the highest isolates accounting for 34.5% of the total isolates; it was followed by *Escherichia coli* (20.7%),*Salmonella spp* (17.2%), *Bacillus sp* (12.1%), *Proetus spp* (8.6%); and *Enterobacter spp* 6.9%.

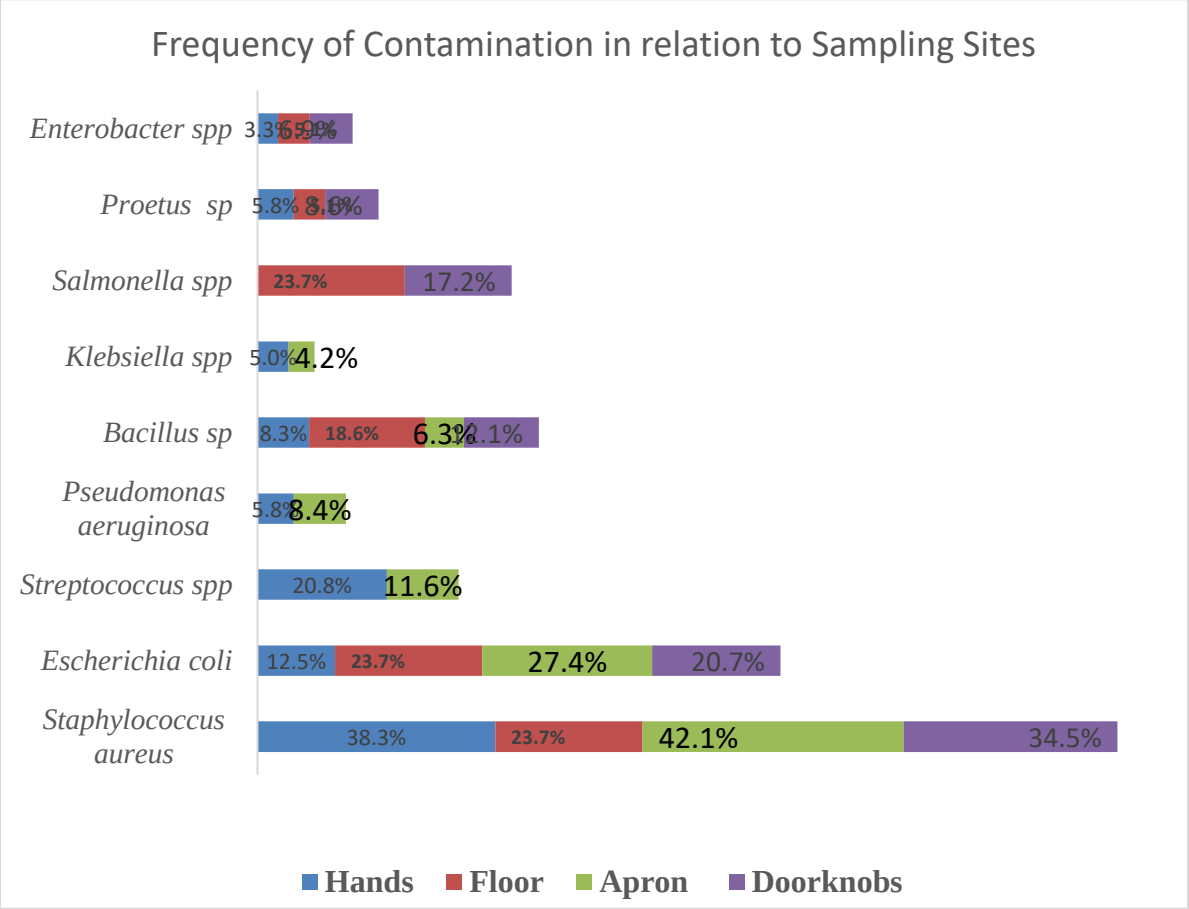

Figure 2:Bacterial contamination of the sampling sites.

3.2. Discussion

The current study was undertaken to assess the bacteriological environment of five restaurants in Abraka Metropolis.

The results indicate that all the restaurants studied were contaminated with bacteria. The highest number of isolates was recorded in Restaurant C, followed by Restaurant B, Restaurant D, Restaurant A, and Restaurant E. This suggests that Restaurant C has a higher risk of transmitting bacterial infections to consumers than the other restaurants.

The study identified the most prevalent bacterial species found in the food establishments, including *Staphylococcus aureus, Escherichia coli, Streptococcus spp, Pseudomonas aeruginosa, Bacillus sp, Salmonella spp, Klebsiella spp, Proteus sp, and Enterobacter spp.*

Hands are potential vectors for transmitting pathogenic microbes.Proper personal cleanliness, hygiene, and safe handlingpractices of food should be maintained by all food handlers to avoid microbial contamination of food (Kumie&Zeru, 2007).Bacteria isolates identified were Staphylococcus *aureus, Stretococcus*sp., *Escherichia coli, Salmonella* sp., *Enterobacter* sp., *Pseudomonas aureus, Klebsiella* sp. and *Proteus* sp. Similar results were obtained in other previous studies conducted in Ondo State (Ibrahim et al., 2013); Benin City (Okareh&Erhahon, 2015) and Kano (Dahiru et al., 2016). The isolation of potential pathogenic bacterial fromfood handlers' hands indicate that food handlers are carriers of pathogens, this finding agrees with Isara&Isah, (2009).

Environmental surfaces are understood to be a potential vector for certain pathogens.Evidence shows that bacteria on floors can be re-suspended into the air with a potential of inhalation, swallowing or contamination of surfaces and hands (Ayliffe et al., 1967; Munoz-Price et al., 2012). The results from this study are in line with the findings of Afunwa et al., (2019) who also isolated *Staphylococcus aureus, Klebsiella spp* and *Pseudomonas spp* from restaurants in Enugu. Floors are not generally considered to contribute to the risk of pathogen dissemination in a similar manner, nor the associated infection risk. Consequently, floor hygiene is considered of low importance when assessing the risk of transmission of pathogens. Research in the last decade is shaping a clearer picture of how floors act as a reservoir for pathogens and may contribute to infection risk(Argyropoulos et al., 2023).

This is also in agreement with the findings of Atlas, (1995) and Rane, (2011) who pointed out that *Staphylococcus aureus* is among those bacteria that cause disruption of normal cells activities resulting in serious ill health and are implicated as sources of street food contamination. The presence of this pathogen is due to poor sanitary conditions of catering establishment and personal hygiene of food handlers which also corroborated with(Haileselassie et al., 2013) that indicated the presences of *Staphylococcus aureus, E. coli* and Campylobacter as organisms isolated due to poor sanitary condition of catering establishments. Although, campylobacter was not isolated in the present study.It is worthy to note that even though numerous control strategies are in place, person-to-person disease transmission has not ceased (Usman, 2019).

Environmental surfaces such as door handles are commonly touched by hands, which may act as sources for bacterial transfer. In particular, the contamination of door handles of restaurants is not surprising, and it is

usually supposed that the users considered are the main source of contamination of the door handles rather than the other parts of the door.Similar results were reported by Koenig et al., (2015)who concluded that the common bacteria on door surfaces were usually coliforms. Door handles contamination investigated in this study resulted in the isolation of these bacteria namely *Staphylococcus aureus, Escherichia coli, Pseudomonas spp, Bacillus spp, Proteus sppand Klebsiella spp.*

In this study, the most frequently isolated pathogenic bacteria was Staphylococcus *aureus.*However, this agrees with the work of Hasssan et al., (2022) who reported *Staphylococcus aureus* as the most common bacterial contaminant. *Staphylococcus aureus* is a major component of the microbiota of the nostrils and skin, as it can easily be transferred by several human activities.The high prevalence of *Staphylococcus aureus* in the food handlers' hands and aprons suggests that the food handlers may be the source of contamination. *Staphylococcus aureus* is an important pathogen that cause boils, abscesses, wound infections toxic shock syndrome and pimples. Also, the result of this study is also in agreement to that of (Bloomfield et al., 2010)*Staphylococcus aureus* also poses a threat to human health because it can lead to food poisoning or food intoxication when the food is not properly preserved or refrigerated which is more severe and persist when the organism is destroyed (Hammuel et al., 2015; Sinclair & Gerba, 2011).

The prevalence of *Escherichia coli* in the hands of food handlers and aprons is also a cause for concern as this bacterium is a common cause of foodborne illnesses. The presence of *Salmonella spp* on the doorknobs is also alarming as this bacterium is a common cause of food poisoning and can be transmitted through contaminated surfaces. Although *Escherichia coli* is a normal flora of the gut, its presence suggests faecal contamination of the floor *Escherichia coli* can be a source of opportunistic infection and is associated with intestinal diseases in humans with symptoms ranging from stomach cramps, fever and diarrhoea depending on the serotypes(Afunwa et al., 2019; Bryan et al., 2012; Harmoosh et al., 2018; Harmoosh & Zottala, 2017; Oluyege et al., 2009).

Pseudomonas spp on the other hand has the tendency to cause folliculitis, puncture wounds leading to osteomyelitis and pneumonia (Kerr & Snelling, 2009; Mulcahy et al., 2014)

However, the other bacteria isolated in this study even though with low prevalence, they are of vital health concerns. *Proteus spp* have been reported to be associated with urinary tract infections and asymptomatic bacteriuria (Matthews & Lancaster, 2011; Papazafiropoulou et al., 2010) and *Klebsiella spp* have reported to be associated with invasive infections (Meatherall et al., 2009; Wang et al., 1990).

Jemikalajah, (2018) in his study, opined that food handlers who are carriers should be detected and treated accordingly to reduce bacterial load. Thus, the presence of *Escherichia coli*, *Staphylococcus aureus, Streptococcus* sp., *P. aeruginosa* and *Salmonella sp*demonstrates a potential health risk since these organisms have been indicated in food borne diseases which may be as a result of faecal contamination from the dirty hands of the food handlers (Okojie & Isah, 2014).

Lack of running water, sewage disposal infrastructure, inappropriate storage conditions, use of unclean aprons, hanker chief, towels and the use bare hands in

handling money and other chores further compound the issue of hands contamination with pathogenic bacteria (Nnebue et al., 2014; Getie et al., 2019).

The presence of these isolates as observed in this study suggests poor personal hygiene and general neglect of regular dry cleaning of aprons, which can pose a health hazard to consumers. Poor hygienic practice may be compounded by the fact that most food handlers were individuals from the lower socio-economic class with low level of education.Jemikalajah (2018) opined that proper sanitary practices during food processing can reduce microbial contamination to safe levels and aprons of food handlers cannot be left out. Enlightenment on wearing clean aprons for food safety and cafeteria hygiene should be put in place with periodic supervisions to ensure adherence to the guidelines.

Total of six (6) bacteria species *Escherichia coli, Staphylococcus aureus, Streptococcus sp., Salmonella sp., Enterobacter sp., Pseudomonas* were isolated from Apron.This is similar to the work of Haun et al., (2016) who stated that clothes and aprons, are likely to be potential vehicle for the transmission of coliform and airborne pathogens especially when proper sanitation and personal hygiene is down played by personnel. In addition, Al Mamun et al., (2013) observed that food handlers can be carriers of pathogens like *Escherichia coli, Salmonella typhi, Shigella* sp., *Campylobacter* sp. and *Staphylococcus aureus* who eventually transfer these food-borne hazards to consumers. Elobeidet al.(2014) suggested that aprons, when not handled with good hygiene and used habitually for hand cleaning, can serve as temporary reservoirs for various fungi and bacteria. The findings of this study show that aprons of food handlers had potential pathogenic bacteria. Hence, food handlers should adhere to proper hygiene from their wears to overall safety measures.

4. CONCLUSION

The findings of this study indicates risk to safety of food served in these restaurants in Abraka. The results clearly show that training on food safety should be imparted to food handlers of small and medium restaurants. it also calls for improved personal and environmental hygiene and provision of hand washing facilities in restaurants.Enlightenment on food safety and restaurant hygiene and periodic supervision of restaurants by Local and State Government Health Authorities is hereby advocated to ensure adherence to the guidelines.

Furthermore, the results of this study highlight the importance of proper hygiene practices and food safety protocols in preventing bacterial contamination and foodborne illnesses in restaurants. Regular monitoring and surveillance, proper training and education, and the use of technology can all play important roles in ensuring food safety and protecting public health.

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