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*Full Length Research Paper*

# Microbial air quality of canteens operating in Captain Elechi Amadi Polytechnic, Rumuola, Nigeria

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The present study was aimed at evaluating the total heterotrophic bacterial and fungal counts in the canteens operating within the Captain Elechi Amadi Polytechnic, Rumuola. This was determined through air sampling using the open plate (sedimentation) technique, the air samples were collected in two sessions. The mean total heterotrophic bacterial count ranged from 7.1 x $10^5$cfum$^3$ to 1.8 x $10^6$ cfu/m$^3$ while the mean total fungal count ranged from 5.3 x $10^5$ cfu/m$^3$ to 5.29 x $10^6$ cfu/m$^3$. The results reveal that a total bacterial count was greater than the total fungal count. The counts obtained are higher than the recommended values of 5000 cfu/m$^3$. Therefore, there is a need to conduct orientation and training for operators of these canteens within the Polytechnic. This will reduce the likely risk of possible infection of staff and students who patronize these canteens, which could result in absence from school and low productivity.

**Keywords:** Microbial air quality, canteen, bacteria, fungi, polytechnic

## INTRODUCTION

There has been a rise in the frequency of consuming meals at dining facilities outside the home. This has been observed in most developed countries over the past few decades, mainly due to the increased mobility of people and increased in employment for woman and single-family (Peri, 2016). There has been an evolution in requirements for out of home meals and attention to consumers is focused on the quality of food rather than quantity. The quality of food is expressed as the overall characteristics of a product or service that has ability to satisfy stated or implied needs and expectation of the customer (Peri, 2016). Microbiological safety which is a basic requisite to ensure the integrity of the product and healthiness is one of the main factors that contribute to obtain a good quality food product (Clementi *et al.*, 2009). Over the past decades, meal supplied in food businesses have been involved in foodborne disease outbreaks which still remain a major cause of morbidity and mortality (Maruzumi *et al.*, 2005; Black *et al.*, 2006). Direct or primary source, consisting in naturally polluted raw material (e.g. meat from infected animals) and secondary source, defined as cross-examination, consisting in transport/transfer of microorganisms from human or animal faeces, mucous membranes, hair infected wounds, dirt and dust, working environment and tools, air undoubtedly plays a key role are the two possible sources of food contaminations. Although airborne microorganisms are natural contaminants of indoor environment, an increase in their load could represent a risk factor, especially for the potential contamination of food with undesirable spoiling and pathogenic bacteria (Di Giulio *et al.*, 2010).

Biological contamination of indoor air is mostly caused by bacteria, moulds and yeasts. They can be dangerous as pathogenic living cells but they can also secrete some substances harmful for health (D' Orazio *et al*., 2009). In recent years, dramatic increase in the number of allergic reactions to fungal spores has been reported, and young people do constitute a large group of allergy sufferer, whose symptoms persist throughout the year (Jain, 2002). Mohan *et al*. (2014) in their studies reported bacteria in the air within the canteens as 6.41 x $10^3$ to 7.36 x $10^3$ cfu/$m^3$ and 3.3 x $10^3$ cfu/$m^3$ to 6.6 x $10^3$ cfu/$m^3$; fungi in the air within the canteens is reported as 1.22 x $10^3$ to 1.31 x $10^3$ cfu/$m^3$ and 1.8 x$10^3$ to 2.2 x $10^3$ $10^3$ cfu/$m^3$. The problem of being jeopardized of safety and quality of our food products and the other being the rising competition for a clean eating environment are two fundamental problems that cover the past decade increasingly have become concerns of the general public. Therefore, this study is aimed at investigating the microbial status of the indoor air quality of canteens operating within Captain Elechi Amadi Polytechnics.

## MATERIALS AND METHODS

The study was carried out in Captain Elechi Amadi Polytechnic, Rumuola, Obio-Akpor Local Government Area, which lies on 4.833°N and 6.9951°E. The sampling was carried in eleven (11) canteens operating within the Polytechnics. The petri dishes containing media (Nutrient Agar and Sabouraud Dextrose Agar) were exposed to air for thirty minutes (1-1:30pm) at each canteen and the procedure was replicated thrice. With the completion of media exposure to indoor air of the canteens, the petri dishes were kept in tight sealed case and taken to the laboratory for incubation at ambient temperature for 24-48 h for bacteria and 5-7 days for fungi. The average of colony forming unit (cfu) for both bacteria and fungi was calculated and converted to colony forming unit per cubic meter of air (Stryjakowska-Sekuiska *et al*., 2007). The formula is as follows:

Colony forming unit cfu/$m^3$ = a.0000/p.t.0.2

Where
a =the number of colonies on the petri dishes
p =the surface of the petri dishes
t =the time of the petri dish exposure.

## RESULTS

The mean total heterotrophic bacterial and fungal counts are shown in (Table 1). The number of bacteria in indoor air of the canteens varied widely during the study period. The mean total heterotrophic bacteria counts range from 7.1 x $10^5$cfu/$m^3$ (Station 8) to 1.8 x $10^6$ cfu/$m^3$ (Station 1) for the sampling period. The bacterial concentration from the canteens in the Polytechnic in the ascending order was 6.25 x $10^5$ (Station 3) 7.1 x $10^5$ (Station 5) > 7.4 x $10^5$ (Station 9) > 7.7 x $10^5$ (Station 6) > 8. 05 x $10^5$ (Station 10) > 8.65 x $10^5$ (Station 4) > 8.7 x $10^5$ (Station 5) > 1.13 x $10^6$ (Station 11) > 1.21 x $10^6$ (Station 2) > 1.4 x $10^6$ (Station 7) > 1.8 x $10^6$ (Station 1). The fungal counts in the indoor air of the canteens also show variations. The mean total heterotrophic fungal counts range from 5.3 x $10^5$ cfu/$m^3$ (Station 5) to 5.29 x $10^6$ cfu/$m^3$ (Station 4) for the sampling period. The ascending order of fungal concentration obtained from the canteens sampled was 5.3 x $10^5$ (Station 5) > 5.7 x $10^5$ (Station 10) > 5.8 x $10^5$ (Station 9) > 7.05 x $10^5$ (Station 3) > 7.2 x $10^5$ (Station 8) > 9.2 x $10^5$ (Station 11) > 1.1 x $10^6$ (Stations 1 and 6) > 1.13 x $10^6$ (Station 7) > 4.5 x $10^6$ (Station 2) > 5.29 x $10^6$ (Station 4).

**Table 1.** Mean bacterial and fungal concentration of canteens in Captain Elechi Amadi Polytechnic.

| Stations (Canteens) | Mean Counts (cfu/$m^3$) | |
|---|---|---|
| | Bacteria | Fungi |
| 1 | 1.8 x $10^6$ | 1.1 x $10^6$ |
| 2 | 1.21 x $10^6$ | 4.5 x $10^6$ |
| 3 | 6.25 x $10^5$ | 7.05 x $10^5$ |
| 4 | 8.65 x $10^5$ | 5.29 x $10^6$ |
| 5 | 8.7 x $10^5$ | 5.3 x $10^5$ |
| 6 | 7.7 x $10^5$ | 1.1 x $10^6$ |
| 7 | 1.4 x $10^6$ | 1.13 x $10^6$ |
| 8 | 7.1 x $10^5$ | 7.2 x $10^5$ |
| 9 | 7.4 x $10^5$ | 5.8 x $10^5$ |
| 10 | 8.05 x $10^5$ | 5.7 x $10^5$ |
| 11 | 1.13 x $10^6$ | 9.2 x $10^5$ |

## DISCUSSION

Food is one of human's primary needs besides clothing and housing. Food holds an important role in human's live, thus a high level of food safety is needed to ensure that human is safe from diseases or dangers that comes from food (Adolf and Azis, 2012). The present study revealed the microbiological status of canteens operating within the Captain Elechi Amadi Polytechinc, Rumuola. The mean total heterotrophic bacteria counts range from 7.1 x $10^5$cfu/$m^3$ (Station 8) to 1.8 x $10^6$ cfu/$m^3$ (Station 1) while the mean total heterotrophic fungal counts range from 5.3 x $10^5$ cfu/$m^3$ (Station 5) to 5.29 x $10^6$ cfu/$m^3$ (Station 4) for the sampling period. The concentrations of bacteria at all the canteens exceeded the recommended limit ($10^3$ cfu/$m^3$) suggested by National Institute of Occupational Safety and Health (NIOSH) and the American Conference of Governmental Industrial Hygienists (ACGIH) has suggested 500 cfu/$m^3$ for culturable bacteria reported by Makut *et al*. (2014).

The study also revealed that the concentrations of fungi in all the canteens exceeded the recommended proposal of $10^3$ cfu/$m^3$ as the threshold limits for fungal concentrations in the air (Gorny and Dutkiewicz, 2002). Extremely high values of microbial concentrations in the canteen can be explained by the fact that these places are most of the time overcrowded with customers. This is a main source of microbiological contamination there. Comparatively, the counts are higher than the 1.5 x$10^3$ cfu/$m^3$ and 2.6 x $10^2$ cfu/$m^3$ for bacteria and fungi respectively reported by Stryjakowska-Sekuiska *et al*. (2007). Mohan *et al*. (2014) also reported a range of 1.6 x $10^3$ cfu/$m^3$ to 4.8 x $10^3$ cfu/$m^3$ and 4.51 x $10^3$ cfu/$m^3$ to 6.18 x $10^3$ cfu/$m^3$ for bacteria and fungi respectively. The human body as well as clothing is a natural place for growing microorganisms. Strong relationship between occupants' density, human activity and microorganism concentration in the indoor air was reported elsewhere (Fleischer *et al*., 2006).

According to earlier studies the microbiological quality of indoor are by two factors: microbiological composition of outdoor air and indoor air microbial sources (Karwowska, 2003). Outdoor air is very much influence by environment, season, the weather and even daytime. Microbial air quality in the various canteen changes in the course of the study due to atmospheric changes and individual activities within the canteens. Some of the canteens were observed to lack good ventilation even as the surrounding appears untidy. Obviously, the presence of a good ventilation system inside buildings eliminates to some extent the influence of indoor sources (Stryjakowska-Sekulska *et al*., 2007). The increased level bacterial and fungal count in the canteens could contribute to serious health challenges by the staff, students and other members of the Polytechnic Community patronizing them. High level of microbial contamination could come from improper sanitation practices at the canteen during the processing period. As reported by Adolf and Azis, (2012), lack of good sanitation practices and proper storage will increase microbial contamination, especially when the operators are not well-educated about the education and socialization of safety practices for sellers of food around the campuses and school canteens. The study reveals that the canteens are highly contaminated and this can affect academic and administrative activities as students and staff may become ill leading to absence.

## Conclusion

The importance of assessing the air quality of the air human breathe indoor, especially in canteens operating within tertiary institutions which is highly patronized by Staff, students and other persons cannot be over-emphasized. This is because the microbial counts recorded in this study exceeds the recommended limit. The number of airborne microorganisms can also be used to determine the degree of cleanliness with a view to ascertain the source of human discomfort and the infections that could arise.

## Recommendations

The study therefore strongly recommend better buildings with proper ventilation; regular monitoring of the canteens by the Polytechnic Authority as well as proper enlightenment and education of the food handlers and in addition to good hygienic practices such as regular sweeping and mopping of the floor and cleaning of the ceilings.

## Authors' declaration

We declared that this study is an original research by our research team and we agree to publish it in the journal.

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