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Fair Strategies to Tackle Unfair Risks? Bacteriological Assessment of Food and Water Prepared in Standard Hotels in Abuja Metropolis, Fct, Nigeria

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Research Article

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Abstract

In Nigeria, with a populace of more than 170 million individuals it was accounted for that just 90,000 cases of food borne ailments happen every year. There was also a report of 60 cases and 3 deaths due to food borne disease with symptomatic gastro intestinal disorders among people who ate in a funeral service. In Nigeria, food safety is not given high preference. Since the hospitality industries manages giving food, drink or convenience to individuals who are away from home, food contamination may emerge at whatever point there is unhygienic food preparation. The study seeks to assess the bacteriological assessment of food and water prepared in standard hotels in Abuja. The study made use of a descriptive cross-sectional study with stratified purposive sampling technique, hotels with 3, 4 and 5 star ratings in Abuja were selected for this study, 45 foods and water samples were aseptically collected for this study. The instrument for data collection was sterile container for sample collection. Data were analysed using, SPSS version 23.0 to present inferential statistics (ANOVA) and descriptive statistics (charts and tables). Staphylococcus aureus (69.75%), *Pseudomonas aeruginosa* (20%), *E. coli* (33.75%) and *Bacillus* spp (18.2%) were isolated in the food samples while *E. coli* (48%), *S. aureus* (77.5%), *P. aeroginosa* (27%), *P. vulgaris* (12%) *Shigella dysentriae* (6%) were isolated in water samples. The percentage occurrence of bacteria isolated in the samples were in compliance with the WHO limit for microorganisms in food and water (10^5) cfu/m. This could be as a result of the poor food handling practices carried out in the hotels. However, According to WHO, there should be zero tolerance of E. coli and *Samonella typhii*, in food and water because at low levels they can still pose risk to health. The results from this study will enable health inspectors and food handlers in hotels to implement stringent food safety methods like HACCP in hotels of their standard to bring about satisfaction and safety of food in their hotels.

Keywords: Water; Food contamination; Hotels; Foodborne pathogens; Bacteria; Foodborne infections; Abuja

Introduction

In Africa, more than 91 million individuals were influenced and that food borne illness are caused by 31 hazards overall as indicated by a report by the World Health Organization [1]. In developing nations, most foodborne infection outbreaks are underreported or thought little of particularly in Nigeria where data are not really accessible in view of insufficient survey systems. As numerous researchers have reported on adverse effects on human health due to exposure to some of these waterborne and foodborne infection outbreaks [2-21]. Considering the Nigeria populace of more than 170 million individuals it was accounted for those just 90,000 cases of food borne

ailments happen every year [4,9,21]. There was also a report of 60 cases and 3 deaths due to food borne disease with symptomatic gastro intestinal disorders among people who ate in a funeral service [4,22]. The deaths were linked to food contamination during processing, preservation and service [9,22]. The improper use of agro chemicals and pesticides to control pests on agricultural products and grains were said to be responsible for the rising cases of food poisoning in Nigeria [23-31]. While hotels have become a fragment of the hospitality industry which structure some part of a bigger establishment regarded to as the travel and the tourism industry [32-34]. Hotels are imperative to the public; this is on the grounds that they make accommodation available for business people and travellers [32-36]. In Nigeria, as in other nations being developed, Food safety is not given high preference. Since the hospitality industries manages giving food, drink or convenience to individuals who are away from home, food contamination may emerge at whatever point there is unhygienic food preparation [9,37]. Thus, there is a need to determine the bacteria level food and water samples prepared in the hotels, to assess the bacteriological quality of cooked food and water samples collected from selected standard hotels in FCT, Abuja and to compare them with the World Health Organization, (WHO) guidelines so as to assess potential health hazard.

Research Hypothesis

- **Null hypothesis:** The total concentration of bacteria in the samples remains the same across the samples.
- **Alternative hypothesis**: The total concentration of bacteria in the food and water samples is not the same across the samples.

Methodology

Study Design

The study adopted a cross-sectional survey research design and was conducted in FCT, Abuja. All the hotels classified by the Nigeria Tourism Development Corporation [38] as three, four or five star-rated were targeted. A purposive and stratified sampling technique was used to select the study units who constituted the respondents for the study. The design allows the use of both descriptive and inferential statistics, permits many aspects of a problem to be addressed, capture the population characteristics and test hypotheses as well as control manipulation of the variables are made possible.

Study Area

Nigeria's Federal Capital Territory is Abuja. The city is located in the country's center. Abuja is a well-organized and planned city that was mostly created in the 1980s. Aso Rock, a 400-metre (1,300-foot) boulder left by water erosion, defines Abuja geography. The Presidential Complex, National Assembly, Supreme Court, and majority of the city are located to the south of Zuma Rock, a 792-metre (2,598-foot) monolith located immediately north of the city on the Kaduna Expressway. Abuja has a total landmass of roughly 7,315 km^2 and is located between latitude 90 4" north of the equator and longitude 70 29" east of the Greenwich Meridian (see Figure 1 below). It is located in a savannah zone with mild weather conditions. Municipality of Abuja council covers 1,769km^2 (683 sq mi) Area, of which 1,728km^2 (667 sq mi) is land and 41km^2 (16 sq mi) is water [3,15].

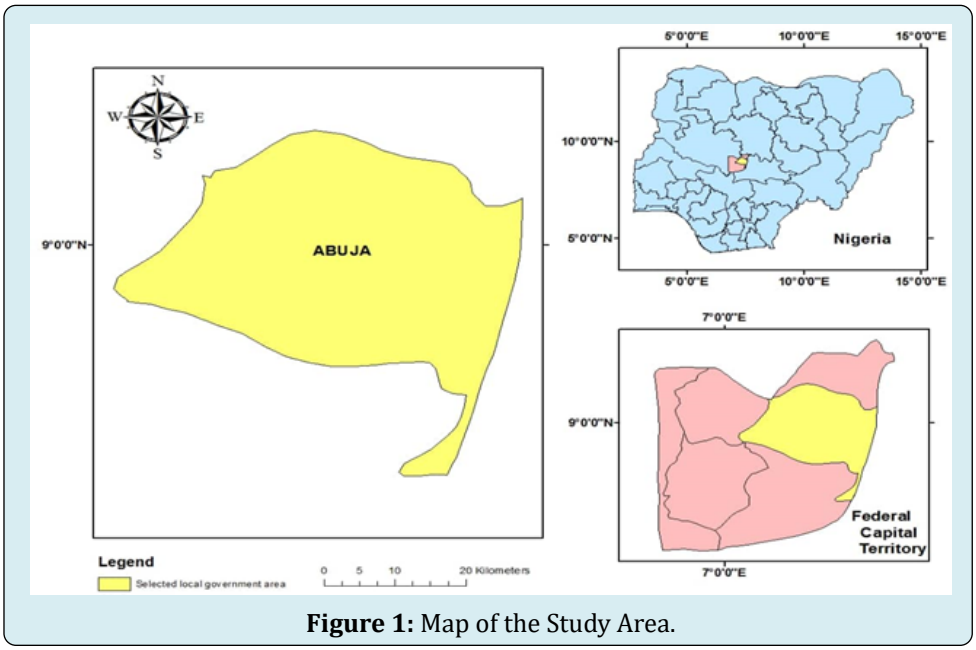


Figure 1: Map of the Study Area.

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Sampling Technique

A purposive and stratified sampling technique was used to select the study units who constituted the respondents for the study. In the stratified random sampling, hotels were divided into strata; the hotels are then selected by applying random selection technique.

Inclusion Criteria

Food and water samples in the hotel's establishments were included in the study. This survey zeroed in on 3 stars to 5 star hotels, that is, hotels with at least 30 rooms, private or public. This classification represents over 70% of the complete hotel stock as per Standard for National Classification and Grading of Hotels and other Serviced Accommodation in Nigeria, created by Nigerian Tourism Development Corporation (NTDC) [38] as a team with Standard Organization of Nigeria (SON). The explanation had been that these classifications of hotels cut across all hotels' inns however reject other overhauled facilities which are ordered with 1 Star inns or lower classification of hotels.

Exclusion Criteria

Food and water samples in other food establishment such as restaurants and street food vendors were excluded from this study.

Method of Data Collection

A total of 45 food and water samples totaling 90 samples were collected aseptically in a sterile container and transported to the laboratory for bacteriological analysis using a cooling pack.

Isolation and Enumeration of Microorganisms from Food Samples

Nutrient Agar (NA), MacConkey Agar (MA), Salmonella-Shigella Agar (SSA) were used for isolation and were each prepared according to the manufacturer's instruction MacConkey agar was used for coliform enumeration while Salmonella-Shigella agar was used for the isolation of Salmonella and Shigella. Total viable bacteria count was performed on Nutrient Agar.

Isolation and Enumeration of Microorganism from Water Samples

Two techniques (plate count and MPN) were used simultaneously to estimate the coliform load in each food and/or water sample. Discrete colonies were randomly selected from each plate (from both temperatures of incubation) and were characterized using standard bacteriological techniques to ascertain that they were coliforms and confirm the specific identity of the isolates. Characterization of isolate was carried pout using gram staining, Triple sugar iron agar, Motility Indole Lysine (MIL), Catalase test, oxidase test, Nitrate reduction, urease activity and gelatin hydrolysis.

Statistical Analysis

In this study, quantitative data collection was used followed by qualitative data collection, analysis of findings and following interpretation of the results. The required data were collected, analyzed and the results appropriately interpreted. The data was cross checked before entry into a computer package called Statistical Package for the Social Sciences (SPSS) version 23. The data was analyzed using techniques such as percentages, figures, tables,] as tools of descriptive data analysis which determines the group characteristics with analysis of variance (ANOVA).

Results (Figures 2-7 & Tables 2)

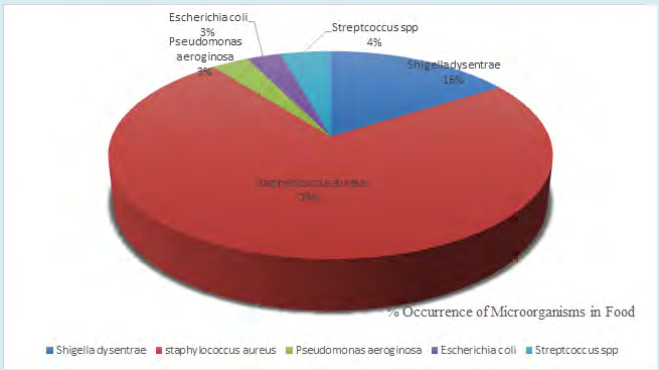


Figure 2: Percentage occurrence of Bacteria in Food Samples.

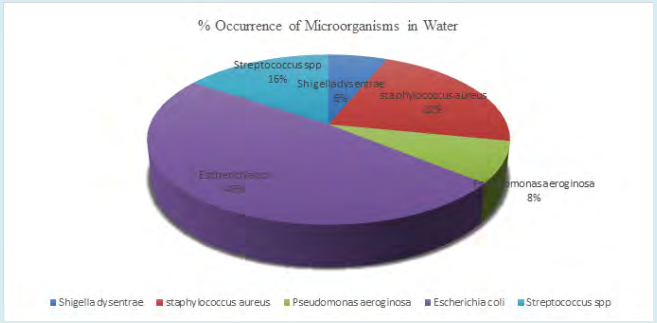


Figure 3: Percentage occurrence of Bacteria in Water samples.

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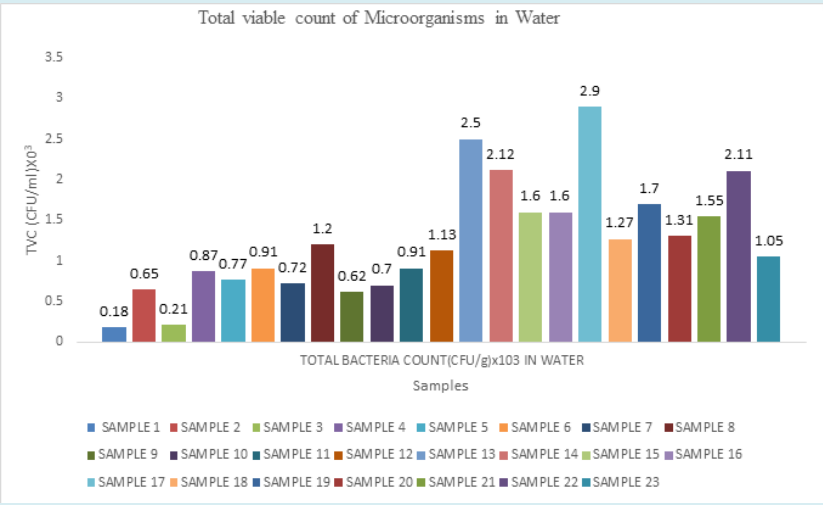


Figure 4: TVC of Bacteria in Water Samples.

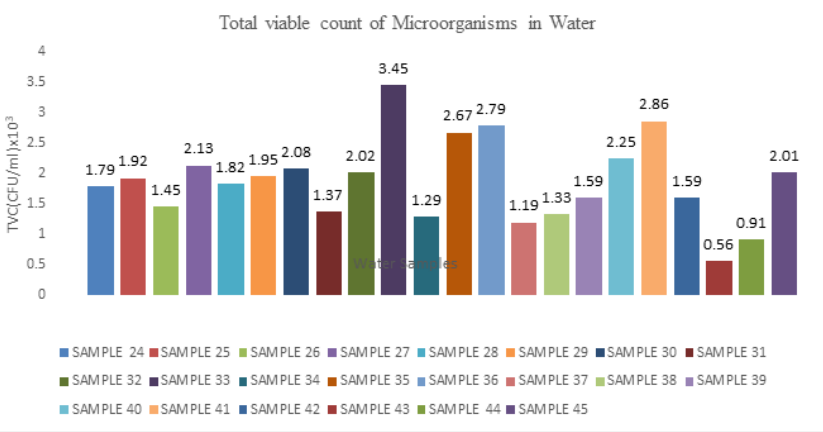


Figure 5: TVC of Bacteria in Water samples.

TVC in Abuja ranges from 0.18-3.45 CFU/ML in samples. Samples 13, 17, 33, 35,36 and 41 with TVC $2.5x10^3$,$2.9x10^3$, $3.45x10^3$, $2.67x10^3$,$2.72x10^3$, $2.83x103$ CFU/ml are highest respectively.

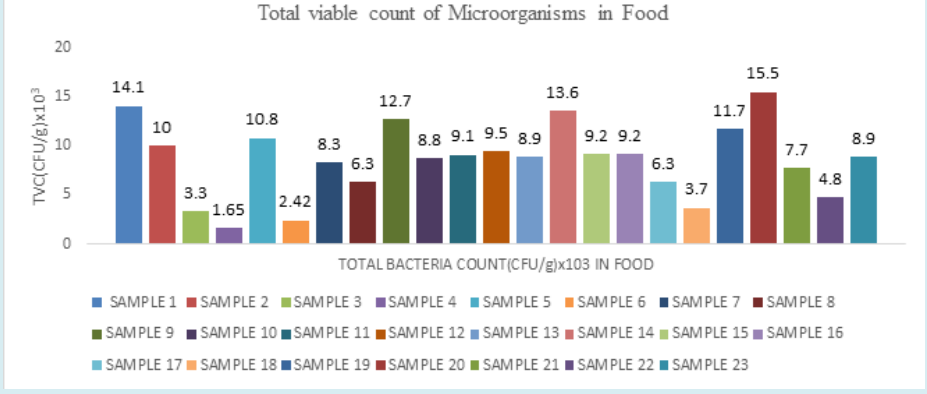


Figure 6: TVC of Bacteria in Food Samples.

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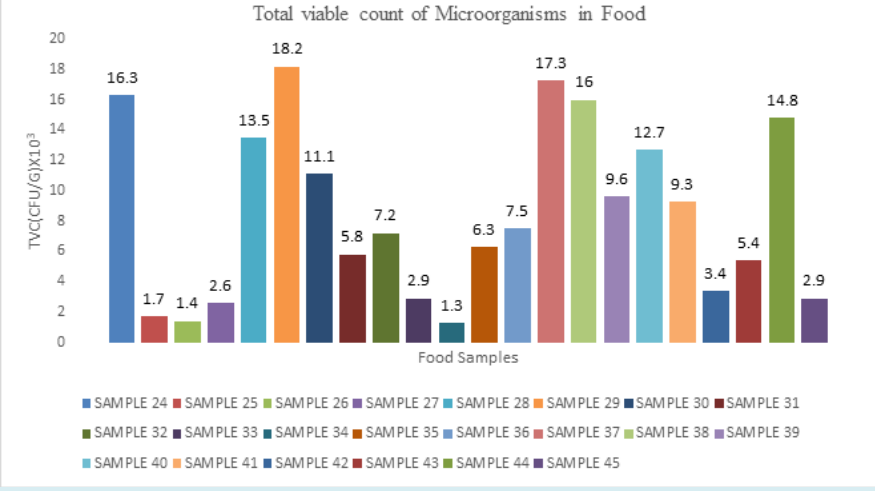


Figure 7: TVC of Bacteria in Food Samples

TVC for food in Abuja ranges from 1.30-18.2x10^3, CFU from samples 1-45. With the highest TVC (18.2x10^3, 17.3x10^3, 16.3x10^3, 16.0x10^3, 15.5x10^3, 14.8x10^3, 14.1x10^3, 13.6x10^3, 13.5x10^3, 12.7x10^3, 11.7x10^3 CFU/g) respectively.

Tests of Between-Subjects Effects			
Dependent Variable: TVC			
Source	**Type III Sum of Squares**	**Df**	**Sig.**
Corrected Model	52.125[a]	2	0.022
Intercept	196.349	1	0
Sample	51.568	1	0.728
MGS	0.557	1	0.006
Error	262.322	42	
Total	1232.188	45	
Corrected Total	314.447	44	
a. R Squared = .166 (Adjusted R Squared = .126)			

Table 1: ANOVA table with concentration of Bacteria in the food samples in the hotels.

Dependent Variable: TVC				
Source	**Type III Sum of Squares**	**Df**	**Mean Square**	**Sig.**
Corrected Model	151.887[a]	2	75.944	0.06
Intercept	79.485	1	79.485	0.083
Sample	71.326	1	71.326	0.1
MGS	80.561	1	80.561	0.081
Error	1062.003	42	25.286	
Total	5121.393	45		
Corrected Total	1213.89	44		
a. R Squared = .125 (Adjusted R Squared = .083)				
b. Computed using alpha = .05				

Table 2: ANOVA table with Concentration of Bacteria in the Water Samples in the Hotels.

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Discussion

Food Analysis

Figure 2 above, shows the occurrence of bacteria in the food prepared in the sampled hotels in Abuja. In this study, *Pseudomonas aeroginosa* was detected with (3%), occurrence. In this study the presence *Pseudomonas aeruginosa* were relatively low which agrees with the work of Donkor, [39] where the presence of *Pseudomonas aeruginosa* which shows 18.2% from Jollof rice from one of the food assessed in the hotels. Pseudomonas can be found almost everywhere; in soil, water, plants and animals and it is the most famous opportunistic human pathogen most commonly affecting immunocompromised patients [40]. Most members are psychrotrophic, can be fluorescent or non-fluorescent, and have long been known to be responsible for chilled food spoilage. Psychrotrophic Pseudomonas species, pose significant food spoilage problems in refrigerated meat, fish, shell fish and dairy products. Probably, the food sample collected in this study was refrigerated and reheated inadequately hence the contamination. Pseudomonas as well can lead to problems in water systems and this could also be the source of the contamination in the food industry. The percentage of *E. coli* in the samples was also found to be (3%) which is comparable with the work of Donkor, [39] with a lower percentage of 5.9 % which was present in jollof rice in one of the hotel assessed. Also, it is in accordance with a study done by Wogu *et al.,* [41] who discovered the presence of *E. coli* in ready-to-eat jollof rice from high class restaurants. *E. coli* lives in the intestines of humans and animals and most types are harmless but some types can cause sickness, for example, *E. coli* 0157: H7 which causes bloody diarrhoea and can sometimes cause kidney failure and even death [4,15]. According to WHO, there should zero tolerance for Detection of *E. coli* in food samples because in little amount it can still cause deleterious effects to human life. Results from this study could be as a result of improper handling during preparation and poor hand washing by the food preparers and some bad habits by food handlers. An infected worker could also be a potential source of contamination. The presence of *S. aureus in the* food samples was high (74%), which is comparable to a study carried out by Gosh, et al. [42] in India who observed a high prevalence (60%) in coriander sauce and ready-to-eat salads (86%) but in contrast with the work done by Nyenje, et al. [43] were he discovered a prevalence of 3.2% *S. aureus* from rice and chicken stew samples in roadside cafeterias in South Africa. *S. aureus* is found on the skin and in the nose and throat of most healthy people. Indeed, small cuts or burns on the hands in food preparation settings can become infected and contain millions of *S aureus* cells which can cause heavy contamination of foods handled by the cooks. It is also possible that injuries and/or infections on the hands of cooks could reduce the inclination of workers to wash and dry their hands properly and frequently and may hence contaminate foods they are in touch with. When *S. aureus* is allowed to grow in foods, it can produce toxins that cause illnesses. Similarly, *Shigella dysentriae* was found in the food samples at (16%) occurrence. This study disagrees with the study conducted in India by Joy, et al. [44], 66.6% of the ready-to-eat salads were contaminated with *Shigella species*, which is higher than the current study The occurrence of *Strep. spp* in the samples was (4.4%). This study TVC has shown acceptable microbiological quality. Results from the Analysis of Variance, in this study (0.728) shows that the null hypothesis was accepted and the alternative hypothesis was rejected. The results interprets that the total viable count of the microorganisms in the samples are the same across the samples with p-vale (0.05), thus the microorganisms where within the acceptable limit. This does not ascertain that the food is safe as accumulation of these microorganisms in the body could lead to harmful health.

Water Analysis

From Figure 3 above, the percentage occurrence *of E. coli* in water samples in the hotels was 24%. The detection of *E. coli* was high, this study which is in agreement with the study carried out by Nwandkor, et al. [45] on bacteriological assessment of different borehole drinking water sources in Umuahia metropolis with Most of the borehole (BH) water assessed a high rate of pollution by giving up to 29 (58%) typical or faecal coliform (*E.coli*). In this study, it was discovered that the samples does not conform to the international standard for safety and potability. It is virtually impossible to obtain drinking water of 100% purity in any naturally occurring sources of water, according to Chave, [46], but a private water supply harboring 34% *E.coli* in the borehole water is an indication of poor hygiene and sanitation, and a general collapse in the provision of safe drinking water. The *E.coli* may not actually constitute a public health hazard in a population of healthy individuals, but their presence is a pointer to the presence of or an indication that pathogenic bacteria, viruses, parasites, protozoa, including other aquatic micro lives that may cause diarrhea. According to WHO, there should be zero tolerance of *E. coli* in water samples as the little amount in water can be deleterious to health. *S. aureus* was present in the samples at (22%). The occurrence of *Staphylococcus aureus* in this study is was low in the water samples which is consistent with the work carried out by Aina, et al. [47] with low occurrence of 5.56% of *S. aureus* (5.56%) in bacteriological analysis of borehole water from different towns in Ogun State, Nigeria. The prevalence of *Staphylococcus aureus* in this study could be as a result of *Staphylococcus aureus* contaminating the well or borehole or has colonised the storage tank or pipe lines, the faucet screen surfaces could have provided nutritional conditions to enhance regrowth for staphylococci deposition

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as contaminated water flowed through the pipes. *S. dysentriae* was found in the samples at (6%), *Strep. spp* was detected in the samples at (16%). In Figures 6 & 7 above, the TVC were within the WHO permissible limit of bacteria in food of 10^5 which is in accordance with the work done by Okareh and Erhahon [48] in Ikpoba-Oha LGA, 5.48 x 104 was found to be the highest while Egor LGA was the lowest, 1.19 x 10^4 in microbiological assessment of food and hand-swabs samples of school food vendors in Benin city, Nigeria. This study is in contrast with a study carried out by Oranusi, et al. [49] with a high bacterial population in some RTE foods including fried and jollof rice, coleslaw and moimoi which were in the range of 2.0 x 104 to 1.2 x 106 cfu/g for bacteria. Olaoye and Onilude [50] stated that relatively high temperature in tropical countries like Nigeria promotes rapid growth of pathogenic bacteria. Results from Figures 4 & 5 above in this study is in contrast to the study by Tadesse, et al. [51] with mean coliform counts ($1.9X10^7$ cfu/ml) of water, this study were also lower than the reports of Arthur and Danso [52] from Ghana ($1.26x10^6$ cfu/ml.) and Lues and Tonder [53] from Ethiopia ($3x10^5$ cfu/ml). this result is also lower to a study in Ghana, the overall mean total aerobic plate counts (6.3x1 CFU/ml) of water obtained in this study was relatively lower than that of (1.04×108cfu/ml) [52]. In the present study, the bacteria counts of samples exceeded the WHO recommended drinking water quality. The presence of *E coli.* Which is a coliform shows there is a recent faecal contamination. This is not within the acceptable limit as WHO [54] recommends zero presence of *E. coli* in water. Which is in contrast with the study by Imran, et al. [55] with a higher TVC, Bacterial counts in Dogon dawa had 26.20 X 10^2cfu/100ml. This study TVC of bacteria in water has shown acceptable microbiological quality. Results from the Analysis of Variance, in this study (0.100) shows that the null hypothesis was accepted and the alternative hypothesis was rejected. The results interprets that the total viable count of the microorganisms in the samples are the same across the samples with p-vale (0.05), thus the microorganisms where within the acceptable limit. This does not ascertain that the food is safe as the presence of *E. coli* in water has rendered the water polluted. According to WHO [54], there should be zero tolerance of *E.coli* in drinking water as it signifies recent faecal pollution.

Conclusion

Microbial growth such as; *Staphylococcus aureus* (77.5%), *Proteus vulgaris* (16%), *E. coli* (48%), *Streptococcus spp* (14.4%) were isolated in food and water samples from the hotels and this in compliance with the WHO limit for Microorganisms in food and water (10^5). This could be as a result of the poor food handling practices carried out in the hotels; the presence of *E. coli* in water samples depicts faecal contamination which could be deleterious to the health of the consumers. The results from this study will enable health inspectors and food handlers to implement stringent food safety methods like Hazard Analysis Critical Control Point (HACCP) in hotels of their standard to bring about satisfaction and safety of food in their hotels. Thus, regular training programmes should be organized for handlers by their establishment and the Environmental Health Officers to acquire new knowledge on food safety. Furthermore, to avert food contamination incidence and foods intoxication, there is need to educate as well as advocate for the importance of environmental sanitation and good food handling practices particularly proper hand-washing practices amongst food vendors.

Recommendations

- Food handlers in hotels should be trained regularly on food safety practices
- Hazard Analysis Critical Control Point (HACCP) system should be employed in hotels to avoid detection of biological (bacteria) food contamination in the end product testing.
- Environmental health officers should adopt the collection of food and water samples for analysis to ascertain the level of their food safety practices.
- Sanctions should be made on hotels whose food and water detected microorganisms above WHO standard.

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