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Full Length Research

ASSESSMENT OF BACTERIOLOGICAL QUALITY OF BREAD SOLD IN KANO METROPOLIS, NIGERIA

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ABSTRACT

Bread is an important staple food that does not require further processing before consumption. A total of 150 locally produced bread samples were randomly collected from three local government areas within Kano State metropolis (Dala, Gwale and Kumbotso). The samples were analysed for bacteriological analysis using standard methods. Samples analysed from Dala, Gwale and Kumbotso local government areas were found to contain total aerobic bacteria counts (mean±SD) ranged from $6.43\pm0.72\times10^2$ to $44.83\pm1.30\times10^2$, $8.78\pm0.18\times10^2$ to $35.95\pm1.04.28\times10^2$ and $20.62\pm0.23\times10^2$ to $48.27\pm0.34\times10^2$, respectively. Various bacterial species were identified and their frequency occurrence include; *E. coli* (18.01%), *S. aureus* (45.00%), *Bacillus sp*. (1.90%), *Enterobacter* sp. (27.92%), *Klebsiella* sp. (1.08%), *Proteus* sp. (4.05%) and *Salmonella* sp. (2.04%). The results reveal that the counts were above the permissible limits recommended by World Health Organization (WHO) and International Commission on Microbiological Specification of Food (ICMFS) in foods. The high bacterial counts of most of the samples can be attributed to the poor hygienic practices which may pose biohazards to consumers. This suggests that related agency should continue surveillance and enforcement of use of Good manufacturing practise in bakeries.

Keywords: Bacteriological analysis; Bread; Bakeries; Bacterial species

INTRODUCTION

One of the readily available foods is bread, which is a staple food that does not require further processing before consumption (Olusegun *et al.,* 2015). It is produced in various forms and eaten in homes, restaurant and hotels throughout Nigeria (Emeje *et al.,* 2010). There are several routes through which bread could be contaminated in the processing chain, especially during packaging at the factory and by vendors, Health Promoting Agency (HPA, 2009). Bread contamination and growth of pathogens alter its quality and a potential source of infection to consumers since improper handling and poor personal hygiene is implicated in most food-borne illnesses (Ehavald, 2009). When food handlers do not practice safe personal hygiene, they become vehicle for transmission of pathogens, through hands, mouth and skin (HPA, 2009). Seiler, 1988; Weiser *et al.,* 1971, reported that the surface of a fresh baked loaf of bread should be practically free of viable microorganisms, but usually become contaminated by bacteria during cooling and

before wrapping. Food-borne diseases are reported to be widespread in the contemporary world and responsible for about one third of death worldwide (WHO, 2002). Also, widespread occurrence of *Staphylococcus aureus* as food poisoning had been said to result from close association of animal to humans within food preparation area (WHO, 2002). Some bacteria that are important from public health point of view may multiply to dangerously high levels in food without changing their appearance, odour and taste (Nwabueze and Archibald, 1997). The study was aimed to assess the bacteriological quality of bread sold in Kano metropolis, Nigeria.

MATERIALS AND METHODS

Materials

All the microbiological Medias and reagents used were of analytical grades and purchased from Ado Jones Scientific Supply and General Enterprises, Kano State. Equipments and Glass Wares used were from the Department of Science Laboratory Technology, Kano State Polytechnic and the Department of Microbiology, Bayero University Kano.

Sample collection

Ten Bread samples were randomly collected from different retail outlets and bakeries in three out of the nine local government areas Kano State metropolis. Representative samples were collected from Dala, Gwale and Kumbotso on monthly basis. The samples analyzed were the mostly consumed at the respective locations. The bread samples were aseptically collected in polyethylene-bag, labelled and then ttransported to laboratory in an iced box maintained at 4^0C until analysis (Unachukwu and Nwakanma, 2015; Isong *et al.,* 2013)

Bacteriological analysis

Enumeration of bacteria was done according to (Anibijuwon and Sunday, 2012) with some modifications using pour plate method. Ten-fold serial dilution of the sample was prepared as follows; one gram (1 g) of each homogenate bread sample was weighed aseptically and dispensed into 9 mL of sterile distilled water to make 10^{-1} dilution. From this mixture, with the use of sterile pipettes, 1 mL was taken from 10^{-1} mixture into 9 mL distilled water in a test-tube to make 10^{-2} dilution rate. Further dilution was made up to 10^{-5}. One mmillilitre (1 mL) each was taken from the dilution using sterile pipettes and dispensed into sterile Petri dishes labels with the sample code and dilution factor used. Cooled molten nutrient agar (NA) was poured aseptically and rocked to bring even distribution of the samples, the plates were allowed to set undisturbed. The nutrient agar plates were incubated at 37°C for 24 hrs and examined for microbial growth; number of colonies on each plate were counted and expressed as cfu/g (colony forming units/gram).

Identification of isolates

Pure cultures were obtained by transferring a representative colony to a sterile solid nutrient agar surface and streaked using sterile inoculation loop. The plates were incubated at 37°C for 24 hours, the colonies were streaked on to Eiosine methylene blue (EMB) agar, MacConkey agar (MCA), Manitol Egg Yolk Polymyxin (MYP) agar, Mannitol Salt Agar (MSA) and *Salmonella shigella* agar (SSA). The organisms identified were subjected to Gram stained and biochemical tests as: IMVIC tests (indole test, methyl red test, Voges-Proskauer test and citrate test.), carbohydrate utilization, triple sugar iron (TSI) agar, coagulase, motility, catalase, oxidase, citrate utilization and urease production.

Statistical Analysis

Data obtained were subjected to statistical analysis using analysis of variance (ANOVA) with SPSS version 16.0 to determine the significant difference at p=0.05.

RESULTS AND DISCUSSION

The results (Table 1) indicates the bacterial counts in cfu/g (mean±SD) for breads sold in Dala local government, the replicates X_1-X_5 were 44.83±14.65 x 10^2, 22.48±13.49 x 10^2, 1019.51±892.68 x 10^2, 29.79±15.06 x 10^2 and 6.43±0.72 x 10^2 respectively. However the bacterial counts (mean±SD) of X_5, X_2 and X_4 were significantly lower ($p<0.05$), where that of X_1, and X_3were higher ($p>0.05$). No significant difference ($p>0.05$) was found between X_2 and X_4, respectively**.** The Bacterial Counts in cfu/g for breads sold in Gwale local government were expressed in (mean±SD) of Y_1-Y_5 were, 25.60±12.59 x 10^2, 35.95±17.28 x 10^2, 34.21±16.83 x 10^2, 33.14±17.33 x 10^2 and 8.78±1.18 x 10^2 cfu/g, respectively. However the bacterial counts (Mean±SD) of Y_5, Y_4, and Y_1were significantly lower ($p<0.05$), where as that of $Y_3$and Y_2 were higher ($p>0.05$). No significant difference ($p>0.05$) was found between Y_1,Y_2, Y_3 and Y_4 Statistically. The Bacterial

count in cfu/g of some breads sold in Kumbotso local government were expressed in (mean±SD) of Z_1- Z_5 were, 48.27 ±20.34 x 10^2, 34.34 ±16.56 x 10^2, 35.70±17.00 x 10^2, 20.62±12.74 x 10^2 and 35.85±17.40 x 10^2, respectively. However the bacterial counts (mean±SD) of Z_4 and Z_2 were significantly lower ($p<0.05$), where that of Z_3, Z_5, and Z_1 were higher ($p>0.05$) respectively. No significant difference ($p>0.05$) was found between Z_2, Z_3, Z_4 and Z_5 and the local governments under study statistically. The bacterial isolates that occur in this study were: *E. coli, S. aureus, Enterobacter* sp., *Klebsiella* sp*., Proteus* sp., *Bacillus* sp. and *salmonella* sp.

Table 1: Mean Total Aerobic Bacteria Counts of Some Selected breads sold in Kano Metropolis.

ZONES	TABPC(cfu/g)
DALA	
X_1	44.83±1.30×10^2
X_2	22.48±0.49×10^2
X_3	10.19±0.24×10^2
X_4	29.79±0.60×10^2
X_5	6.43±0.72×10^2
GWALE	
Y_1	25.60±0.51×10^2
Y_2	35.95±0.44×10^2
Y_3	34.21±0.41×10^2
Y_4	33.14±0.32×10^2
Y_5	8.78 ±0.18×10^2
KUMBOTSO	
Z_1	48.27±0.34×10^2
Z_2	34.34±0.24×10^2
Z_3	35.70±0.19×10^2
Z_4	20.62±0.23×10^2
Z_5	35.85±0.40×10^2

Key: TABPC = Total Aerobic Bacteria Plate Count; cfu/g = Colony Forming Unit/gram; X, Y and Z are replicates of the samples.

Table 2 Frequency Occurrence of Bacteria in the Study for the Three Local Governments

S/N	ORGANISMS ISOLATED	FREQUENCY (%)
1	*Baccilus* sp.	1.90
2	*Entrobacter* sp.	27.92
3	*Esterichia coli*	18.01
4	*Klebsiella* sp.	1.08
5	*Proteus* sp.	4.05
6	*Staphylococcus aureus*	45.00
7	*Salmonella sp*.	2.04
	TOTAL	**100%**

The International Commission for Microbiological Specification for Foods (ICMSF, 1996; ICMSF, 1998) state that ready-to-eat foods with plate counts between 0 to 10^3 is acceptable, between 10^4 to ≤ 10^5 is tolerable and 10^6 and above is unacceptable. It was observed that almost all the bread samples examined had bacterial load above the acceptable limit and are therefore microbiologically unacceptable. The bacterial species identified in this study were those common to bread (Ogundare and Adetuyi, 2003). The presence of *B. cereus*, *S. aureus*, *E. coli, Klebsiella sp.* and *Proteus* sp. in bread samples used in this study, corroborates with the findings of (Nichols *et al*., 1999; Mensah *et al.,* 2002; Idowu, 2006; Taulo *et al.,* 2008) in which these organisms were implicated in ready-to-eat-foods. Therefore, presence of *E. coli, S. aureus* and *B. cereus* demonstrates a potential health risk as these organisms are pathogenic and have been implcated in food borne diseases (Granum, 2005; Wagner, 2009; CFIA, 2009). *S. aureus*, *E. coli*, *Bacillus* sp. *Klebsiella* sp. and *Salmonella* sp. in relatively high rates could be a matter of serious concern, since these organisms are involved in health complications (Gyar *et al.,* 2014). the occurrence of *Bacillus* sp. in the foods could be due to the fact that it is a spore former. These heat resistant spores may have survived processing while vegetative cells were eliminated. Contamination of foods can result from inappropriate processing, incomplete heating, or secondary contamination through contact with contaminated equipment and utensils (Oranusi *et al.,* 2013). the presence of *E. coli* and Enterobacter is an indication of possible faecal contamination of food by workers and poor hygiene practices during food processing (Little *et al*., 1998; Tambekar *et al*., 2007). The presence of *S. aureus* is largely as a result of human contact and this suggests poor hygiene practices of the operators since this organism is a normal flora of the skin and nasal passage (Garret, 1988; Nichols *et al*., 1999), and the high occurrence of *S. aureus* is of serious public health importance because of its ability to cause a wide range of infections especially food-borne intoxication. This was equally reported by Aboh and Oladosu, 2014). *Salmonella* sp. an enteric bacteria is the causative agent of typhoid fever. The increased frequency of food-borne *Salmonella* sp. has been causing recurring outbreaks, sometime with fatal infections which has been linked to the unsanitary practices of food and beverages processes leading to contamination of foods by *Salmonella* sp. The detection of *Salmonella* in the environment including in foods and beverages is a necessary component of public health program (Gyar *et al.,* 2014). The presence of *Klebsiella* sp. as recorded in this study is usually associated with faecal contamination. Being an enteric bacterium its presence indicates poor practices among handlers. Due to the significance of the faecal-oral route transmission for many bacterial food-borne diseases, basic hygiene measures assume a decisive importance in food safety management (Uzeh *et al*.,

2006). Vendors have been reported to introduce contaminant and pathogens that survive and multiply in sufficient numbers to cause illness in the consumer (WHO, 1989; Greig *et al.,* 2007; Todd *et al.,* 2007a,b).

CONCLUSION

This study reveals that there were contaminants in bread sold in Kano, which may pose serious bioharzad to consumers. Since, bread is a highly nutritional food consumed by all groups of peoples ranging from infant to the elderly in Nigeria irrespective of sex or status; its microbiological quality should therefore be enhanced. Microbiological standard of food provides safe, sound and wholesome quality and also protects the heath of consumers. Bread being a meal that is usually eaten without further processing makes it a veritable source of food borne illness if improperly handled. Foodborne illness can be prevented by good hygiene practices such as the use of Good Manufacturing Practices (GMP) and Hazard Analysis Critical Control Point (HACCP) application in the chain of food production and processing.

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CONFLICT OF INTEREST

None declared.

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Author's Contributions:

Author AAI, and RHD designed the study, AAI AND NSA wrote the procedure and interpreted the data. Author AAI, ISA and anchored the experiments. Authors AAI and AUA managed the literature search and produced the initial draft. Authors AAI, ISA and HM reviewed the write up and effect corrections. Authors RHD, AUA and HM managed the financial activities. All authors approved final manuscript.