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Microbiological Safety Evaluation of Snacks Sold in Fast Food Shops in Ota, Ogun State, Nigeria

S. Oranusi, F. Omagbemi and A.O. Eni
Department of Biological Sciences, Covenant University, Canaanland, Ota, Ogun State, Nigeria

Abstract: The microbial quality of snacks (ready to eat foods) sold in Ota, Ogun state was investigated. A total of 100 different samples from 3 vending sites namely, a university cafeteria, a top class snacks bar and a local kiosk were analyzed for total aerobic plate count, coliform count and for specific pathogens and fungi. The university cafeteria had mean total aerobic plate count and coliform count ranging from 1.1×10^3-3.0×10^4 and 1.0×10^2-2.2×10^3. The snacks bar had mean total aerobic plate count and coliform count ranging from 2.0×10^3-5.8×10^5 and 1.4×10^2-1.8×10^5 while the local kiosk had mean total aerobic plate count and coliform count ranging from 2.1×10^3-5.4×10^5 and 1.0×10^2-8.0×10^4, respectively. The fungal counts from the three sites are within 1.0×10^2-4.0×10^2. Six different bacterial and three fungal isolates were identified to include *E. coli*, *S. aureus*, *Bacillus cereus*, Enterococcus, *Klebsiella* sp., *Pseudomonas* sp. and *Aspergillus niger*, *Penicillium* sp. and Mucor. The presence of *E. coli* and Enterococci which are indicator organisms call for concern. Adoption of good manufacturing practice and Hazard Analysis Critical Control Point (HACCP) are necessary to preventing occurrence of food borne illness.

Key words: Food safety, pathogens, snacks, ready to eat foods, coliform, Nigeria

INTRODUCTION

Food borne illnesses are diseases, usually either infectious or toxic in nature caused by agents that enter the body through the ingestion of food (WHO, 2007), microbial agents that cause food borne illness may include, bacteria such as Salmonella, *Staphylococcus aureus*, *Escherichia coli* (pathogenic strains) *Bacillus* sp., *Clostridium botulinum*, *Listeria monocytogens*; viruses such as hepatitis A and E, Norovirus; molds, fungi and yeasts (CDC, 2010). In addition, poisonous chemicals or other harmful substances can cause food borne diseases if they are present in food.

Symptoms of food borne illnesses may differ amongst pathogens but general symptoms may include diarrhea, nausea, vomiting, fever and abdominal cramps. Some can cause organ failure. Ready to eat foods are foods that are consumed in the same state as that in which it is sold and does not include nuts in the shell and whole, raw fruits and vegetables that are intended for hulling, peeling or washing by the consumer (Gilbert *et al*., 2000). Some ready-to-eat foods are regarded as potentially hazardous because such foods can support the growth of pathogens. Such food must be kept at certain temperatures and conditions to minimise the growth of any pathogens that may be present in the food or to prevent the formation of toxins in the food. There is a wide variety of ready-to-eat foods including but are not limited to sandwiches, kebabs, hotdogs, meat pie, salad, doughnuts, takeaway foods and bakery products. Ready-to-eat foods usually include a number of ingredients which may or may not be cooked. Due to the nature of these foods and their methods of preparation involving extensive handling, they are usually prone to contamination/cross contamination from soil, water, air, storage/distribution facilities, environment and human activities (food handlers and vendors).

Convenience/modern life style, industrialization, economic down turn, quest for more wealth, materialism and their associated lack of time to prepare proper meal, low purchasing power are reasons for the increased patronage for ready to eat foods (Nielsen, 2006). WHO (2007) estimated that a significant proportion of the approximately 1.5 billion episodes of diarrhea and >3 million deaths globally recorded annually results from consumption of food with microbial pathogens and toxins. We live in a microbial world and there are many opportunities for food to become contaminated as it is produced and prepared many of these food borne microbes are found in healthy animals raised for food

Corresponding Author: S. Oranusi, Department of Biological Sciences, Covenant University, Canaanland, Ota, Ogun State, Nigeria

(usually in their intestines). Meat and poultry carcasses can become contaminated during slaughter by contact with small amounts of intestinal contents. Similarly, fresh fruits and vegetables can be contaminated if they are washed or irrigated with water that is contaminated with animal manure or human sewage.

A number of foods in Nigeria have been reported to have high level of contaminants (Adesiyun, 1995; Oluwafemi and Simisaye, 2005; Shamsuddeen, 2009; Clarence *et al*., 2009; Okonko *et al*., 2009; Angela *et al*., 2010), however there is scanty information about the extent of microbial contamination of snacks sold in Nigerian fast food shops and supermarkets. This study was undertaken to determine the microbial profile of snacks sold amongst 3 socio economic classes (upper, middle and lower class) in Ota, Ogun state, Nigeria with a view of proffering food safety advice.

MATERIALS AND METHODS

Sources of sample: Three ready-to eat-food vending sites in Ota, Ogun state were sampled. These sites were chosen because they are highly patronized by members of the general public of different socio economic classes (upper, middle and lower class).

These locations include; a university cafeteria (upper class), a snacks bar/fast food shop (middle class) and a local kiosk (lower class).

Sample collection: About 20 samples each of fresh hot dog, sausage, meat pie, egg roll and doughnuts were purchased from these locations. Samples were randomly selected without order. Two each of the samples were collected on alternate days from the sites. The samples were aseptically collected in sterile polyethylene bags and transferred immediately to the laboratory for further analysis.

Culturing of food samples: About 10 g of each food samples was blended and homogenized in 100 mL of sterile distilled water (10^{-1} dilution). Serial dilutions of the homogenates were made to 10^{-2} and 10^{-3}. About 1 mL of each dilution was plated in replicate using both Pour Plate and Spread Plate Methods on nutrient agar for total aerobic plate count and isolation of other microorganisms, eosin methylene blue agar for coliform count and isolation.

Mannitol salt agar and Potato Dextrose Agar (PDA) plus gentamycin were inoculated for Staphylococci and fungi isolation. The plates were incubated at 37°C for 24 h except for PDA that was incubated for 3-5 days at room temperature 28-30°C.

Coliform test

Presumptive test: About 1 g of each sample was transferred to sterile McCartney bottles containing lactose broth and inverted Durham tubes. Incubation was for 24-48 h at 37°C. Tubes showing gas production and/or colour change of dye were streaked on EMB plates. Incubation of plates for Confirmatory test was at 37°C and 44°C for 24 h; colonies from EMB plates were picked and inoculated into tubes containing lactose broth for completed test and onto nutrient agar slants for further characterization. Inoculated tubes and slants were incubated for 24 h at 37°C (Oranusi *et al*., 2004).

Identification of isolates: The bacteria isolates were identified based on standard methods of Speck (1976) and Cheesbrough (2004). Fungal isolates were identified based on cultural and morphological characteristics with reference to standard atlas (Watanabe, 2002).

Statistical analysis: The values obtained for total aerobic and coliform counts were subjected to analysis of variance (Snedecor and Cochran, 1976).

RESULTS AND DISCUSSION

The mean total aerobic plate count of sample from the vending sites is as shown in Table 1. It shows that hot dog from local kiosk and egg roll from snacks bar had significant higher counts compared to other samples. It also reveals that samples from the local kiosk and snacks bar had relatively higher counts compared to the university cafeteria. Table 2 shows mean coliform count of samples; it reveals that sausage from snacks bar had significant higher counts than sausage from other sites. Table 3 shows mean fungal count of samples from the

Table 1: Mean total aerobic plate count (cfu g^{-1})

	Source of samples		
Food samples	University cafeteria	Snacks bar	Local kiosk
Meat pie	2.0×10^{3a}	2.7×10^{4a}	2.1×10^{3a}
Hotdog	2.0×10^{3a}	2.8×10^{3a}	5.4×10^{5b}
Sausage	3.0×10^{4a}	3.3×10^{4a}	8.0×10^{3a}
Egg roll	8.2×10^{3a}	5.8×10^{5b}	4.8×10^{4ab}
Doughnut	1.1×10^{3a}	2.0×10^{3a}	3.0×10^{4a}

Table 2: Mean coliform count (cfu g^{-1})

	Source of samples		
Food samples	University cafeteria	Snacks bar	Local kiosk
Meat pie	NG	6.0×10^{2a}	2.0×10^{2a}
Hotdog	1.0×10^{2a}	1.4×10^{2a}	5.0×10^{2a}
Sausage	2.2×10^{3a}	1.8×10^{5b}	1.0×10^{3a}
Egg roll	6.0×10^{2a}	1.0×10^{3a}	8.0×10^{4a}
Doughnut	NG	NG	1.0×10^{2a}

[a, b]Mean within row with the same letter for same count are not significantly different ($p>0.05$)

Table 3: Mean fungal count (cfu g^{-1})

	Source of samples		
Food sample	University cafeteria	Snacks bar	Local kiosk
Meat pie	NG	3.0×10^2	NG
Hotdog	NG	2.0×10^2	2.0×10^2
Sausage	4.0×10^2	NG	3.0×10^2
Egg roll	3.4×10^2	2.8×10^2	4.0×10^2
Doughnut	2.0×10^2	1.0×10^2	NG

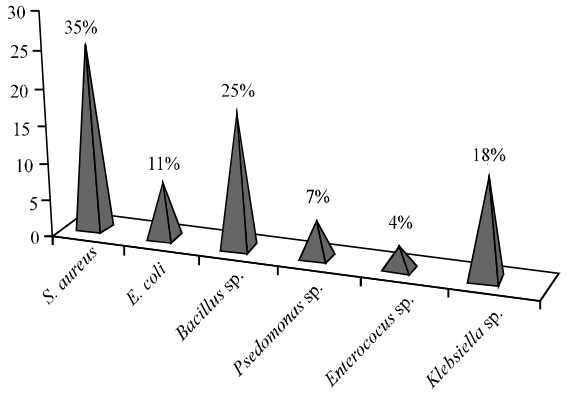

Fig. 1: Percentage occurrence of bacterial isolates from samples

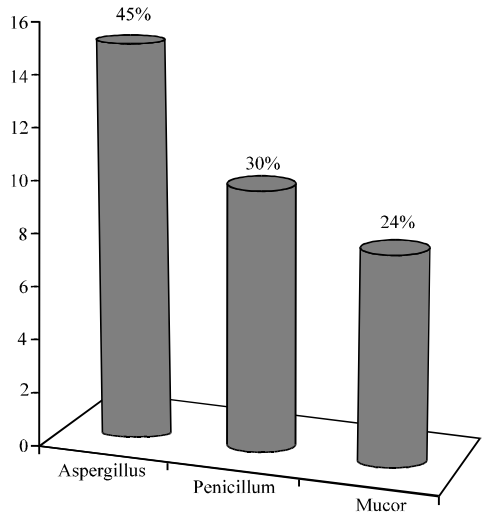

Fig. 2: Percentage occurrence of fungal isolates from samples

three sites. Egg roll had growth in all the cases. *E. coli*, *S. aureus*, *Pseudomonas* sp., Enterococcus, *Bacillus cereus*, *Klebsiella* sp., *Aspergillus niger*, Mucor and Penicillium were isolated as shown in Fig. 1 and 2. The snacks sold in these vending sites had microbial loads within acceptable microbiological quality (ICMSF, 1974; FSANZ, 2001), declares ready to eat foods with aerobic plate counts 10^4 to $<10^5$ as acceptable. Egg roll and sausage had higher plate counts, these could be due to the nutritional content of the major ingredient used in their preparation, i.e., eggs and hams which offers a rich nutrient media for microbial growth (Phillips, 2003). The presence of coliforms points to poor sanitary practices by food personnel and could be an indication of possible feacal contamination. Doughnut preparation does not involve egg and meat addition this could have accounted for the relatively lower count for this product. The higher counts in microbial loads observed in the local kiosk and snack bar could be attributed to the levels of exposure of these products.

The presence of *E. coli*, *Enterococcus*, *Klebsiella* sp., *Staphylococcus aureus* is of concern and further support the possibility of feacal contamination of products due to poor sanitation (Oranusi *et al*., 2007). *Bacillus* and *Pseudomonas* sp. were isolated; however *Salmonella* and *Shigella* sp. were not detected. These organisms are known to be environmental contaminants and opportunistic pathogens have been implicated in food borne diseases and are known to cause food spoilage that can lead to economic loss. The most predominant bacterial contaminants was *S. aureus* with 25.56%, this could be traced to the fact that it is abundant in human body (skin, nails hair) (Balaban and Rasooly, 2000; Oranusi *et al*., 2006a, b). Similarly, *Bacillus cereus* showed high percentage (18%), its presence can be traced to the fact that it is abundant spore former in soil, air and water, hence can easily be present in these foods. This report is in agreement to reports of Oluwafemi and Simisaye (2005), Clarence *et al*. (2009) and Okonko *et al*. (2009), they isolated similar organisms from sausages, meat pie and sea foods, respectively.

The presence of Aspergillus, Penicillium and Mucor could be attributed to the surrounding air and packaging materials (Aboloma, 2008; Kawo and Abdulmumin, 2009) *Aspergillus* sp. are very common fungal agent of food borne illness (Peraica and Domijan, 2001; Katherine *et al*., 2006). A comparison of the level of contamination of snacks from sampling points representing 3 socio-economic classes; upper, middle and lower class shows no significant difference in their levels of contamination although, the snacks bar and the local kiosk had relatively higher level of contamination compared to the university cafeteria.

Snacks (ready-to-eat foods) are eaten by all age groups with high popularity amongst school children and youths, it is therefore mandatory that these foods must be free from contamination as much as possible. Food borne illness can be prevented by good hygiene practice during the preparation of food. To prevent occurrence of food borne illness it is therefore, important to ensure that foods

sold are safe and hygienic, public awareness programs should be employed to educate personnel involved in food preparation, food processors and food vendors. The general public should be educated on the need for food safety and the requirement for water meant for human consumption and for food processing (Taulo *et al*., 2008; Okonko *et al*., 2008a, b). Proper and regular hand washing, sanitization of all equipment and utensils, care for the environment and the packaging materials so as to prevent the spread of contaminants will help in safety of food. Adoption of the HACCP (Hazard Analysis Critical Control Point) principle in snacks preparation is advocated.

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