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ORIGINAL RESEARCH PAPER

IMPLICATION OF HUMAN HANDLING ON PACKAGED SAUSAGE ROLLS DURING SALE

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In other to identify the implication of human handling of packaged sausage rolls after production, a microbiological safety evaluation was carried out on sausage rolls sold on street and in shops. Among the sausage rolls, gala purchased from street vendors has the highest bacterial load of 2.82×10^4 CFU/g and 4.3×10^6 spore/g of fungal load, followed by meaty with bacterial load of 1.71×10^4 CFU/g and fungal load of 1.6×10^5 spore/g and was least in rite sausage roll with 1.46×10^4 CFU/g and 1×10^5 spore/g bacterial and fungal loads respectively. Seventeen bacteria species were isolated from both street vended and shop sold sausage rolls, the isolates identified including: *Bacillus cereus, Acinetobacter calcoaceticus, Alcaligenes faecalis, Citrobacter freundii, Klebsiella ozaenae, Staphylococcus epidermidis, Enterobacter aerogenes, Staphylococcus aureus, Aeromonas hydrophila, Plesiomonas shigelloides, Moraxella catarhalis, Bacillus substilis, Escherichia coli, Salmonella typhi, Aeromonas anaerogenes, Aerococcus viridans* and *Azomonas agilis.* Five fungi species were isolated from street vended sausage rolls only. The fungal species are *Penicillium notatum, Aspergillus parasiticus, Aspergillus flavus, Penicillium italicum* and *Gliocephalis* spp. From this study, street vended samples have higher microbial contamination than shop sold sausage rolls due to improper handling during sales.

Keywords: street, packed rolls, microbiological, shops, vended, proximate, human handling

Introduction

Ready-to-eat foods are the types of foods to be consumed after purchase without further treatment. Such foods could be uncooked or cooked, hot or cold. There are certain appealing factors that make certain ready-to-eat foods more popular as food sources. These include familiarity, taste, low cost and convenience (Mahakarnchanakul *et al*., 2010). Different terms have been used to describe ready-to-eat foods. Examples of such ready-to-eat foods include pastries, meat pie, sausage

rolls, burger, moin-moin, salad or coleslaw, fried meat, fried chicken, milk and milk products (Caserani and Kinston, 1974). Our society shows a social pattern characterized by increased mobility, large number of itinerary workers and less family or home centred activities. This situation, however, has resulted in more ready-to-eat foods taken outside the home. Ready-to-eat foods form an important and well established sector of the food industry in developing countries, Nigeria inclusively (Adu-Gyamfi and Nketsia-Tabiri, 2007). The ready-to-eat food industry plays a very important role in meeting food requirements of commuters and urban dwellers in many cities and towns of developing countries, as it feeds thousands of people daily with a large range of foods that are relatively cheap, easily accessible (Adu-Gyamfi and Nketsia-Tabiri, 2007; Tambekar *et al.*, 2008; Feglo and Sakyi, 2012), nutritionally-balanced and also provide a source of income for the vendors (Adu-Gyamfi and Nketsia- Tabiri, 2007).

In Nigeria, most of these products are stored under non-hygienic conditions. They are often displayed in open trays or container in the market or are hawked along the street. Contamination of food can occur at any point in the production chain (i.e. from the raw materials, processing, packing, transportation, storage or marketing) to consumption. Because of improper processing, handling and storage of these foods could be subject to contamination by microorganisms (Iwegbue, 2011).The study is aimed at isolating microorganisms, antibiotic sensitivity of isolated microorganisms, microbiological and proximate composition of packed rolls.

Materials and methods

Collection of sample

Triplicate samples of Gala, Rite and Meaty rolls stored at room temperature were purchased from one of the tuck shops in Afe Babalola University, Ado Ekiti, Ekiti State Nigeria. Triplicate samples of the same sausage rolls were purchased from street vendors along Akure - Ibadan road.

Isolation, characterization and identification of microbial species

Two grams of each sausage rolls were mashed in 20 ml of sterile distilled water in a sterile mortar. 1 ml of the mashed sausage was aseptically introduced into 9 ml of sterile distilled water in a test tube. This was properly shaken and further diluted to 10^{-5}. One ml of 10^{-3} and 10^{-4} of samples were cultured on Plate count agar, MacConkey agar, Salmonella /Shigella agar, Nutrient agar and Potato dextrose in triplicates using pour plate method. The plates were incubated aerobically for 37 °C for 24 hours (bacteria) and 27 °C for 3 to 5 days (fungi). After incubation, colonies were counted using the illuminated colony counter. The count for each plate was expressed as colony forming unit of the suspension (CFU/g). Colonies of bacteria and fungi were selected from each plate and isolated by sub culturing into nutrient agar plates and potato dextrose agar plates respectively. Pure isolates were stocked in slants and stored at 4 °C. Isolates were identified by cultural, morphological, physiological and biochemical characteristics as described by Fawole and Oso

(2001); (Holt *et al*. (1994); Claus (1992) and Bergey's Manual of Systematic Bacteriology (Sneath *et al*., 1986).

Antibiotics sensitivity test

Antibiotic sensitivity is the susceptibility of bacteria to antibiotics. Antibiotics sensitivity testing (AST) is usually carried out to determine which antibiotic will be most successful in treating a bacterial infection *in vivo*. Testing for antibiotic sensitivity was done by the Kirby-Bauer method. Twenty four hours culture of test bacteria was aseptically spread over a gelled Mueller Hinton agar using a sterile swab and the plate was allowed to stand for one hour and a half. With a sterile forceps, a commercial antibiotic disc was placed at the center of the agar. The disc paper arm where known concentrations of antibiotics are impregnated were pressed firmly into the agar and incubated at 37 °C for 24 hours. Bacteria sensitive to the antibiotic will produce a clear zone of inhibition around the disc which is measured and interpreted as degree of sensitivity (Hindron *et al*., 2008).

Proximate composition on the sample

Determination of moisture content

The moisture content of each sample was determined with the method described by AOAC (1990). Two grams of the sample was weighed into a previously weighed crucible, and then transferred into an oven at 650 °C. Weight of sample was taken until a constant weight is attained.

Determination of ash content

The ash content of each sample was determined using the method described by AOAC (1990). The sample (2 g) was weighed into a weighed crucible, which had been dried in an oven and then cooled in the desiccators. It was then heated over electric heater to char organic matter and then transferred into a muffle furnace at 600 °C for 4 - 6 hours or until whitish-grey ash is obtained. The crucible with sample was then cooled in the desiccators before it was weighed.

Determination of crude fat

The crude fat content was determined by the method described by AOAC (1990). An amount of 2 grams of each sample was weighed into a fat free extraction thimble and then blocked lightly with cotton wool. The thimble was placed in the extractor and fitted up with reflux condenser. A 250 ml Soxhlet flask which had been dried in the oven, cooled in the desiccator, was weighed. The Soxhlet flask was filled with ¾ volume of petroleum ether (boiling point of 40 °C – 60 °C). The flask, extractor with condenser set was placed on the heater for 6 hours with constant tap running water for condensation of the ether vapour. As the ether vapour reaches the condenser through the side arm of the extractor, it condenses to liquid form and drop back into the sample in the thimble, the ether soluble substances are dissolved and are carried into solution through the siphon tube back into the flask. The extraction continues for at least 6 hours. The thimble is removed and most of the solvent is distilled from the flask into the extractor. The flask is then disconnected and placed in an oven at 65 °C for 4 hours, cool in desiccators and weighed.

Determination of crude fibre

Two grams of the sample was weighed into a beaker with capacity of 600 ml, and 200 ml of pre-heated 1.25% H_2SO_4 was added and then placed in digestion apparatus with pre-heated plates. This was allowed to boil and reflux for 30 minutes in order to hydrolyze the carbohydrates and protein. This was followed by filtering through Whatman No 1 filter paper and thus washing of the residue with hot distilled water until filtrate was neutral. The residue was transferred into the beaker and 200 ml of pre-heated 1.25% NaOH was added before returning to the digestion apparatus to boil and reflux for 30 minutes (this affects the saponification of fat). It was filtered and washed with hot distilled water until filtrate is neutral. The residue was then transferred into the crucible and dried at 65 °C for about 24 hours. It was cooled in the desiccators and weighed (A) before placing in the furnace at 600 °C for a period of 4-6 hours. It was cooled and weighed again (B).

$$\% \text{ Crude Fibre} = \frac{DWR - WR}{SW} \times 100,$$

where: DWR represents dry weight of residue before ashing, WR the weight of residue after ashing and SW sample weight

Determination of crude protein

The crude protein of each sample was determined using the Kjeldahl Nitrogen method described by AOAC (1990). Two grams of each sample were carefully weighed into the Kjeldahl digestion tubes to ensure that all materials get to the bottom of the tubes. One tablet of Kjeldahl catalyst and 10 ml of concentrated H_2SO_4 were added before setting in the appropriate hole of the digestion block heaters in a fume cupboard for 4 hours. The digest was then cooled and carefully transferred into 100 ml volumetric flask thoroughly rinsing the digestion tube with distilled water. 5 ml portion of the digest was then pipetted into the distillation apparatus and 5 ml of 40% (w/v) NaOH was added. The mixture was steam distilled for 2 minutes into 500 ml conical flask containing 10 ml of 2% Boric acid with mixed indicator solution and placed at the receiving top of the condenser. The solution was then titrated against 0.01N HCl in a 50 ml burette.

$$\% \text{ Nitrogen} = \frac{14 \times VA \times 0.1 \times W}{100 \times 100} \times 100$$

where VA is the volume of acid used and W the weight of sample

% crude protein = % Nitrogen x 6.25

Determination of carbohydrate

The carbohydrate content of the sausage samples was determined by difference.

Statistical Analysis

The results were expressed as mean ± standard deviation (SD) and were subjected to one way analysis of variance (ANOVA). The least significant difference (LSD) was performed for the pair wise mean comparisons, to determine the significant treatment dose at 95% level of confidence. Values were considered statistically significant at (P<0.05).

Results and discussion

Seventeen bacteria species were isolated from both street vended sausage rolls and shop sold sausage rolls. The characterized and identified bacteria species from street vended sausage rolls are: *Bacillus cereus, Acinetobacter calcoaceticus, Alcaligenes faecalis, Citrobacter freundii* and *Klebsiella ozaenae* which were found in rite sample, *Staphylococcus epidermidis* and *Enterobacter aerogenes* which were found in gala samples while *Staphylococcus aureus, Aeromonas hydrophila, Plesiomonas shigelloides* and *Moraxella catarhalis* were found in meaty sample. Six (6) species of bacteria were identified from shop sold sausage rolls: *Bacillus substilis* from gala sample, *Escherichia coli* and *Salmonella typhi*, from meaty sample, while *Aeromonas anaerogenes, Aerococcus viridans* and *Azomonas agilis* were isolated from rite sample. *Acinetobacter calcoaceticus, Citrobacter freundii* and *Moraxeella catarhalis* has the highest frequency of occurrence in street vended sausage rolls samples, while *Staphylococcus aureus* has the highest frequency of occurrence in shop sold sausage rolls samples (Figure 1).

Table 1 represents the microbial load from street vended and shop sold sausage rolls. Among the sausage rolls, gala purchased from street vendors has the highest bacterial load of 2.82×10^4 CFU/g and 4.3×10^5 spore/g of fungal load, followed by meaty with bacterial load of 1.71×10^4 CFU/g and fungal load of 16×10^4 spore/g. The lowest bacterial count of 1.46×10^4 CFU/g and fungal count of 10×10^4 spore/g was recorded form rite sausage roll. Highest bacterial count from gala purchased from shop was 6.3×10^5 CFU/g, followed by rite with bacterial load of 2.6×10^5 CFU/g and least count of 1.1×10^5 CFU/g from meaty roll. Fungi growth was not detected on any of the shop sold sausage rolls, but from street vended sausage rolls, five fungi species were isolated. The fungi species identified from street vended sausage rolls were *Penicillium notatum, Aspergillus parasiticus, Aspergillus flavus, Penicillium italicum* and *Gliocephalis* spp. *Penicillium italicum* has the highest frequency of occurrence in street vended sausage rolls samples (Figure 2).

Table 1. Microbial load of street vended and shop sold sausage rolls

Sausage samples	Total bacterial count (CFU/g)	Total fungal count (spore/g)
Gala		
Street vended	**2.82×10^4**	**4.3×10^5**
Shop sold	**6.3×10^5**	**-**
Rite		
Street vended	**1.46×10^4**	**1.0×10^5**
Shop sold	**2.6×10^5**	**-**
Meaty		
Street vended	**1.71×10^4**	**1.6×10^5**
Shop sold	**1.1×10^5**	**-**

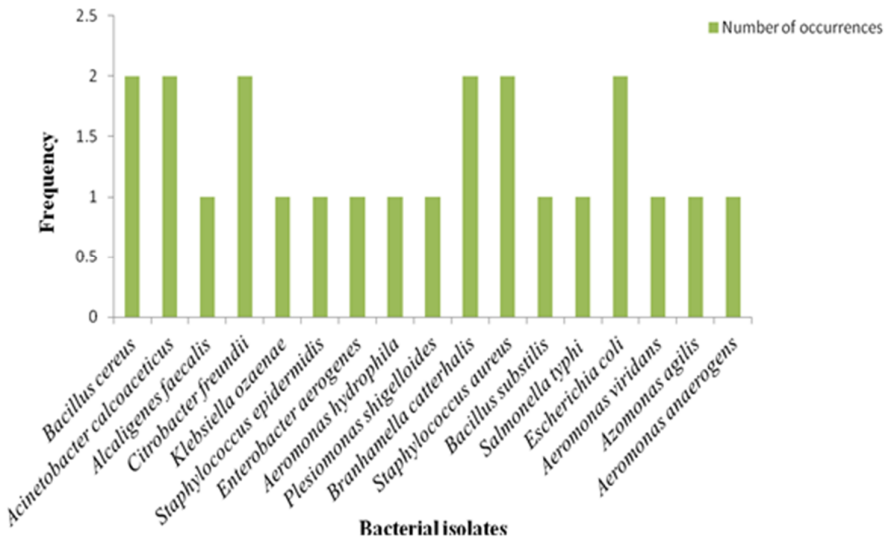

Figure 1. Frequency of occurrences of bacteria isolates

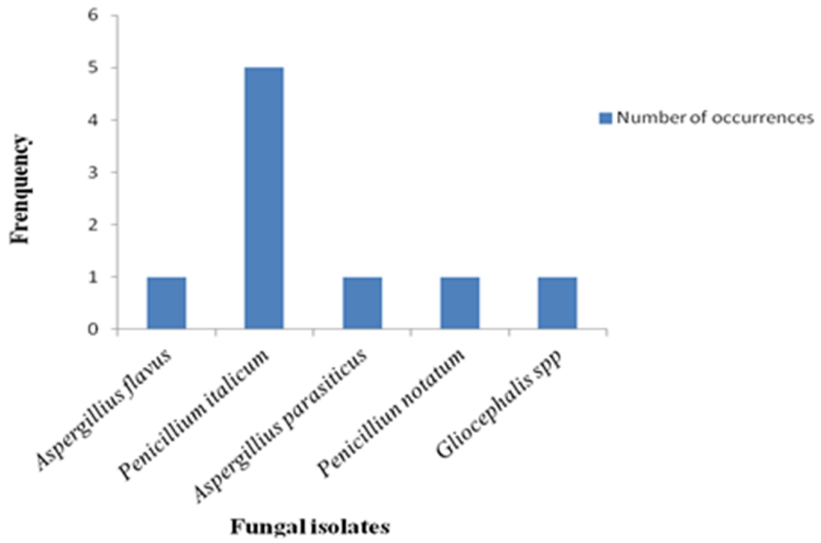

Figure 2. Frequency of occurrences of fungi isolates

Table 2 shows the susceptibility of bacteria isolated from street vended sausage rolls to both Gram positive and Gram negative commercial antibiotics. Among the commercial antibiotics, streptomycin, septrin, pefloxacin, erythromycin, rocephin, ciprofloxacin and gentamicin inhibited the entire Gram positive bacteria isolates.

Bacillus cereus was observed susceptible to only septrin, pefloxacin, gentamicin, rocephin, ciprofloxacin, streptomycin and erythromycin with inhibition zones of 20, 20, 15, 15, 30, 15 and 25 mm respectively. *Staphylococcus aureus* was inhibited with 19, 20, 15, 15, 25, 14 and 10mm by septrin, pefloxacin, gentamicin, rocephin, ciprofloxacin, streptomycin and erythromycin respectively. S*taphylococcus epidermidis* was inhibited with 21, 20, 16, 20, 14, 20 and 15mm by septrin, pefloxacin, gentamicin, rocephin, ciprofloxacin, streptomycin and erythromycin respectively. However, all the bacteria isolates were resistant to amoxicillin, ampiclox and zinnacef.

Chloramphenicol, sparfloxacin and ciprofloxacin inhibited all the Gram negative bacteria isolated. *Plesiomonas shigelloides* was observed susceptible to all antibiotics while. *Acinetobacter calcoaceticus* was also observed susceptible to all the antibiotics tested, being resistant only to gentamycin. *Klebsiella ozaenae* was resistant to pefloxacin and tarivid while *Citrobacter freundii* was resistant to amoxicillin and augmentin. *Alcaligenes faecalis* was observed susceptible to septrin, chloramphenicol, sparfloxacin, ciproflaxacin, gentamicin, tarivid and streptomycin with inhibiton zones of 12, 20, 15, 16, 15, 20 and 14 mm respectively; *Enterobacter aerogenes* was inhibited with 20, 14, 14, 20 and 18 mm by septrin, chloramphenicol, ciprofloxacin, pefloxacin, and streptomycin respectively. *Branhamella catterhalis* was susceptible only to chloramphenicol, sparfloxacin, ciproflaxacillin, and gentamicin with inhibition zones of 15, 18, 15 and 20 mm respectively. *Aeromonas hydrophila* was inhibited with 20, 20, 16, 30 and 9 mm by septrin, chloramphenicol, sparfloxacin, pefloxacin, and streptomycin respectively.

The susceptibility of bacteria isolated from shop sold sausage rolls to gram positive and gram negative commercial antibiotics is presented also in Table 2. Septrin, pefloxacin, gentamicin and streptomycin inhibited all tested bacterial species, while ampiclox, zinnacef, augmentin and tarivid were not effective on tested bacterial isolates from shop sold sausage rolls. *Azomonas agilis* was the only microorganism susceptible to amoxicillin with an inhibition zone of 15 mm. *Bacillus subtilis* and *Aeromonas viridans* were susceptible to rocephin with a zone of 15 mm each while *Azomonas agilis* and *Aeromonas anaerogenes* were also susceptible to sparfloxacin with an inhibition zone of 15 mm each. *Escherichia coli* and *Aeromonas anaerogenes* were the only microorganisms with resistance to ciprofloxacin. *Salmonella typhi* was inhibited with 13, 15, 20, 15 and 10 mm by septrin, pefloxacin, ciprofloxacin, streptomycin and chloramphenicol respectively.

The highest moisture content of 40.58% was recorded for the street vended rite roll, followed by meaty roll with a value of 40.36%, and the lowest value was obtained in case of gala (30.17%). However, the highest moisture contents recorded from the shop sold rolls are 40.36% for meaty roll, followed by gala roll with a value of 40.30%, and the least value of 33.95% for rite roll. The highest ash content of 1.71% was recorded for street vended rite and meaty, and the least value in case of gala roll with 1.14%. However, the highest ash content recorded from the shop sold products are 2.14% for rite roll, followed by meaty roll with a value of 1.14%, and the least value of 1.12% for gala roll.

Table 2. Antibiotic susceptibility for street vended and shop sold sausage rolls (Gram positive and Gram negative bacteria)

Bacterial species	Antibiotic / Zone of inhibition (mm)													
	ST	**PF**	**CN**	**AX**	**Z**	**AM**	**R**	**CP**	**S**	**E**	**CH**	**SP**	**AU**	**OF**
Bacillus cereus	20	20	15	-	-	-	15	30	15	25	-	-	-	-
Staph. epidermidis	21	20	16	-	-	-	20	14	20	15	-	-	-	-
Staph. aureus	19	20	15	-	-	-	15	25	14	10	-	-	-	-
Acinetobactercalcoaceticus	13	20	-	-	-	20	-	20	15	-	15	20	15	20
Alcaligenesfaecalis	12	-	15	-	-	-	-	16	14	-	20	15	-	20
Citrobacterfreundii	20	10	16	-	-	-	-	20	13	-	10	20	-	15
Klebsiellaozaenae	15	-	15	-	-	11	-	10	12	-	10	15	15	-
Enterobacteraerogenes	20	20	-	-	-	-	-	14	18	-	14	-	-	-
Moraxella catarrhalis	-	-	20	-	-	-	-	15	-	-	15	18	-	-
Aeromonashydrophila	20	30	16	-	-	-	-	-	9	-	20	16	-	-
Plesiomonasshigelloides	15	21	20	-	-	20	-	20	17	-	12	13	20	13
Bacillus subtilis	20	21	15	-	-	-	15	25	15	26	-	-	-	-
Salmonella typhi	13	15	20	-	-	-	-	15	20	-	10	-	-	-
Aeromonasviridans	17	25	15	-	-	-	15	20	16	10	-	-	-	-
Azomonasagilis	25	15	10	-	-	15	-	20	10	-	12	15	-	-
Escherichia coli	15	20	15	-	-	-	-	-	25	-	13	-	-	-
Aeromonasanaerogenes	20	25	15	-	-	-	-	-	10	-	20	15	-	-

Concerning protein content, 4.0% was recorded in street vended gala roll, followed by rite roll with a value of 3.84%, and the least value was recorded for meaty roll with 3.76%. However, the highest protein content recorded for the shop sold products was 9.0% for each meaty, rite and gala.

The fat content of 30.32% was recorded for street vended gala roll, followed by meaty roll with a value of 30.15% and the least in rite roll with a value of 30.00%. However, the highest fat content recorded for the shop sold products was 25.34% for gala roll, followed by meaty roll with a value of 25.30%, and the least value of 25.10% was recorded for rite roll.

Carbohydrate content of 23.0% was recorded for street vended gala roll, followed by meaty roll with a value of 19.97%, and the least value of 16.6% for rite roll. The highest carbohydrate content recorded for the shop sold products was 26.0% for rite, 23.0% for gala and 20% for meaty rolls

The highest crude fibre content of 0.67% was recorded for street vended meaty roll, followed by gala roll with a value of 0.55%, and the least value of 0.45% for rite roll. However, the highest crude fibre recorded for the shop sold products was 0.44% for meaty rolls, followed by gala with a value of 0.42%, and the least value of 0.38% from rite sausage (Table 3).

Table 3. Proximate composition of sausage rolls samples

	Meaty		Rite		Gala	
	SV	SS	SV	SS	SV	SS
Moisture (%)	32.71 ±2.43	40.36 ±0.12	40.58 ±0.23	33.95 ±0.4	40.30 ±0.25	30.17 ±0.14
Ash (%)	1.71 ±0.45	1.14 ±0.62	1.71 ±0.25	2.14 ±0.42	1.14 ±0.16	1.12 ±0.33
Protein (%)	3.76 ±1.14	9.0 ±0.16	3.84 ±0.24	9.0 ±0.13	4.0 ±0.32	9.0 ±0.16
Fat (%)	30.15 ±2.02	25.30 ±0.15	30.0 ±0.24	25.10 ±0.23	30.32 ±0.30	25.34 ±0.22
Carbohydrate (%)	19.97 ±0.18	20.0 ±0.61	16.6 ±0.21	26.0 ±0.4	20.7 ±0.34	23.0 ±0.21
Fibre (%)	0.67 ±0.02	0.44 ±0.12	0.45 ±0.21	0.38 ±0.43	0.55 ±0.26	0.42 ±0.23

Discussion

High moisture content accelerates food spoilage and generally enhances the growth and proliferation of microorganisms, especially bacteria. The bacteria count obtained is indicative of post contamination by human activities in the light of hand touch of the sausage rolls or by customers during pricing and selection. Similar post was reported by Ogugbue *et al*. (2011). However, the controlled environment for storage of products is necessary hence exposure to air has been identified as the main source of microbial contamination of most vended foods. This work identified that street vended packed sausage rolls were more contaminated with different bacterial and

fungal species than the shop sold which might pose a threat to the health of regular consumers of this snacks. The finding is in agreement with the work of Ajao and Atere (2009) and Oranusi and Braide (2012). Most of these contaminants are commonly found in water and soil which could have come in contact with the food samples in populated microbial environment where they were kept along street.

Higher moisture content in street vended sausage rolls could be a result of the condition of their storage under the sun, which promotes heat and condensation on the rolls. This may result in a higher microbial load observed than in the shop sold sausage rolls. However, the lower moisture content in shop sold sausage rolls was as a result of their being stored in a cool and dry environment, which results in low microbial load in the rolls. Lesser protein content was observed in the street vended sausage rolls due to the higher microbial load. The majority of these street vended products are under intense heat during the day and high humidity during the raining season, which, of course, will make associated microorganisms increase in population. Under the circumstances, left over products after a day's sale ought to be returned to microwave or oven in order to keep the products dry and reduce moisture, which of course will hamper microbial growth. According to Barro *et al.*, 2007, lack of these storage facilities will heighten the chances of microbial contamination. A smaller carbohydrate value was observed on the street vended products than the shop sold ones, which could be a result of microorganisms utilizing the carbohydrate present in the rolls, and this will contribute to the reduction of the nutritional value of rolls.

The presence of *Staphylococcus aureus* in the samples is indicative of human contamination after production. This could be from direct human contact, such as skin and infected cuts, or indirectly through additives or utensils. This bacterium is associated with exotoxin characterized by short incubation period (1 - 8 hours), violent nausea, vomiting and diarrhea. Nkanga and Uraih, (1981) reported high prevalence rate of *Staphylococcus aureus* in meat samples from traditional market in Benin City, Nigerian. *Bacillus cereus* is another isolate that is associated with the production of toxin, diarrheal and emetic in food, which causes food poisoning. It is found in dust, soil and raw food and can survive under normal cooking conditions as a heat resistant spore (Rajkowski and Bennett, 2003). *Aeromonas hydrophila* has been associated with foodborne infections. This organism is often found in normal and diarrheal human intestines. Certain strains of *A. hydrophila* are able to produce enterotoxins (Sha *et al.*, 2002). Diseases caused by *A. hydrophila* include gastroenteritis (cholera- and dysentery-like illness) and extra-intestinal infections such as septicemia and meningitis in immunocompromised individuals or people with malignancies. *Alcaligenes faecalis* is an important food spoilage bacterium. It has also been isolated from diverse sources such as soil, water, medical specimens (blood, urine, faeces, sputum, wounds and pleural fluid), nematodes and insects. Some species are common inhabitants of the intestinal tract of vertebrates. *Plesiomonas shigelloides* isolated in this study has been implicated in fish, shellfish, aquatic animals, fresh water (e.g. rivers, ponds, streams), cattle, swine, goats, cats, dogs, monkeys, vultures and toads. *Plesiomonas shigelloides* is capable of producing

many diseases, ranging from enteritis to meningitis. It can cause occasional opportunistic pathogen infections in humans (known as *Plesiomonas enteritis* or *gastroenteritis*). The possible source for isolation of this bacterium might be through contaminated hands or from soil where the rolls are kept by the roadway during sale by vendors. Alabl and Odugbemi (1990) have isolated *Plesiomonas shigelloides* from patients with or without diarrhea in Nigeria.

The presence of *Escherichia coli*, *Salmonella* spp, *Klebsiella ozaenae* and *Enterobacter aerogenes* suggested faecal contamination. They are mainly transmitted through food or drink or water contaminated with urine or faeces of infected people or a chronic carrier (CDC, 2008; Ibekwe *et al*., 2008). Food-borne salmonellosis has been associated with consumption of various foods especially meat and poultry products (Adesiyun, 1993). The presence of *Salmonella spp*, *Escherichia coli*, *Klebsiella* spp and *Enterobacter* spp calls for concern as these organisms are frequently associated with poor sanitary practices and could indicate the danger of possible food borne infection (Eni *et al*., 2010; Oranusi *et al*., 2007). *Klebsiella* spp has been isolated in food such as fruits and vegetables, meat, milk and dairy products, salads, and drinking water, coming from the general environments of soil, dust, air and water and from social environments. Some of the common fillings like minced meat are recorded to harbor a large amount of microbial load (Phillip, 2003). Waites and Arbuthnott (1999) reported *Staphylococcus aureus* and *Escherichia coli* contamination in minced meat, sausage rolls and pies. The presence of the isolated microbes in the sausage rolls depicts a deplorable state of poor hygiene and sanitary practices employed by infected personnel who buy or sell these products. This is also in accordance with the assertion of Okonko *et al.,* (2008; 2009a; 2009b) that improper handling and improper hygiene might lead to the contamination of ready-to-eat foods and this might eventually affects the health of the consumers. Similar microorganisms were isolated by Abdalla *et al*., (2009); Okonko *et al.*, (2009a) from street vended ready-to-eat foods. Detection of *Staphylococcus epidermidis* in ready-to-eat food (sausage rolls) was observed in this study. Biological contaminant of bacterial origin represents a major cause of food–borne illnesses (Edema *et al.,* 2005). The presence of *Bacillus subtilis* has been correlated with food poisoning which is usually caused by meat dishes such as sausage rolls, meat pasties and stuffed poultry, but also includes pizza and whole meal bread (Gilbert *et al*., 1981; Kramer *et al*., 1982).

The presence of *Penicillium italicum, Penicillium notatum, Aspergillus flavus, Aspergillus parasiticus* and *Gliocephalis* spp in the food sample is not surprising as they are disperse in the form of spores which is abundant in the environment and can be introduced through dust and soil. Their presence in these food samples is of serious public health concern as they have all been implicated with the production of mycotoxins (Makun *et al*., 2009).

This study clearly confirmed the deplorable state of street vended sausage rolls over shop sold sausage rolls. Among the total bacteria counts, the Enterobacteriaceae family were mainly encountered. This is an indication of potential microbial contamination during distribution, storage and sales by contaminated human hands

and environmental factors. Their presence in large numbers in food indicates inadequate poor hygienic handling storage facilities.

Conclusions

Exposures during sale and before final consumption normally lead to the increase in microbial load. Lack of appreciation of basic safety issues by vendors contribute to increase of the microbial loads. Most food pathogens are of soil or intestinal origin and are transmitted through poor food preparation, personal hygiene or public sanitation practices. Therefore, to ensure the safety of the foods, producer and hawkers must maintain a clean environment, minimize contact with the food samples after production and also maintain a high level of personal hygiene. Constant provision of relevant and current information and the exposure to training programs for food vendors and consumers, by approved bodies, will enhance the consumption of wholesome ready-to-eat foods including snacks like sausage rolls.

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