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Incidence of Antibiotic Resistance in Some Bacterial Pathogens from Street Vended Food in Ogbomoso, Nigeria

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Abstract: This study was conducted to examine the level of bacterial contamination in some selected cooked food in Ogbomoso, Nigeria and to determine the antibiotic susceptibility profile of the bacterial contaminant. A total of nine (9) organisms were isolated, the isolates were subjected to various biochemical tests and the isolates were identified as *Bacillus licheniformis*, *Aeromonas hydrophila*, *Enterobacter aerogenes*, *Bacillus cereus*, *Proteus mirabilis*, *Pseudomonas putida*, *Proteus vulgaris*, *Pseudomonas chlororaphi* and *Proteus morgani*. Survival of isolates at different temperature ranges of 50-80°C was determined and it was discovered that as the temperature increased the growth of the isolates decreased. Survival of isolates at different pH ranges was determined using Spectrophotometer at wavelength of 560 nm as the pH changed to basicity from acidity growth of isolates increased. Effect of different concentration of Sodium Chloride (NaCl) on the growth of isolates shows that the rate of growth of isolates decreased as the concentration of NaCl increased. Finally, antibiotic susceptibility test was conducted and the result indicated 53.85% resistance while 46.15% are sensitive to the antibiotics.

Key words: Antibiotics, pH, NaCl, temperature, street vended food, bacterial contaminant

INTRODUCTION

The term 'street food' refers to a wide variety of ready-to-eat foods and beverages sold and sometimes prepared in public places, relatively cheap and easily accessible (Mensah *et al.*, 2002; FAO, 1989). Street food may be consumed where it is purchased or can be taken away and eaten elsewhere, the consumers who depend on such food are more interested in its convenience than in question of its safety and hygiene (Barro *et al.*, 2002b; Collins, 1997; Mensah *et al.*, 2002).

The consumption of street food is common in many Countries where unemployment is high, salaries are low, work opportunities and social programmes are limited and where urbanization is taking place. Street food vendors benefits from a positive cash flow, often evade taxation and can determine their own working hours (Collins, 1997). The hygiene aspects of vending operations are a major source of concern for food control officers, for examples, stands and often crude structures and running water may not be readily available. Also, toilets and adequate washing facilities are rarely available. The washing of hands, utensils and dishes is often done in buckets or bowls. Disinfection is not usually in no organized sewage disposal, so food is not adequately protected from flies and refrigeration is usually unavailable (Mensah *et al.*, 1999).

In addition, street foods (cooked) are subjected to cross contamination from various sources such as utensils, knives, raw foodstuffs, flies that are sporadically landing

on the foods, by vendors bare hand serving occasionally, food handling by consumers (Marks *et al.*, 1998; Bryan, 1988; Gorris, 2005). Ready-to-eat foods (street food) are processed (peeled, squeezed, cut up and/or cooked) and readily available for purchase and consumption. However, street foods have been implicated in the transmission of foodborne disease (Chomvarin *et al.*, 1993; Gillespie *et al.*, 2000; Fang *et al.*, 2003).

Foodborne illness is a major international health problem and an important cause of reduced economic growth (WHO, 1983). Foodborne illness of microbial origin is major cause of death in developing Countries (WHO, 2002a,b; Rehydration Project, 2004). The problems of food safety in the industrialized world differ considerably from those faced by developing Countries. Whereas, in developing countries traditional methods of processing and packaging, improper holding temperature, poor personal hygiene of food handlers are still observed during food marketing and technology (Barro *et al.*, 2002a, 2002b; Mensah *et al.*, 2002).

The use of antibiotic(s) after the intake of the organism(s) may not be effective as the organisms may be susceptible or resistant to it. Resistance to antibiotics in foodborne pathogens may create problems for disease or illness treatment while antibiotic susceptibility leads to healing of the illness which the organism(s) caused. Traveler's diarrhea is a major inconvenience to visitors arriving in developing Countries from more industrialized areas (Dupont *et al.*, 1982).

Foodborne illnesses affect people's health and well being as well as have an economic impact on individuals and nations. Diarrhea disease has been a major public health problem causing high morbidity and mortality among children especially in Thailand for many years (Bureau, 2004). Foodborne illness outbreaks from enteropathogenic bacteria, such as *Salmonella*, *Vibrio cholerae*, *V. parahaemolyticus* and *Staphylococcus aureus*, are common causes of foodborne infection throughout the world including Thailand (Chomvarin *et al.*, 1993; Mosupye and Von Holy, 1999; Adams and Moss, 2000; Bangtrakunonth *et al.*, 2004; Meldrum *et al.*, 2006).

Salmonella caused diseases ranging from diarrhea to septicemia. *Salmonellosis* from contaminated food generally causes diarrhea. *Aeromonas species* are an emerging important pathogens causing diarrhea and can be found in food and water (Kirov, 1993). They assess (i) the safety of food for consumers, (ii) adherence to good manufacturing practices, (iii) the keeping quality (shelf life) of perishable foods and (iv) the suitability of a food or ingredient for a particular purpose (Montville and Matthews, 2005). Therefore, isolation of relevant bacterial pathogens and indicator organisms is used to evaluate microbiological safety and quality of food.

Food contamination with antibiotic resistant bacteria can be a major threat to public health, as the antibiotic resistance determinants can be transferred to other pathogenic bacteria potentially compromising the treatment of severe bacterial infections. The prevalence of antimicrobial resistance among foodborne pathogens has increased during recent decades (Chui *et al.*, 2002; Davis *et al.*, 1999; Garau *et al.*, 1999; Threfall *et al.*, 2000).

In addition, the lack of stringent controls on antimicrobial usage in human health and particularly in animal production systems increases the risk of antibiotic resistant foodborne microbes. Also, *Enterococci* are common components of the micro-floral in soil, on plants and in water. These organisms are particularly challenging to eliminate because of their ability to adapt to environmental stresses. Thus, it is not surprising that antimicrobial resistant variants of *Enterococci* have been found within probiotic formulations (Giraffa, 2002). More so, in the clinical environment, *Enterococci* can persist for long periods of time on surfaces and can readily be transferred among patient population (O'Connell and Humphreys, 2000).

According to street foods studies carried out in Africa, their tremendous unlimited and unregulated growth have placed a severe strain on city resources such as water, sewage system and interferences with the city plan through congestion and littering adversely affecting daily life (Canet and N'Daiye, 1996; Barro *et al.*, 2002a). FAO and several authors stipulated that street vended food raise concern with respect to their potential for

serious food poisoning outbreak (Estrada-Garcia *et al.*, 2002, 2004; Collins, 1997; King *et al.*, 2000; Tjoa *et al.*, 1977; Umoh *et al.*, 1984), due to improper use of additives, the presence of pathogenic bacteria, environmental contaminants and improper food handling practices based on un-respect of good manufacturing practices and good hygiene practices (Barro *et al.*, 2002b; Canet and N'Daiye, 1996).

Vendors are often poor level education, unlicensed, untrained in food hygiene, technology and work under crude unsanitary conditions (Barro *et al.*, 2006; Muinde and Kuria, 2005). In the context of poverty, street food accounts for a part of the family income, daily diet and so contribute towards meeting nutritional requirements (Chakravarty and Canet, 1996), following example of the most developing Countries urbanization in West Africa generates many concerns as the difficult access to potable water, presence of different waste everywhere, lack of efficient drainage system, indeed in most Countries, organic wastes and sewage are discarded on the street which causes contamination through flies. Thus, street food importance has consequence such as its association to epidemic and disease outbreak in case of microbiological quality failure (Barro *et al.*, 2005; Cardinale *et al.*, 2005; Estrada-Garcia *et al.*, 2004; WHO, 2002b).

Traveler's diarrhea may be an important factor inhibiting tourism to developing Countries. In visitors to Mexico, approximately 80% of diarrhea is of bacteria origin (Dupont *et al.*, 1982). Epidemiological evidence has implicated food as an important vector of enteropathogenic bacteria (Ericson *et al.*, 1980; Tjoa *et al.*, 1979). Several authors have reported low level of enteropathogenic organisms in foods in various Countries including Sweden (Danielsson *et al.*, 1979), the United States (Sack *et al.*, 1977) and the Philippines (Echeverria *et al.*, 1978).

Jiwa *et al.* (1981) reported that enterotoxigenic organisms of many general were found in food and water in an Ethiopian community e.g. *E. coli*. Also, restaurant foods from Guadalajara (Mexico) were generally more contaminated with coliforms, the food samples from mexican restaurant in Houston contained enterotoxigenic bacteria including *Enterobacter aerogenes*, *Klebsiella pneumoniae* and was unable to isolate *Salmonella* or *Shigella*.

Antibiotic resistance of *E. coli* and *Salmonella* isolates was determined by the disk diffusion method using the standard procedure of the Clinical Standard Institute (CLSI, formerly NCCLS) (NCCLS, 2004). The isolates were classified as susceptible, intermediate, or resistant according to interpretation of the zone diameter standards recommended by CLSI (CLSI, 2005). Isolates were screened for antibiotic resistance against 15 antibiotics and 50.5% of the *Salmonella* isolates were found to be resistant to at least one antibiotic, on the

other hand 83.8% of *E. coli* isolates were resistant to at least one antibiotic. Also, multiresistance (resistance to at least three different classes of antibiotics) was detected in 20.9 of *Salmonella* isolates (Thi Thu Hao Van *et al.*, 2007).

Moreso, a study which was carried out by Chariya *et al.* (2006) to investigate the microbiological quality of ready to eat food in the Municipality of Khon Kaen, Thailand was recorded that four categories of 186 food samples were collected (i) high heat food (ii) low heat food (iii) no heat food (iv) on-site prepared fruit juices and beverages; 73% (145) were recorded to failed to meet acceptable and morphological standards, including fruit juice and beverages (100%), no heat food (91.7%), low heat food (81.7%) and high heat food (57.9%). Also, pathogenic bacteria were found in 6.5% of food samples, *Salmonella*, *Vibrio cholerae* and *Aeromonas hydrophila* were found in 4.3, 1.6 and 0.5% of the total food samples respectively and *Staphylococcus aureus* were found in 2.7% of the samples which resulted in that more than half of the ready-to-eat foods tested in Khon Ken did not meet microbiological national standards and many kind of enteropathogenic bacteria were found which may be a source of foodborne disease (Kirov, 1993; Fang *et al.*, 2003; Gillespie *et al.*, 2000; Ohasshi *et al.*, 1978; Mosupye and Holy, 1999).

Gillespie *et al.* (2000) studied and isolated 146 raw (minced, chicken, beef) and cooked (red meat, chicken) meat sampled which was analyzed for the presence of *Listeria spp.* The isolates were characterized by morphological, cultural and biochemical tests according to Bergey's Manual and was later confirmed by API-*Listeria* kit. It was recorded that out of a total of 146 meat samples, 79 (54.10%) were found to be contaminated with *Listeria spp.*; with the highest incidence (86.4%) occurring in raw minced meat. *Listeria monocytogenes* was isolated from 9 (6.16%) of the 79 samples examined by them. Other species isolated were *L. innocua* 68 (46.57%), *L. welshimeri* 1 (0.69%) and *L. murrayi* 1 (0.68%). In their conclusion, it was later discovered that *Listeria* strains isolated from meat and meat products were mostly resistant to cephalothin and nalidix acid but exhibited a high degree of susceptibility to kanamycin, chloramphenicol and tetracycline. The objectives of this study therefore are to isolate and characterize some bacterial pathogens from street vended food, evaluate the antibiotic susceptibility profile and the physiological properties of the isolates.

MATERIALS AND METHODS

The study was carried out in science laboratory Technology Dept., Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria between January, 2009 and December 2009.

Collection of samples: Street vended food samples were purchased from different selling point in Ogbomoso, South West Nigeria in January, 2009. The samples are moimoin, yam, spaghetti, beans, bean cake, rice, indomie. The samples were already cooked and ready to be eaten, the samples were purchased and aseptically transported to the laboratory for analysis.

Isolation of microorganisms: 10 g of each vended street food sample was mashed in sterile mortar and pestle and was serially diluted. 1 mL of an appropriate dilution was inoculated on sterile MacConkey agar and Nutrient agar, the plates were incubated for 24 h at 37°C. After 24 h, sterile wire loop was used to pick the isolate from the plate and was streaked on a freshly prepared nutrient agar then incubated for 24 h at 37°C in order to get pure culture. The routine laboratory method of Cruickshank *et al.* (1975) was used to characterize different isolates. The isolates were identified using their macroscopic, cellular, physiological and biochemical characteristics.

Antibiotics susceptibility test: Sterile nutrient agar medium was poured into sterile petri dishes and allowed to solidify. A suspension of the isolated organisms was transferred into petri-dishes accordingly and swab over the entire plate, it was then incubated for 1 h at 37°C and a forcep was used to transfer each sensitivity disc on the plate and incubated for 24 h at 37°C. The antibiotics used included Amoxyllin, Streptomycin, Chloramphenicol, Tetracycline, Gentamycin, Ofloxacin, Augmentin, Ciprofloxacin, Cotrimoxazole, Nitrofurantion, Ampiclox, Cefroxine and Erythromycin.

Survival of isolates at different temperatures ranges: Nutrient broth was prepared and dispensed into series of screw-capped bottles and sterilized. It was allowed to cool and the test organisms were inoculated into it, then incubated at different temperature ranges (50, 60, 70 and 80°C) for 24 h after which Cecil 2031 (automatic) spectrophotometer was used to detect increase or decrease in turbidity of the growth medium.

Growth of isolate at different pH ranges: Nutrient broth was prepared and the pH was adjusted using O.IM phosphate buffer of different pH to adjust the pH of the broth to 3.0, 5.0, 7.0 and 9.0. It was then dispensed into screw capped bottles and then sterilized in the autoclave at 121°C for 15 min. After cooling, the various test isolates were inoculated into it and incubated at 30°C for 48 h. Growth was detected by increase turbidity using Cecil 2031 (automatic) spectrophotometer. Uninoculated tubes serve as control. This test was done to detect the best pH that favours growth and metabolism as indicated by the increased turbidity (Schillinger and Lucke, 1989).

Growth of isolates in different concentration of NaCl:

Nutrient broth containing 2% (w/v), 3% (w/v), 4% (w/v) and 5% (w/v) NaCl was prepared and sterilized at 121°C for 15 min. 20 ml of the broth was dispensed into sterile screw capped vials aseptically. After cooling, the tubes were inoculated with the test organisms and incubated for 24 h at 30°C. Increased turbidity of the medium was recorded as positive for growth while a negative result shows no turbidity. Uninoculated tubes serve as control (Schillinger and Lucke, 1987).

RESULTS

A total of eleven (11) organisms were isolated from street food in Ogbomoso. *Bacillus licheniformis* and *Aeromonas hydrophila* was found present in Beans, *Enterobacter aerogenes* in Moinmoin, *Bacillus cereus* and *Proteus mirabilis* was present in rice, *Proteus mirabilis* and *Pseudomonas putida* in Spaghetti, also, *Proteus vulgaris* in Bean cake, *Pseudomonas chlororaphi* and *Pseudomonas putida* in Indomie and *Proteus morgani* was found in Yam (Table 1).

The isolates were differentiated on the basis of the cultural and cellular morphological studies, after which they were subjected to various biochemical and physiological test and the isolates were identified to be *Bacillus licheniformis*, *Aeromonas hydrophila*, *Enterobacter aerogenes*, *Bacillus cereus*, *Proteus mirabilis*, *Pseudomonas putida*, *Proteus vulgaris*, *Pseudomonas chlororaphi* and *Proteus morgani*.

Table 1: List of sources of isolates

Code	Source	Isolates
B: a	Beans	<i>Bacillus licheniformis</i>
B: b	Beans	<i>Aeromonas hydrophila</i>
Moi ₂	Moinmoin	<i>Enterobacter aerogenes</i>
W.R ₁	Rice	<i>Bacillus cereus</i>
W.R ₂	Rice	<i>Proteus mirabilis</i>
Spag ₁	Spaghetti	<i>Proteus mirabilis</i>
Spag ₂	Spaghetti	<i>Pseudomonas putida</i>
BC ₂	Bean Cake	<i>Proteus vulgaris</i>
Ind ₁	Indomie	<i>Pseudomonas chlororaphi</i>
Ind ₂	Indomie	<i>Pseudomonas putida</i>
Ya	Yam	<i>Proteus morgani</i>

Antibiotic susceptibility of all the isolated organisms were determined by agar diffusion method. All isolates were found resistant to Erythromycin (ERY), almost all isolates are resistant to Chloramphenicol (CHL) except *Bacillus licheniformis* with 10.5 mm. *Pseudomonas chlororaphi* and *Pseudomonas putida* with the zone of inhibition of 9.0 mm each were found sensitive to Nitrofurantion (NIT) while others were resistant; also, *Bacillus licheniformis* and *Bacillus cereus* were found sensitive to Streptomycin (STR) with 8.0mm and 13.5 mm respectively while others were resistant. Some isolates were found resistant and some sensitive to Cotrimaxazole (COT). Most isolates were resistant to Ceftrazone (CEF) except *Aeromonas hydrophila* and *Proteus mirabilis* with zone of inhibition of 11.0 mm each. For Amoxylin (AMX) almost every isolates were sensitive except *Aeromonas hydrophila* and *Proteus mirabilis*; *Enterobacter aerogenes*, *Proteus mirabilis* and *Proteus vulgaris* were found to be resistant to Ofloxacin (OFL) while other isolates were sensitive to it ; *Bacillus licheniformis*, *Proteus vulgaris* and *Proteus morgani* were resistant to Gentamycin (GEN); *Pseudomonas chlororaphi* was resistant to Pefloxacin (PEF) while the other isolates were found to be sensitive, almost all isolates were sensitive to Ciprofloxacin (CPX) except *Enterobacter aerogenes* and *Proteus vulgaris* that were resistant. *Bacillus licheniformis*, *Bacillus cereus* and *Proteus mirabilis* were resistant to Augmentin (AUG) while other isolates were sensitive to it. *Enterobacter areogenes*, *Proteus vulgaris*, *Pseudomonas chlororaphi* and *Pseudomonas putida* were sensitive to Tetracycline (TET) with zones of inhibition of 11.0, 12.5, 11.5 and 11.0 respectively some while other isolates were resistant to it (Table 2).

Spectrophotometer at a wavelength of 560nm was used to determine the effect of different pH ranges on the growth of isolates and it was found that rate of growth of the isolates was increasing as the pH of the medium changed from basic to acidic. The Optical Density (OD) reading shows that as pH increased from 3 to 9, *Bacillus licheniformis* increased from 0.065 to 1.564, *Aeromonas hydrophila* increased from 0.136 to 1.288, *Enterobacter aerogenes* increased from 0.109 to 1.291 and *Bacillus cereus* from 0.157 to 1.355 (Table 3).

Table 2: Antibiotic susceptibility profile of the isolates

Isolates	AMX	OFL	STR	CHL	CEF	GEN	PEF	COT	CPX	ERY	NIT	AUG	TET
<i>Bacillus licheniformis</i>	14.5	14.0	8.0	10.5	-	-	15.5	-	18.5	-	-	-	-
<i>Aeromonas hydrophila</i>	-	11.0	-	-	11.0	12.0	17.5	17.5	18.0	-	-	15.0	-
<i>Enterobacter aerogenes</i>	11.5	-	-	-	-	13.5	17.5	12.5	-	-	-	12.0	11.0
<i>Bacillus cereus</i>	15.5	18.5	13.5	-	-	12.0	19.0	-	18.5	-	-	-	-
<i>Proteus mirabilis</i>	-	-	-	-	11.0	-	14.5	-	16.0	-	-	-	-
<i>Proteus vulgaris</i>	11.0	-	-	-	-	14.5	19.0	-	-	-	-	13.5	12.5
<i>Pseudomonas chlororaphi</i>	14.0	13.5	-	-	-	18.5	-	-	18.5	-	9.0	13.5	11.5
<i>Pseudomonas putida</i>	11.5	13.0	-	-	-	16.5	19.0	-	15.5	-	9.0	10.5	11.0
<i>Proteus morgani</i>	11.5	15.5	-	-	-	-	15.5	10.0	15.0	-	-	8.0	-

Note: (-) Resistant

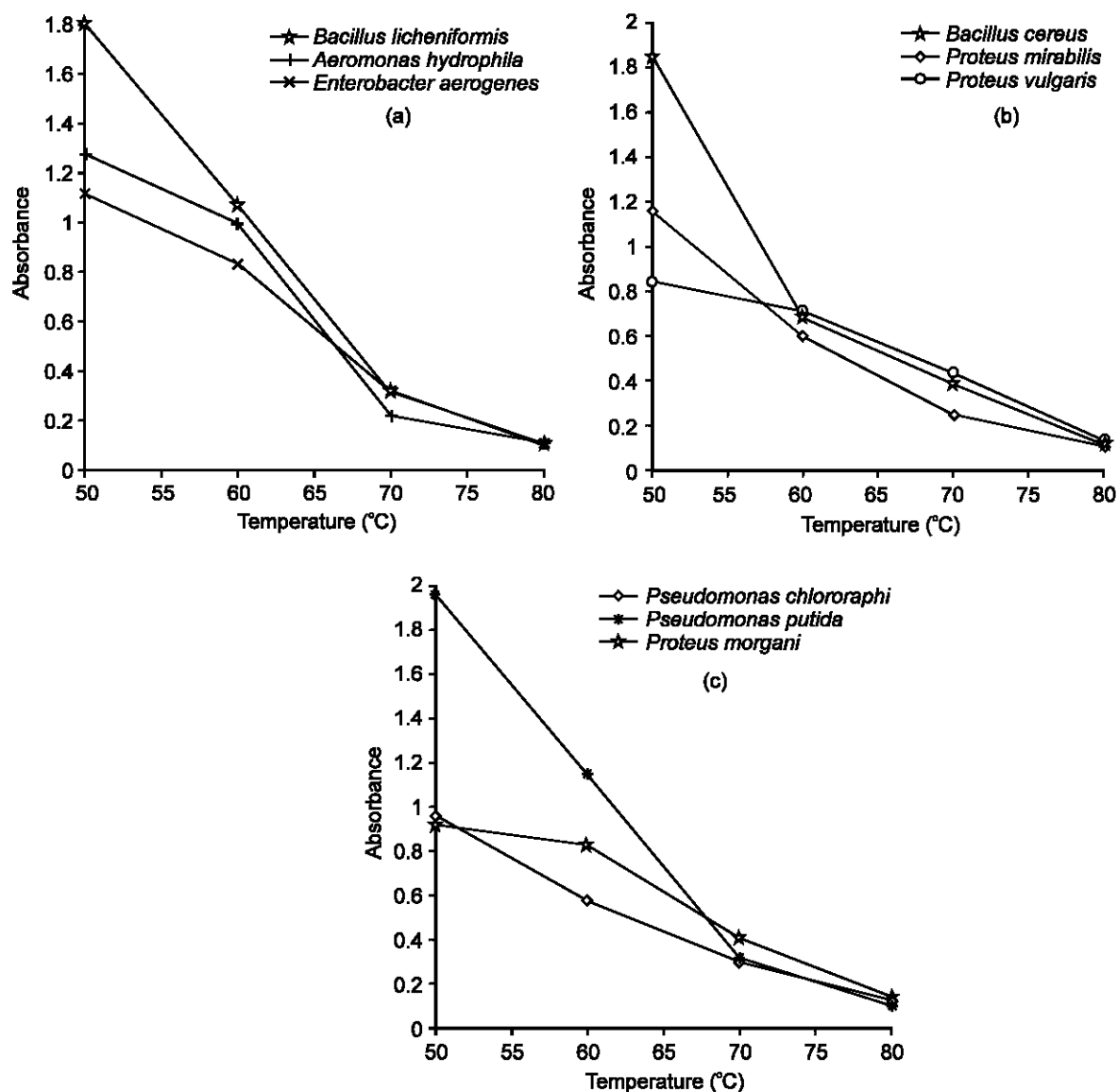


Fig. 1: Growth of isolates at different temperature ranges

Table 3: Growth at different pH ranges

Isolates	Growth of Isolates at different pH ranges (OD at 560 nm)			
	3	5	7	9
<i>Bacillus licheniformis</i>	0.065	0.936	1.360	1.564
<i>Aeromonas hydrophila</i>	0.136	1.100	1.253	1.288
<i>Enterobacter aerogenes</i>	0.109	1.140	1.242	1.291
<i>Bacillus cereus</i>	0.157	1.228	1.310	1.355
<i>Proteus mirabilis</i>	0.149	0.358	1.334	1.472
<i>Proteus vulgaris</i>	0.250	0.980	1.024	1.048
<i>Pseudomonas chlororaphi</i>	0.195	0.825	0.894	0.896
<i>Pseudomonas putida</i>	0.108	0.812	0.902	1.038
<i>Proteus morgani</i>	0.110	0.608	1.176	1.253

The effect of different temperature ranges on growth rate of the isolates was determined and it was found that

rate of growth of the isolates was decreasing as the temperature of the medium was increasing. The Optical Density (OD) reading shows that as temperature increased from 50-80°C, *Bacillus licheniformis* decreased from 1.800 to 0.101, *Enterobacter aerogenes* decreased from 1.112 to 0.101, *Proteus mirabilis* decreased from 1.152 to 0.103 and *Pseudomonas chlororaphi* from 0.958 to 0.120 (Fig. 1a, 1b and 1c) etc. Effect of different concentration of Sodium Chloride on the test isolates was determine by using Spectrophotometer at wavelength of 560 nm, it was found that as the rate of concentration of NaCl increased, the rate of growth of isolates decreased. The Optical Density (OD) reading shows that as concentration of sodium chloride increased from 2-5%,

Table 4: Survival of isolates at different concentration of sodium chloride (NaCl)

Isolates	Growth of isolates at different NaCl ranges (OD) at 560 nm			
	2%	3%	4%	5%
<i>Bacillus licheniformis</i>	1.516	1.059	1.054	0.467
<i>Aeromonas hydrophila</i>	1.961	1.074	0.800	0.615
<i>Enterobacter aerogenes</i>	0.947	0.883	0.732	0.695
<i>Bacillus cereus</i>	1.971	0.652	0.545	0.120
<i>Proteus mirabilis</i>	1.213	1.089	0.879	0.731
<i>Proteus vulgaris</i>	1.028	0.891	0.697	0.558
<i>Pseudomonas chlororaphi</i>	1.157	1.145	1.100	0.956
<i>Pseudomonas putida</i>	1.124	0.936	0.574	0.467
<i>Proteus morgani</i>	1.523	1.035	0.527	0.101

Aeromonas hydrophila decreased from 1.961 to 0.615, *Proteus vulgaris* decreased from 1.028 to 0.558, *Pseudomonas putida* decreased from 1.124 to 0.467 and *Proteus morgani* from 1.523 to 0.101 and so on (Table 4).

DISCUSSION

The result of this study demonstrated that the food samples vended for consumer consumptions were contaminated by pathogenic bacteria which if ingested may be deleterious to consumers' health and may lead to foodborne illness or disease.

Antibiotic susceptibility results indicated 53.85% resistance and 46.15% sensitivity among vended food isolates. The prevalence of antimicrobial resistance among foodborne pathogens has increased during recent decades (Boonmar *et al.*, 1998a,b; Chui *et al.*, 2002; Davis *et al.*, 1999; Threfall *et al.*, 2000), possibly as a result of selection pressure created by the use of antimicrobials in food-producing animals (Aarestrup 1999; Angulo *et al.*, 2000; Bywater, 2004; Teuber, 2001; Van den Bogaard and Stobberingh, 2000). The coexistence of resistance genes with mobile elements such as plasmids, transposons and integrons facilitates the rapid spread of antibiotic resistance genes among bacteria (Sunde, 2005). Also, high rates to antibiotics resistance of bacteria may possibly resulted from inappropriate or uncontrolled use of antibiotics in farming practices, so it is necessary to pay more attention to food hygiene practices to reduce or eliminate the risk from antibiotic resistance and pathogenic bacteria originating from food. In addition, the use of antibiotics in animal feeds need to be regulated strongly to minimize the opportunity for organisms to develop resistance (Thi Thu Hao Van *et al.*, 2007).

Most of the organisms isolated have being reported to adapt to environmental stress and as a result, it is always a challenge to eliminate them from the environment. This fact is reflected in the physiological study of the isolates. Increasing physiological parameters such as temperature and sodium chloride did not eliminate but rather reduced the rate of growth of the vended food isolates.

The results of this study have illustrated the extent of antibiotic resistance in all the isolated organisms found. It is necessary to pay more attention to food hygiene practices to reduce or eliminate the risk from foodborne pathogens; especially those that are originated from street food. Also, strict implementation of food sanitation code and license for street food vendors is needed to make the consumers save. If possible, public health authorities should intensify efforts to monitor conditions of sanitation and hygiene in establishment serving food and drink to the public.

So, food safety education is a critical part of the overall strategy to reduce the incidence of foodborne illness and complements regulatory and other activities. However, meeting the huge challenge of food safety in the 21st Century will require the application of new methods to identify, monitor and access foodborne hazard. Both traditional and new technologies for assuring food safety should be improved and fully exploited. This need to be done through legislative measures where suitable, but much greater reliance on voluntary compliance and education of consumers and professional food handlers.

Finally, it is necessary for public health organizations to be concerned since microorganisms causing foodborne hazards and food spoilage can be isolated from raw materials and finished products; thus reduction of contamination is an achievable policy objective.

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