academicJournals

Vol. 7(4) pp. 71-75, April 2013
DOI: 10.5897/AJFS2013.0977
ISSN 1996-0794 ©2013 Academic Journals
http://www.academicjournals.org/AJFS

African Journal of Food Science

Full Length Research Paper

Studies on foodborne bacteria in commercially hawked ready-to-eat fish in Jos and its environments

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Accepted April 18, 2013

Studies on foodborne bacteria in hawked fish (*Trachurus capensis*) were carried out with 200 flesh and 24 surface swab samples collected at various selling points in Jos and surrounding suburbs. The samples were separately cultured in bacteriological broth and agar media. The isolates were identified and their viable counts determined. The analysis gave the following bacteria species: *Escherichia coli*, 26 (16.8%); *Bacillus* species, 25 (16%); *Shigella* species, 22 (14.2%); *Staphylococcus aureus*, 19 (12.6%); *Proteus* species, 12 (7.7%); *Klebsiella* species, 8 (5.2%); *Neisseria catarrhalis*, 6 (3.9%); *Staphylococcus epidermidis*, 4 (2.6%); *Streptococcus faecalis*, 4 (2.6%); Enterobacter species, 4 (2.6%); *Pseudomonas* species, 2 (1.2%); *Lactobacillus* species, 2 (1.2%) and *Citrobacter* species, 1 (0.6%). These results show the bacteria load species distribution in the hawked fish. The result is quite informative with respect to public health hazard and calls for urgent improvement in sanitation maintenance of good hygiene by food producers, handlers and vendors in the study area as a possible control measure through the processing chain.

Key words: Foodborne bacteria, Fish, *Trachurus capensis,* bacterial load, Public Health.

INTRODUCTION

Ready-to-eat foods can be described as the status of food being ready for immediate consumption at the point of sale. These could be raw, undercooked or cooked, hot or chilled and can be consumed without further heat treatment (Tsang, 2002). Different terms have been used to describe such ready-to-eat foods. These include convenient, ready or instant and fast foods, such as pastries, meat pie, sausage, rolls, burger, salad or coleslaw, fried meat, fried chicken, milk and milk products and fish (Caserani et al., 1974; Patience et al., 2002).

Fish has been an important source of protein for humans throughout recorded history. They are harvested either from wild fisheries or farmed in much the same way as livestock and poultry. They are also exploited by recreational fishers and fish-keeper, and are exhibited in public aquaria (Tidwell and Allan, 2001).

In other to meet the fish food demand, there is the possibility of contamination during the processing, preparation and packaging of the fish, it may encounter bacteria which may make it unsuitable for consumption. Torok et al. (1997) stated that outbreaks of food borne diseases are caused by foods that are contaminated intrinsically or extrinsically during harvesting, processing or preparation. The bacteria may come from the fish contact surfaces,

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the surrounding environment as well as fish handlers or vendors. Sapers et al. (2005) and Peariso (2005) stated that, during food processing, contamination is possible from infected food handlers and that poor hygiene is a major factor.

Serious consequences relating to national productivity and development can arise from lack of hygiene and sanitation in such outlets. There have been several reports on the health risks associated with the consumption of processed seafood, ranging from allergic reactions, stomach and intestinal cancerous growths, a general degeneration of peripheral cellular tissues to gradual breakdown of the digestive and excretive systems (Edema et al*.,* 2005).

Phyllis (2007) illustrates how critical factors come together to produce tragic and large preventable results. Modern microbes often team up with old practices, short sighted decisions, or current consumer trends to produce an outbreak. Recipes that do not include an adequate final cooking step have become increasingly popular with consumers and can be a significant source of food borne illness. According to Higgins (2007), anyone who works in food safety sooner or later discovers that one of the most valuable tools for prevention is simply reading about and understanding how past outbreaks have occurred. This study is aimed to evaluate the bacterial load and distribution of bacterial pathogens in processed ready-to-eat *Trachurus capensis* at some of their various sale outlet points in Jos metropolis and its environs.

MATERIALS AND METHODS

Sample collection

Ready-to-eat fried fish (*T. capensis*) samples were purchased from the different selling spots located in the Jos and its environs. These include the Jos, Bukuru, Kaduna-Vom (K-Vom) and Vom Christrian (Vwang) areas and screened for pathogenic bacteria. Outlets such as, hawkers, kiosks and restaurants were utilized. A total of 200 fish (*Trachurus capensis*) were purchased from all the selling spots; 20 each were bought from the kiosks and hawkers, while 10 each from the restaurants in each of the location. These were collected from April 2010 to May 2010.

The samples were aseptically collected separately in sterile paper foils and labeled accordingly. They were immediately transported to the bacteriology laboratory, Federal College of Veterinary and Medical Laboratory Technology (FCVMLT) Vom for prompt analysis. The sterile swab sticks were dipped into sterile nutrient broth and selenite fluid respectively which were then used to swab the contact surfaces (10 x 10 cm^2) utilized by the vendors for the preparation and hawking of the fishes such as cutting boards or working tables, showcases and hawking trays. They were also conveyed alongside the fish samples immediately to the college bacteriology laboratory for prompt analysis.

Enumeration of bacteria load

The outer layer of the fish samples were aseptically swabbed with sterile swab sticks. The swab stick samples were held into Bijou bottles containing 5 ml each of sterile nutrient broth. They were cut aseptically into the bottles using sterile scissors. Bacterial load of each of the fish sample was enumerated by carrying out bacterial colony count using the Miles and Mizras method of bacteria colony count (Ochei and Kolhatkar, 2008).

Culture

The outer layers of the fish samples were aseptically swabbed with sterile swab sticks. The swabbed samples held into the respective sterile Bijou bottles containing the nutrient broths and selenite fluids separately were cut using sterile scissors. They were incubated at 37°C overnight.

The swabbed sample from the contact surfaces used by the fish vendors were also cut aseptically into the respective sterile bijou bottles containing the nutrient broth and selenite fluid respectively. These were similarly incubated at 37°C overnight.

All the organisms observed to grow both in the nutrient broth and selenite fluid culture were aseptically sub-cultured onto blood agar and MacConkey agar. The blood agar plates were incubated both aerobically and anaerobically while the MacConkey agar plates were incubated aerobically at 37°C overnight. The organisms in the selenite fluid were aseptically sub-cultured using a sterile wire loop unto *Salmonella Shigella* agar and were incubated aerobically at 37°C overnight.

All the organisms observed to grow in any of the culture plates were picked and sub-cultured unto nutrient agar slopes and stored in the refrigerator for further test for identification and characterization.

Identification and characterization of bacteria isolates

The cultural characteristics of the isolates were examined based on colonial morphology (macroscopically and microscopically), physiologically and biochemically according to Barrow et al*.* (1993).

RESULTS

A total of 224 samples (200 fish samples, *T. capensis* and 24 swab samples) were analyzed. All the 224 samples (100%) were found positive that is, all samples yielded growths of at least one bacterium species. The highest total coliform counts of 5.7 x 10^{11} cfu/ml was obtained in fish samples at Jos area followed by 5.6 x 10^{11} cfu/ml at Bukuru area, 3.7 x 10^{11} cfu/2 ml at K-Vom area and 3.0 x 10^{11} cfu/ml at Vwang. Table 1 shows the distribution of swab samples collected from the different areas, selling points and their numbers. Table 2 shows bacteria isolates from fish samples, their distribution and occurrence rates. Table 3 shows the bacteria isolates from fish at different bacteria species total and mean distributions at the various locations. The histogram illustrating comparatively the percentage occurrence of bacterial isolates is shown in Figure 1.

The bacteria isolates included; *Salmonella* species*, Bacillus* species*, Proteus* species, *Citrobacter* species*, Shigella* species*, Enterobacter* species*, E. coli, Klebsiella* species, *Lactobacillus* species, *Neisseria catarrhalis, Pseudomonas* species, *S. aureus, S. epidermidis and S. faecalis*.

DISCUSSION

The presence of a good number of aerobic bacterial isola-

Table 1. Total coliform count and their distribution at the various selling points

Location		Total coliform count (cfu/cm^2)	Number of sample
Jos	Hawkers	3.1 x 10^{11}	20
	Kiosks	2.5 x 10^{11}	20
	Restaurants	5.1 x 10^{9}	10
	Total	**5.7 x 10^{11}**	**50**
Bukuru	Hawkers	3.3 x 10^{11}	20
	Kiosks	2.3 x 10^{11}	20
	Restaurants	4.0 x 10^{9}	10
	Total	**5.6 x 10^{11}**	**50**
Vwang	Hawkers	2.6 x 10^{11}	20
	Kiosks	3.2 x 10^{10}	20
	Restaurants	4.8 x 10^{9}	10
	Total	**3.0 x 10^{11}**	**50**
K/Vom	Hawkers	3.4 x 10^{11}	20
	Kiosks	2.6 x 10^{10}	20
	Restaurants	3.8 x 10^{9}	10
	Total	**3.7 x 10^{11}**	**50**

tes give an overall picture of the level of contamination of fried fish (*T. capensis*) and the sanitary conditions of its preparation and handling. The results obtained in this study are highly suggestive that these products are prepared and sold under conditions that would permit the survival and multiplication of various organisms. The presence of these isolates which included some pathogenic bacteria can pose serious public health problems to the unsuspecting consumers.

According to Doyle and Evans (1999), food borne diseases are diseases resulting from ingestion of bacteria, toxins and cells produced by microorganisms present in food. During food processing, contamination is possible from infected food handlers as poor hygiene is a factor (Sapers et al*.,* 2005; Peariso, 2005). *E. coli* and *S. aureus* are normal flora in human and animals, their presence in foods are indications of excessive human handling (Adamolekun and Adamolekun, 1992).

In Nigeria, a number of ready-to-eat foods have been reported to have high incidence of pathogenic bacteria (Adesiyun 1995; Chukwu et al*.*, 2006; Chukwu et al*.*, 2009; Okonko et al*.*, 2009). *E. coli*, *Klebsiella*, *S. aureus*, *Bacillus* species, *Enterobacter* and *Pseudomonas* has been isolated from foods implicated in illness (Oluwafemi and Simisaye, 2005; Okonko et al*.*, 2009). *S. aureus* can cause food poisoning even with very small amount (100 to 200 µg) of its heat stable enterotoxin (Evenson et al*.*, 1988; Jay, 2000). *E. coli* were found to be the most prevalent bacteria in all the fish samples analyzed followed by *Bacillus* species. *Staphylococcus* species are normal flora of human body and is found on the skin cavities, mucous membranes and also in the air. Based on these reports, it is not surprising that the fish samples screened, tested positive to *S. aureus* isolates. Handling and aerial microbial load could therefore be the major sources of contamination in hawked foods. The reservoir of *Salmonella* in the environment is the intestinal tract of animals such as chickens, turkey and pigs; man too can act as a carrier of *Salmonellae*. Both the animal and human sources play an important role in cross contamination of cooked foods.

Bacteria colony count of the fried fish samples were also carried out with the highest total coliform counts of 3.3 x 10^{11} being obtained from hawkers followed by 2.5 x 10^{11} from kiosks which shows exposure to contamination. This study has revealed high contamination of the ready-to-eat fish from the highest dilution calls for proper reheating before consumption. Bacteria like *Bacillus* species are readily present in air and dust. Contamination of ready-to-eat fried fish may also result from other sources like the utensils used in the preparation, water used in the washing of the fishes, working tables, showcases and trays used in processing and carrying of the fishes. The isolation of *Neisseria catarrhalis* in the fish may also indicate some unhygienic practices of the food handlers or the consumers because this bacterium is a normal flora in nasal or respiratory tract, its presence therefore would indicate sneezing or coughing over the products at one stage or another.

Of all the isolates, *E. coli* had the highest percentage occurrence of 26 (17%) followed by *Bacillus* species, *25* (*16%); Shigella* species, 22 (14%); *Salmonella* species, 20 (12.5%); *S. aureus*, 19 (12.3%); *Proteus* species, 12 (7.7%); *Klebsiella*, 8 (5.2%), *Neisseria catarrhalis*, 6 (3.9%); *Enterobacter* species, 4 (2.5%); *S. epidermidis* 4 (2.5%), *Streptococcus faecalis*, 4 (2.5%); *Lactobacillus* species 2 (1.2%); *Pseudomonas* species, 2(1.2%) and *Citrobacter* species 1 (0.6%).

Total bacteria isolates from the kiosks and hawked products are 38.71 and 40.00%, respectively higher than that from the restaurant with 21.29%. This could be attributed to a number of reasons; Hawkers and kiosks vendors usually do not cover the fishes during and after preparation. Some buyers often have the habit of inspecting the fish products with their bare hands while talking or sneezing before finally choosing the one they want thereby contaminating them. Food poisoning/ illnesses are entirely preventable by practicing good sanitation and food handling techniques (Betty and Richard, 1994). If the monitoring of the bacteriological quality of this fish food can be improved during preparation, handling and sampling, the bacterial load of the fish products (*T. capensis*) can be eliminated.

In conclusion, all the fish samples analyzed appears to be contaminated with bacteria. This culminates a potential public health danger if allowed unaddressed or unabated. The Public Health Officers in Jos and its environs

Table 2. Bacteria Isolate from Fish Samples, their distribution and occurrence rates

Location	Number collected	Number positive	% Positive	Bacteria	Number of Isolate	% Occurrence
Jos	56	54	98.2	*Escherichia coli*	8	14.8
				Streptococcus faecalis	4	7.4
				Proteus spp.	5	9.2
				Staphylococcus aureus	8	14.8
				Shigella spp.	10	18.5
				Pseudomonas spp.	2	3.7
				Bacillus spp.	10	18.5
				Salmonella spp.	6	11.1
				Neisseria catarrhalis	1	1.9
Bukuru	56	49	87.5	*Neisseria catarrhalis*	5	10.2
				Enterobacter spp.	4	8.2
				Bacillus spp.	6	12.2
				Salmonella spp.	8	16.3
				Escherichia coli	10	20.4
				Staphylococcus aureus	5	10.2
				Staphylococcu epidermidis	4	8.2
				Klebsiella spp.	3	6.1
				Proteus spp.	4	8.2
Vwang	56	26	46.4	*Citrobacter* spp.	1	3.9
				Escherichia coli	3	11.5
				Lactobacillus spp.	2	7.7
				Klebsiella spp.	3	11.5
				Shigella spp.	6	23.1
				Bacillus spp.	5	19.2
				Staphylococcus aureus	6	23.1
K/Vom	56	26	46.4	*Escherichia coli*	5	19.2
				Bacillus spp.	4	15.4
				Salmonella spp.	6	23.1
				Klebsiella spp.	2	7.7
				Proteus spp.	3	1.5
				Shigella spp.	6	23.1
Total	**224**	**155**	**69.2**		**155**	

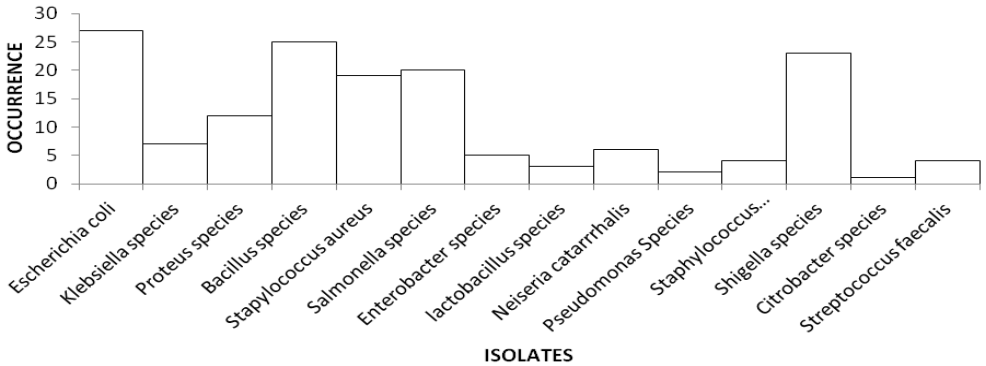

Figure 1. Histogram showing the percentage occurrence of bacteria isolates.

Table 3. Bacteria isolates from fish and their mean distribution

Bacterial Isolate	Kiosk	Hawker	Restaurant	Total	Mean (X)
Escherichia coli	9	11	6	26	8.67
Klebsiella species	3	3	2	8	2.67
Proteus species	6	5	1	12	4.00
Bacillus species	9	12	4	25	8.33
Staphylococcus aureus	7	7	5	19	6.33
Salmonella species	7	8	5	20	6.67
Enterobacter species	2	2	0	4	1.33
Lactobacillus species	0	2	0	2	0.67
Neisseria catarrhalis	4	2	0	6	1.33
Pseudomonas species	1	1	0	2	0.67
Stapylococcu epidermidis	2	0	2	4	1.33
Shigella species	10	6	6	22	7.33
Citrobacter species	0	1	0	1	0.33
Streptococcus faecelis	0	2	2	4	1.33
Total	**60**	**62**	**33**	**155**	**51.66**

should screen food - handlers periodically, so that carriers or sufferers of communicable diseases can be disallowed from handling foods meant for other people and should be treated as well. Public health officers should inspect the premises meant for preparation and selling of foods periodically. The public health unit should organize basic training on personal hygiene for food handlers. This will go a long way in improving the hygienic standards of their food products.

ACKNOWLEDGEMENT

The authors are grateful to the staff of the Departments of Molecular Biology and Bacteriology of Federal College of Veterinary and Medical Laboratory Technology, Vom for their assistance in sampling. Also, to the Staff of Central Diagnostic Laboratory, National Veterinary Research Institute, Vom for their assistance in sample diagnosis.

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