Nigerian Vetrinary Journal 2007 Vol. 28(1): 21-26

OCCURRENCE OF FOODBORNE BACTERIAL PATHOGENS IN SMOKED FISH AT RETAIL LEVEL IN JOS, NIGERIA

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SUMMARY

Sixty five (65) smoked fish samples (30 catfish and 35 *Tilapia*) were obtained form three retail market locations in Jos South, Nigeria, and screened for foodborne bacterial pathogens. Potential human pathogens were isolated from all the samples studied through culture, growth characteristics, morphological, physiological and biochemical reaction of substrates and enzyme activities. Organisms isolated include *Staphylococcus aureus*, 29 (44.6%), *Listeria monocytogenes* 6 (9.2%), *Pseudomonas aeruginosa* 7 (10.7%), *Proteus mirabilis* 5 (7.7%), *Escherichia coli* 1 (1.5%), *Bacillus cereus* 2 (3%) and *Yeast* cells 10 (15.4%). However, there were no significant differences (P>0.05) in the occurrence of the isolates and the markets sampled. This study reveals that smoked fish sold on the retail market in Jos, Nigeria could be a potential source of foodborne bacterial pathogens if not properly handled. Improvements in processing and handling are required, and the need for foodborne bacterial disease surveillance is indicated.

KEY WORDS: Foodborne, Bacterial pathogens, Smoked fish, Retail, Nigeria.

INTRODUCTION

Foodborne infection, one of the most common ailments that afflict man, has recently become an emerging public health concern. Millions of people suffer from foodborne illness yearly and most of these infections go undetected and unreported (Mahon, 1998). Factors such as new food vehicles of transmission, poor processing and storage methods, consumer lifestyle and eating trends have been attributed to the increased risk for foodborne infection (Mahon, 1998). Between 1992 and 1999, 1425 general foodborne outbreaks of Infectious Intestinal Disease (IID) were reported in England and Wales. Of these, 148(10%) were associated with the consumption of fish and shell fish (Gillespie et al., 2001). Smoked fish is a fish slowly cooked on a rack from smoldering hardwood at a high temperature reaching up to 82°C to give a firm and flaky product infused with smoke flavor, yet remaining moister than grilled fish (Harlow, 1987) .Fishery products are an excellent source of protein, calcium and other minerals such as phosphorus, iron, selenium, potassium and vitamins which are all important for achieving and maintaining good health (Kromhout *et al.*, 1985; Darlington and Stone, 2001). However, fishery products also act as a vehicle of foodborne pathogens (Hassan *et al.*, 1994; Wallace *et al.*, 1999; Harrera *et al.*, 2006).

Worldwide, only a small fraction of foodborne outbreaks due to seafood are reported. Huss *et al.*, (2000) noted that seafood accounts for up to 10% of all foodborne outbreaks in most

countries. Several reports exist on the microbiology of smoked fish produced in different countries (Hassen and Huss, 1998; Hansen *et al*, 1998; Heinitz and Johnson, 1998; Gonzalez Rodriguez, 2002). In Nigeria, although there are no available surveillance data on foodborne disease (FAO, 2004), laboratory studies have revealed the presence of foodborne pathogenic bacteria in some ready-to-eat foods such as milk and milk products, and processed meat (Shehu and Adesiyun, 1990; Umoh *et al.*, 1990; Owhe Ureghe *et al.*, 1993; Chukwu, *et al.*, 2006).

With the increasing cost of meat, consumers have become increasingly interested in fish as a source of dietary protein. Fresh fish spoil easily and need to be properly preserved. There are several methods of fish preservation, some of which includes freezing, irradiation, canning, salting and drying, pickling and smoking (Schafer, 1990). Smoking is one of the oldest methods of preserving fish. Today, fish smoking is no longer necessary, but it remains very popular especially in less developed countries (Harlow, 1987). On the other hand, if the process is not handled correctly, smoked fish products can support the growth of pathogenic bacteria (Gonzalez Rodriguez *et al.*, 2002). The high incidence of diarrhea among newborns and young children are indications of alarming food hygiene situation in Nigeria. Surveillance of foodborne diseases is inadequate or non existent, which hinders government's ability to truly assess the impact of food contamination problems on public health (FAO, 2004). This study reports the occurrence of bacterial pathogens in smoked fish displayed at the retail markets in Jos, Nigeria.

MATERIALS AND METHODS

Sampling

Sixty five (65) samples of smoked fish (30 catfish and 35 *Tilapia*) displayed for sale were obtained at random from three local markets (about four to ten fish sellers per market) in Jos South, Nigeria. One, two or three samples were obtained at each selling point in the market depending on the quantity displayed for sale every 2 weeks for a period 6 weeks. This comprises of 29(44.6%) samples from Bukuru market, 18(27.7%) and 18(27.7%) from K-Vom and Vwang markets respectively. The samples were collected into polythene bags as traditionally packaged and immediately transported to the laboratory for analysis.

Bacteriology

Ten (10) grams of each intact specimen was pulverized with an autoclaved surface pestle and mortar and then homogenized into sterile labeled bottles containing Nutrient broth and incubated at 37°C for 24hours. Each sample was inoculated by streaking onto blood agar and MacConkey agar, and incubated at 37°C for 24hours. Twenty-four hour cultures were further purified by sub-culturing onto blood agar and incubated at 37°C for 24 hours. Suspected bacterial isolates were identified by morphological, physiological and biochemical characteristics. These included colonial appearance of bacterial isolates on plates, Gram reactions, motility at room and 37°C temperatures and fermentation reactions on substrates of glucose, lactose, sucrose, xylose, rhamnose, mannitol, maltose and enzyme activities on Hydrogen peroxide (catalase), urea (urase) and oxidase as described by Barrow *et al*, (1993).

RESULTS

Table I summarizes the prevalence of foodborne bacterial pathogens from the fish sampled from retail markets. *Staphylococcus aureus*, which accounted for 29 (44.6%) had the highest prevalence rates. *Pseudomonas aeruginosa* was detected in 7 (10.7%), *Listeria monocytogenes* in 6 (9.2%), while *Proteus mirabilis* in 5 (7.7%) of the tested samples, *Escherichia coli* and *Bacillus cereus* were detected only in the catfish samples at a prevalence rate of 1 (1.5%) and 2 (3%) respectively. Fungal growth (mainly yeast) was demonstrated in 10 (15.4%) samples.

The occurrence of foodborne pathogens according to retail market is presented in Table II. *Staphylococcus aureus, Pseudomonas aeruginosa, Listeria monocytogenes, Proteus mirabilis, Escherichia coli, Bacillus cereus* and yeast cells were detected in the samples from Vwang retail market. *Proteus mirabilis*, *Escherichia coli* and *Bacillus cereus* were not

detected in samples from Bukuru market while only *Escherichia coli* was not detected in samples from K-Vom market. There were no significant differences (P>0.05) in the occurrence of the bacterial isolates, and the markets sampled.

TABLE I: Incidence of food borne bacterial pathogens in smoked fish on the retail market

Isolates	Cat fish (30)*	*Tilapia* (35)	Total number (65)
staphylococcus aureus	16	13	29 (44.6%)
Listeria monocytogenes	4	2	6 (9.2%)
Pseudomonas aeruginosa	3	4	7 (10.7%)
Proteus mirabilis	3	2	5 (7.7%)
Escherichia coli	1	0	1 (1.5%)
Bacillus cereus	2	0	2 (3%)
Yeast cells	6	4	10 (15.4%)

* Number of samples examined
† Number of positive samples

TABLE II: Presence of foodborne bacterial pathogens in the different retail market in Jos, Nigeria

	Number of positive isolates						
Market source	***Staphylococcus aureus***	***P. aeruginosa***	***L. monocytogenes***	***Proteus mirabilis***	***E. coli***	***Bacillus cereus***	**Yeast cells**
Bukuru 29*	12 (41.4)	3 (10.3)	2 (6.9)	0 (0.00)	0(0.00)	0(0.00)	2 (6.4)
K-Vom 18	10 (55.6)	3 (16.7)	1 (5.6)	2 (11.1)	0(0.00)	1 (5.6)	3 (16.7)
Vwang 18	7 (38.9)	1 (5.6)	3 (16.9)	3 (16.7)	1 (5.6)	1 (5.6)	5 (27.8)

There were no statistical differences (P>0.05) in the occurrence of the isolates and the markets sampled.
P- Pseudomonas; L- Listeria; E- Escherichia
* Number of samples examined
† Number of samples positive
( ) Percentage

DISCUSSION

The presence of these potential human bacterial and yeast pathogens in smoked fish at retail level pose a very serious health hazard to the consuming public in our locality because they can be a source of foodborne diseases (Listeriosis, Salmonellosis and Colibacillosis) if not properly handled.

This study shows a prevalence rate of 44.6% for *Staphylococcus aureus*. The detection of *Staphylococcus aur*eus from the samples in our study agrees with earlier report by Gonzalez Rodriguez *et al.* (2002) from the temperate areas. It has been postulated that all coagulase-positve *S. aureus* produce enterotoxins (Buchanan and Gibbons, 1974) and counts of S. aureus in food (meat) above 100CFU/gram is considered unwholesome (Ajogi *et al,. 2005)*. The enterotoxins produced by this bacterium are heat stable and are not affected by processing temperatures (Tatimi, 1981). Herrera *et al.*, (2006) reported that Staphylococcal food contamination is usually traced to workers who are carriers and/or to contact with inadequately cleaned equipment.

The presence of *Listeria monocytogenes* 6(9.2%), an organism which is pathogenic to humans is also of importance. *L. monocytogenes* is an environmental contaminant (Donelly *et al*, 1992; Jinneman *et al*, 1999; Chukwu *et al*, 2004) therefore, contamination can occur from environmental transfer during processing, transportation and handling at the retail level (Gubdjornsdottir *et al*, 2004; Herrera *et al*, 2006).

Pseudomonas aeruginosa and *Proteus mirabilis* produce severe Pneumonia. *Escherichia coli* were isolated in the smoked catfish (1.5%) and only in samples from Vwang market. There are hundreds of strains of

this bacterium. Most are harmless, however, *Escherichia coli* 0157:H7 produces a toxin that can cause severe foodborne illness. Symptoms typically develop within 2-5 days of infection and can include severe bloody diarrhea and stomach cramps. In young children, the elderly and immunocompromised individuals, infection can lead to hemolytic uremic syndrome (HUS), causing destruction of the red blood cells and kidney failure (Shehu and Adesiyun, 1990; Abram, 1995). *Bacillus cereus* is also responsible for food poisoning (Benenson, 1995). Fungal growth (yeast cells) are said to be common in smoked fish (Gonzalez- Rodriguez *et al.* 2002). However, their presence in large number may affect the quality of the product (Laroi *et al*, 2001). The common practice of unhygienically displaying smoked fish on the ground without being prepackaged in any form or protected from dust and flies in local markets is of great concern.

CONCLUSION

In conclusion, we found that smoked fish at the retail level in Nigeria is a potential source of foodborne bacterial pathogens and therefore poses a problem to public health. The isolation of *S. aureus, E. coli, B. cereus* and *L. monocytogenes* reveals the danger associated with smoked fish to consumers. This emphasizes the need for authorities to enhance foodborne diseases surveillance and monitoring capacities, implement food safety regulations through an efficient inspection system and develop food safety education programs. Therefore, it is adjudged that smoked fish products in the open markets are unwholesome. Thus, we recommend proper cooking of smoked fish products before consumption.

ACKNOWLEDGEMENT

We sincerely appreciate the contributions of Dr. E.O.A Irokanulo and the technical assistance of the staffs of the general laboratory unit of bacterial research department, National Veterinary Research Institute, Vom.

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