Food Science and Quality Management
ISSN 2224-6088 (Paper) ISSN 2225-0557 (Online)
Vol.33, 2014

Fish Quality Survey: *Staphylococcus Aureus* And *Salmonella* Spp Occurrence In Nile Tilapia At Informal Markets Of Nairobi

Davies M. Makilla
State Department of Fisheries, P.O. Box 58187-00200 Nairobi, Kenya
* E-mail of the corresponding author: dmmakilla@gmail.com

Abstract

The quality of fish sourced from Kenya has been a problem both locally and internationally. Things worsened when it was realized that some fishermen were using chemicals to fish coupled with unhygienic handling and inadequate storage facilities. This study was carried out to analyze the microbial hazards during the retailing of Nile tilapia (*Oreochromis niloticus*) at Kibera, Kawangware and Korokocho markets. The work was carried out for a period of three months (December, 2002 to February, 2003). Results of this study showed fish samples contained coliforms and faecal coliforms. No isolations of *Staphylococcus aureus*, *Vibrio cholerae* and *Salmonella* spp made from fish.

Keywords: key words, Nile tilapia, *Staphylococcus aureus*, *Vibrio cholerae* and *Salmonella*

1. Introduction

1.1. Fish quality

When fish and seafoods such as shellfish are contaminated with spoilage microorganisms for countries that need revenue from fish exports as Kenya, the economic loss resulting from such spoilage is of concern. Even when seafoods are not for exports, microbial contaminants may result to infections of humans. Bacteria can be present in food when it is eaten especially in fish. They get into the body and then release endotoxins which irritate the stomach and the bowels. This causes stomach cramps diarrhea and fever and is called food-borne infection. One type of bacteria that causes food-borne infection is *Salmonella spp* (Barnett, 1985). Other bacteria can grow on certain foods producing exotoxins and cause sickness when the food is eaten. Examples of these type of bacteria that produce such intoxications include *Staphylococci* and *Bacillus cereus* (Barnett, 1985). For example, in a study around beaches and markets within Winam Gulf of Lake Victoria, it (Odhiambo *et al.,* (2000) was noted that *Vibrio cholerae* and *Staphylococcus aureus* were present in smoked tilapiine fishes. It was further reported that there were *S. aureus* and *Escherichia coli* in smoked Nile perch. At industrial level in Kenya, incidents of *Salmonella* spp and *Vibrio cholerae* have been reported in fish samples collected in two establishments as 1% and 1.4% respectively (Mungai *et al*., 2002).

There have been reports of typhoid and cholera outbreaks in Kenya (Ministry of Health Annual Reports, 2001). These outbreaks have been linked to water sources. However, they may also be sourced from fish. The microorganisms causing these diseases are *Salmonella* spp and *Vibrio cholerae* for typhoid and cholera respectively. However, studies on local retail markets far away from landing beaches have not been done despite the fact that some quality changes are expected to take place as fish is transported to these markets. It was against the above background that this study was designed to conduct a survey on the hygienic status of retail 'wet' or fresh fish in some major retail markets in Nairobi. In the study, aerobic mesophilic colony count of viable organisms, indicator organisms for contamination and organisms of public health significance were enumerated.

1.2. Objectives

The objective was to:

(i) To establish the levels of *Staphylococcus aureus*, and *Vibrio cholerae* and *Salmonella* spp in fish at retail markets.

2. Materials and methods

Six whole fresh Nile tilapia were bought from the markets on every sampling occasion for the period from December 2002 to February 2003 and taken to National Public Health Laboratory in a cooler box filled with ice. The retailers from whom the fish were bought were randomly selected on each sampling date.

2.1. Bioassays

Fish samples (10g) were excised aseptically and transferred to 90 ml of 0.1% buffered peptone water (Difco) in sterile flasks and homogenised to make a 1:10 M/V dilution. The homogenate was thoroughly mixed before making serial dilution(s) according to International Commission of Microbiological Specifications for Food

(ICMSF) (ICMSF 1978). The resulting homogenate was used for all the microbiological tests (Stock solution).The media used in this study are as edited by Rohde, P.A.1973.

2.2. Data Management and Analysis

The data was managed and analyzed using the SPSS package. The package assisted in obtaining the means. Where significance was indicated, Tukey's test was used to determine the source of the observed differences.

3.0 Results

Coliforms and Faecal coliforms and Faecal coliforms

The results of coliforms and faecal coliforms of Nile tilapia at Kibera, Kawangware and Korokocho markets are shown in Table1.

Table1: Average of triplicate count

Market	Fish species	Coliforms (mpn/g)	Faecal coliforms (mpn/g)
Kibera	Nile tilapia	1.1 x10^3	1.1 x10^3
Kawangware	Nile tilapia	2.4 x10^3	2.4 x10^3
Korokocho	Nile tilapia	4.1 x10^2	2.7 x10^2

Organisms such as Enterobacteraceae, Coliforms, faecal coliforms and *Escherichia Coli* are used as indicators of faecal contamination (Matches and Abeyta, 1983). ICMSF recommended a limit of 10^3 mpn/g for enterobacteriaceae and a limit of 4 x 10^2 mpn/g for both coliforms and faecal coliforms (ICMSF, 1986). In this study, coliforms and faecal coliforms were used as indicator organisms.

4.0. DISCUSSION

At the markets, both coliforms and faecal coliforms on Nile tilapia were found to be less than 4 x 10^2 mpn/g. However, the presence of these organisms indicated the direct or indirect contamination of the fish with faecal matter and possible presence of other potential enteric pathogens. Based on the recommended guideline 4 x 10^2 mpn/g (ICMSF, 1986), the samples tested had coliform and faecal coliform counts in excess of the limit for good quality fish respectively. This showed possible contamination from an external source and presence of other potential enteric pathogens on the fish.

Staphylococcus aureus may cause food poisoning. Staphylococcal food poisoning is caused by the ingestion of a pre-formed enterotoxin produced by growth of the bacteria in food (Frazier and Westhoff, 1988). In this study, there was no isolation of *S. aureus* at all the studied markets. The recommended limit of *S.aureus* is 10^3 cfu/g (ICMSF, 1986). The absence of *S. aureus* could be due to low temperatures under which fish is kept. The retailers keep on sprinkling cold water on displayed fish to keep it cool. *S. aureus* is mesophilic with a minimum growth temperature of 10^{o}C, but higher temperatures (>15^{o}C) are required for toxin production (Huss, 1994b). In addition, this shows that contamination via the retailers did not take place. Fish may be contaminated with *S.aureus* through infected food handlers or from another source previously contaminated by humans (White and Hall, 1985; Ganowiak, 1990).

Cholera is caused by *V. Cholerae* and is usually a waterborne disease. However, food-borne cases especially fish outbreaks are also known (Miller *et al.*, 1985). *V. cholerae* was not isolated in any sample at all the studied markets. Perhaps lack of alkaline environment at various locations made the new conditions unfavourable for *V. cholerae* to survive. Karunasagar and Karunasagar (1994) reported that *V. cholerae* prefer alkaline environment to thrive well. In cholera-endemic areas, fish could be contaminated with *V. cholerae* reaching the environment through the sewage discharge (Brian, 1980; Karunasagar and Karunasagar (1994). If such contamination occurs, *V. cholerae* can survive for 1-2weeks at 0^{o}C (Ganowiak, 1990). Possibly there was no cholera outbreak at the Lake Victoria region for *V. cholerae* to be transmitted to the markets at the time of this study. The results further reveal that the retailers were not carrying *V. cholerae* at the time of the current investigation. Post-harvest

contamination could occur due to poor sanitary conditions at retail markets and carriers who handle the fish (Miller *et al*., 1985).

Salmonella spp were not detected in any fish collected at various times at markets. This may be attributed to lack of cross-contamination of fish at the source or markets. Reports have indicated that *Salmonella* spp should be absent from fish samples of 25g (EEC, 1993; ICMSF, 1986). This guideline is based on the fact that *Salmonella* spp are not naturally present in the marine environment and therefore are unlikely to be detected in freshly harvested fish. *Salmonella* spp are common in animal faeces and wastes from slaughterhouses and poultry processing plants (Bryan, 1980). The organism is spread by community sewage discharge. Therefore, fish can be contaminated with S*almonella* while next to such sewage discharge (Reilly and Twiddy, 1992). This is because the organism is pathogenic and can cause food poisoning and is also the causative agent for the typhoid epidemic. The organism should be avoided at all costs especially in slums where it can cause serious mass deaths. Presence of this pathogenic organism in fish is a potential health hazard to the consumers. Although the fish may look wholesome and fresh, the presence of Salmonella organism in them can lead to serious health problems.

5. Conclusion and recommendations

5.1. Conclusion

This study has revealed that the ultimate quality of fish is decided by the sanitary and hygienic conditions prevalent in the markets. The handling and general marketing practices were highly inadequate in maintaining the fresh quality of fish.

5.2. Recommendations

From the present study, the following are recommendations to the Department of Fisheries:

- Immediate steps should be taken to train persons engaged in fish trade on good sanitary and hygienic practices in fish handling through seminars.
- Further research work required for different fish species at different markets.

References

Anonymous. (1997a), “Perch on a precipice.” **Seafood International April.**
Barnett, A. (1985), “Food **and Nutrition for you**, Hutchinson and Co. Ltd, U.K.
Bryan, F.L.(1980), “Epidemiology of Food-borne diseases transmitted by fish, shellfish and marine crustaceans in United states,1970-1978.” **J. Food Prot. 43(11),** 859-876.
Cheng, J.W., D.W.Cook and J.R.Kirk. (1985), “Use of chlorine compounds in the food industry,” **Food Technol**. **39**,107-112.
European Economic commission (EEC) (1998), “Commission decision on protective measures with regard to fishery products from or originating in Uganda, Kenya, Tanzania and Mozambique 98/84/EEC,” **Official Journal of the European communities No. L15,** 21,p.43.
European Economics commission (EEC). (1993), “Commission decision on the microbiological criteria applicable to the production of cooked crustaceans and molluscan shellfish. 93/51/EEC, **Off. J. Eur. Comm. No. L. 13,** 11-13.
Ganowiak, Z.M.(1990), “**Sanitation in marine food industry**. In: E.S. Zdzislaw (Ed) Seafood, Resources, National composition and preservation CRC, Press, Inc, Florida, pp. 211-230.
Huss, H.H. (1994b), “**Assurance of seafood quality**. FAO Fish Techn. Pap.334, Food and Agriculture Organization, Rome, pp169.
International Commission of Microbiological Specifications and Foods (ICMSF). (1986), “**Microorganisms in foods. 2. Sampling or microbiological analysis: principles and specific applications, 2nd ed.** Blackwell scientific publications, Oxford, 101 pp.
International Commission of Microbiological Specifications and Foods (ICMSF). (1978), “**Microorganisms in foods I. Their significance and methods of enumeration**. 2nd Ed. University of Toronto Press, Toronto, pp228.
Karunasagar, I. and I., Karunasagar.(1994), “Methods of detecting Vibrio species hazards in the seafood industry.” **Fish Tech. News, 15**, 3-8.
Matches, J.R. and C. Abeyta. (1983), “Indicator organisms in fish and shell fish.” **Food Technol. 37,** 114-117.
Miller, C.J., R.G. Feacham and B.S. Drasar. (1985), “Cholera epidemiology in developed and developing countries; New thoughts on transmission, seasonality and control.” **Lancet, 1**, 261-269.

Mungai, D.N., W. Mwatha and P.O. Okemo. (2002), "*Salmonella* and *Vibrio cholerae* in Nile perch (*Lates niloticus*) processing establishments in Kenya." **Kenya Soc. of Microbiol. J.Trop. Mcrobiol. 1:**80-89.
Odhiambo, O., V.M. Muchiri and P. Thakor. (2000), "**Investigation of bacteriological quality of smoked fish.** Kisumu Regional Conference (In Bulleting).
Okumu, M. and A.W. Sifuna. (2000), "**Levels and causes of fish post harvest losses. A case study of Nyakach Bay.** Kisumu Regional Conference (In Bulleting).
Paperna, I. (1980), "**Parasites infections and diseases of fish in Africa.** FAO Publications. CIFA Technical ppNo. 7215.
Reilly, P. J.A. and D.R.Twiddy. (1992), "*Salmonella* and *Vibrio cholerae* in brackish water cultured tropical shrimps." **Int. J. Food Microbiol**. **16**, 293-301.
Republic of Kenya. (2001), "Ministry of Health Annual Report. Government printer.
Rhodes, M.W. and H. Kator. (1988), "Survival of *Escherichia coli* and *Salmonella* spp. in estuarine environments, **Appl. Environ. Microbiol**. **54**, 2902 - 2907.
White, C.A. and L.P. Hall. (1985), "Laboratory examination of frozen foods." In: R.K. Robinson (Ed.) **Microbiology of frozen foods**. Elsevier, New York, pp. 251-234.
World Health Organization (WHO). (1984), "**Guidelines for drinking water quality.** Vol.1. Recommendations. Vol.2 Health criteria and other supporting information. WHO, Geneva.

Acknowledgement

I would like to thank Kenyatta University, National Public Health Laboratory (N.P.H.L) Managements and the leaders of informal fish markets in Nairobi for having enabled me access to the necessary facilities, tool and materials for this study. Thanks are due to Mr. Andrew Kamau and Mrs. Julia Mutwika of Kenyatta University and N.P.H.L. respectively for their technical assistance.

The IISTE is a pioneer in the Open-Access hosting service and academic event management. The aim of the firm is Accelerating Global Knowledge Sharing.

More information about the firm can be found on the homepage:
http://www.iiste.org

CALL FOR JOURNAL PAPERS

There are more than 30 peer-reviewed academic journals hosted under the hosting platform.

Prospective authors of journals can find the submission instruction on the following page: http://www.iiste.org/journals/ All the journals articles are available online to the readers all over the world without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself. Paper version of the journals is also available upon request of readers and authors.

MORE RESOURCES

Book publication information: http://www.iiste.org/book/

IISTE Knowledge Sharing Partners

EBSCO, Index Copernicus, Ulrich's Periodicals Directory, JournalTOCS, PKP Open Archives Harvester, Bielefeld Academic Search Engine, Elektronische Zeitschriftenbibliothek EZB, Open J-Gate, OCLC WorldCat, Universe Digtial Library , NewJour, Google Scholar