FISH SAFETY AND QUALITY – SOURCES OF CONTAMNAITION AND HYGIENE INDICATORS IN FRESH AND PROCEED FISH A REVIEW

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Abstract
The knowledge of sources and routes of fish contamination is a very important aspect in maintaining the quality of safety of fish. This is paramout because the sources constitute the acess through which most unwanted microorganisms may be transmitted onto fish and fishery products. Unwanted microorganisms mau be found in the final product through raw material, personal handling or mobile equipment such as forklifts, through leakage and openings in building, or through pests. Some pathogens may even become established in the rocessing equipment and rough contact surfaces such as fish retail tables and from niches where they can survive for long periods of time. Many of these microorganisms occur naturally in aquatic and general enviroments, and may be tranmissited onto fish before capture, during and after processing. Also, contamination via air can occur through dust particles or via aerosols. Water is also a vehicle for transmission of many agents of diseases. Thus, the quality of the raw material, personnel hygiene, equipment used for processing, the quality of the water used and pests are key issues in this context. As for quality assurance, methods such as the Good Manufacturing Practice (GMP), Good Hygiene Practice (GHP) and Hazard Analysis Critical Control Point (HACCP) are recommended by the Codex Alimentarius Commission for use by any food processing establishment to ensure safe, wholesome and nutritious food for human consumption.
Keywords: Contamination, sources, microoganisms, raw materials, processing equipment, personnel, pests water.

INTRODUCTION

Unlike other animal products, quality of fish is often more difficult to control duc to variations in species, sex, age, habitats and action of autolytic enzymes as well as hydrolytic enzymes of microorganisms on the fish muscle (Huss, 2003)

A major goal for any fish producer, processor and marketer is to provide safe, wholesome and acceptable fish to the consumer, and control of microorganisms is essential to meet this objective (Alberth, 2003), Ihahi and Omojowo 2007). However, this can be very difficult as contamination of products in a fish processing environment may take place at all stages, during production (both pre and post-harvesting) and processing (De Rover, 1999, Ligia, 2002)

Fish is assumed to be the safest food for for consumption, and therefore, all the risks and associated with its production, processing and marketing activities are ignored, leading to poor standard hygienic opearations conditions and without emphasis and harzard control mechanisms. In general, indicator microorganisms are most often used to assess food sanitqation (Jay, 1992).

As fish and other free-swimming aquatic animals do not usually carry those organisms, particularly of mammalian microflora, including Escherichia coli and faecal coliform, their presence on proceed fish is a clear evidence of contamination from terrigenous source (ICMSF 1986, Alberth, 2003). Thus, the presence of these organisms may not only indicate the hygienic condition under which the processing operates but also the presence of potential microorganisms that may be harmful to the consumer.

The main pourposr of this study is to outline sources of contamination of fresh and proceed fish and identify certain indicator organisms. Also, the quality assurance systems such as Good Manufacturing Practice (GMP), Good Hygiene Practice (GHP) and Harzard Analysis Critical Control Point (HACCP)

Fish and Hygiene and Sanitation

Hygiene means the science of good health and, in the everyday use; it signifiies cleanliness and freedom from the risk of infectiontions dieases (Espejo-Hermes 1988). Hygiene in foods and food processing indicates good quality as well as the absence of any food poisoning hazard. A hygienically prepared manner that the consumer has every confidence in is purchase. The major cause of spoilage of fish flesh is contamination with baceria. If the flesh is contaminated with pathogenic (dieases-causing) bacteria, it can cause illness or even death in the consuming public.

Cleanliness

Cleanliness is needed at every stage of fish handling and praparation. The word "clean" means the absence of visisble dirt or unwanted matter (Huss, 1997) while cleaning alone, however, will not reduce, dirt, grease or other objectionable matter (Shewan, 1962). Cleanning alone, however, will not reduce the number of microbles significantly; hence, a further treatment called "sanitaion or disinfection" is required. Sanitaion is the process of reducing the numbr of living micro-organisms (but not the spores) to a level judged safe by public health authorities (Espajo-Hermes, 1998).

The efficincy of cleaning is affected by factors such as the cleaner, temperature and time. The cleaner must know how to clean, must have a good attitude towards his work and must be physically capable. Temperature has a very important effect during cleaning. Increasing the temperature will decrease the strength of bond between soil and surface, decrease viscosity, increase the slubility of the souluble materials and increase chemical reaction rate. Eficient sanitizers or disinfectants do not basically kill all micro-organisms presnets but reduce their numbers to a level at which they can be reasonably presumed to present no danger to health. No disinfection preceudre can exert its full effect unless thorough cleaning has been done before its application. Sanitisers should be selected according to trget microorganism, the type of food being processed and the material making up the food contact surfaces and less risk to personnel. Sanitation or disinfection can be made by physical treatment such as heat, UV irradiation, or by means of chemicals compounds.l The chimicals disinfectants commonly used inthe food indutry include chlorine and cholrine compounds, iodophors, quaternary ammonium compounds, paracetic acid and hydrogren peroxide (Huss,1994).

Personal Hygine

High degree of personal hygine of fishermen, fish processors and markets is required in the preparation and processing of acquatic product. This can be accomplished by providing adequate washing facilities and other paraphernalia such as soap, towel, uniform etc. Good personal hygine can be practiced through:

- Regular bathing and washing of mouth
- Using appropriate deodorants
- Washing hair at least weekly for women in fisheries
- Keeping nails clean and trimmed
- Wearing clean uniforms and clean underclothing
- Using a hair net or cap and paper masks ove nose and mouth when on duty
- Prepaeirng for work in a systematic fashion so that the individual and his clothing are clean at the time he start to work

Washing of hands is most important in the prevention of contamination in food. Washing of hands must be done with plenty of soapy water to remove surface skin bacteria and other bacteria picked up while handling fish or equipment. Washing of hands must be done regularly after performing the followwing activities:

- Coughing and sneezing
- Visiting the toilet
- Smoking
- Handling equipment and other items
- Handling raw fish
- Handling garbage or soilded materials
- Handling money

Adequate supply of clean, possibly (chlorinated) water must be available to clean fish, presonnel, equipment and others. Cut fisih are more susceptible to contamination then whole fish and must be processed, or packaged and chilled immediately. Fish either whole or cut must be shielded from direct sunlight, particularly in the tropics where the amibient temperaturew are high. Handling of fish with care must be observed at all times to prevent physical or mechanical damage (cuts, punctures bruises etc).

Overview of sources of contamination in fish

Raw material

Many pathogenic bacteria are naturally present in aquatic environment Clostridum botulium type E, pathogenic Vibrio sp., Aeromonas) and the general environment (C.botalium type A and B, Listeria monocytogenes) Huss, 2003). Other microorganisms are of the animal/human reservior (Salmonella, Shigella, E.coli entric virus) Huss et all 2000). Thus, there is always a possibility that these microorganisms may be passed on to the raw material during production and processing. In geneal, when a healthy fish is caught, the flesh is sterile as its immune system prevents bacteria to peroliferate easily whereas after dealth the fish's immune system collapes allowing easy access of microorganisms into the flesh (Huss, 1995). Some microorganisms have been found on the entire outer surface (skin and gills). Liston (1980) estimated the total number of microorganisms to vary enermously from a normal range of $10^5 - 10^7$ cfu (colony forming units) cm2 on the skin surface, whereas counts between 103-109cfu/g on the gills and intestines were foundby Shewan (1962).

Processing equipments

Contamination of fish products through contaminated surfaces has also been observed in many cases (Reij et al., 2003). Unclean, insufficient or inadequate cleaned processing equipment have been identified as a source of bacterial contamination in proceed fish (Reij et al., 2003). Containers, pumps or tanks used for holding or transporting unprocessed raw materials, have occasionally been used for processed products without any cleaning and disinfecition (Morgan et al, 1993). It is therefore necessary that equipment for fish processing coming in contact with fish, be constructed in such a way as to ensure adequate cleaning, disinfection and proper maintenance to be avoid the contamination (CAC, 1997a)

Personnel

Transfer of microorganisms by personnel particularly form hands, s of vital importance (Alberth, 2003; Blookfield, 2003). During handling and preparation, bacteria are transfered from conaminated hands of food workers to food and subsequently to other surface. (Espjo-Hermes, 1998 Montiville et al., 2002). Low infectious doses of organisms such as Shigella and pathogenic *Escherichia*

coli have been linked to hands as a source of contamination (Snderl, 1998) Poor hygiene, particularly defient or absence of hand washing has been identified as the causative mode of transmission (Reij *et al.,2003).* Propoer hand washing and disinfection has been recognised as one of the most effective measures to control the spread of pathogens, especially when cosidered along with the restriction of ill workers (Alder 1999, Montville *et al,* 2001).

Pests

Insects, birds and rodents have been recognized as important carriers of pathogens and other microorganisms (Eyo, 2001). In one intersting case a *Salmonella* outbreak was traced back to ampihians, which had accidentally entered the productionfaciluty (parish, 1998). Beveridge (1988) demostrated that some aquatic birds spread for example *Salmonella* and other human pahtogens in the environemtn. GHP should be employed to avoid creating an environment conducive to pests (CAC, 1997b).

Water

Water, like food, is a vehicle for transmission of many agents of dieases and continues to cause significant outbreaks of dicase in developed and developing countries world-wide (Kirby *et al, 2003*) In Cannada, an outbreak of *E.coli* reported (Kondro, 2000) and in the USA Crytosporadium affected aproximately 400,000 consumers and caused 45 deaths in 1993 due to consumption of contaminated water (Kramer et al 1996). A chelera epidemic in Jerusalem in 1970 was traced back to the consumption of salad vegetables irrigaed with raw waste waer (Shuvual et al 1996). It is therefore important that potable water is used throughout the production process, for cleaning equipment, washing food, as well as ice making.

Qualitify assurane system

The production of safe food is based on the implementation and appliation of general preventative measures such as GMp (Reij et al 2003). GMP is the overall managment (organising, implemting and adhering) of procedures, processes, control and other precaustions that exclude, prevent, minimize, and inhibit product failures, and consistently yield safe, suitable foods of uniform quality, according to their intended use (Huss, 2003) GHP is part of GMP concerned with general hygine, microbal safety and product spoilage (Heggum, 2001). While it is not possible to achieve zero risk under GMP, the develooment and use of other approaches, such as HACCP, to ensuring safe food, cannot not be omitted.

HACCP is a systematic approach to identification, assessment and control of hazard diring prodution, processing, manufactuting,preparation and use of food, water or otehr substances (Kirby et al 2003). However, the approach by itself is not enogh to secure fish products to be free of the pathogens. Thus, good hygiene, cleaning and sanitation are necessary to secure low levels of microorganisms on the final product (Huss 1997). Good hygiene is however not sufficent to secure safty and a second ine of defence (preventiion of growth) must be esablished (Huss 1997).

On the other hand, siginificant specific hasards are addressed by applying the HACCP system. Equipment hygiene as well as personnel hygiene and sanitation are for example CCP's in the prevention of contamination of products with microoganism, filth and any other foreign material during processing (Huss 1994). Limits may then be established such as microbiologial criteria or guides at various steps in the production process or in the final product while monitoring the CCP's points. Monitoring should measure accurately the chosen factors which control the CCP's should be simple, give quick results, and be able to detect deviations from specifications or criteria (Huss 1994). When there is a failure, corrective actions may be taken for the

CCP that is not under control followed by verification as well as docomentation concerning all procedures and records according to the HACCP principles and their application (CAC, 1997a). Before applying the HACCP system, any food establishment should operate according to the Codex geneal principles of food hygiene that appropriate Codex Codes of practice, and appropriate food safety legislation to achieve he goal of ensuring food safetly and suitabilty fo human consumption (CAC, 1997a). The system has taken on a global perspective in the production of fish and fishery products.

Bacterial indicators

Various bacteria are found in the digestive tracts and faeces of animals and humans. Some of these bacteria, i.e. faecal cliforms, *E.Coli* (the predominant group of the faecal cliform group), and *Enterococcuss* ssp., are used as hygiene indicators (Frahm and Obst., 2003) Indicator microogranisms are microoranginsms indicative fo rthe possible (Mossel *et al., 1995)* In general, they are most often used to aseess food sanitation (JaY, 1992). There is no univeral agreement on which indicator microorganism(s) is most useful, nor are there federal regulations mandating a single standard for bacteria indicators. Thus, different indicators and differnt indicator levels identified as standards are used in different states, countries, and regions. Today, the most commonly measured bacteria indicators are total cloiform (TC), faecal coliforms (FC) and entercocci (EC). More recently, *E.Coli* was established as prefered indicator (Nonle *et al.*, 2003)

Refernces

Alder,K (1999): Recommendation on bare-hand contact with ready to eat food by micro committee. *Food Chemistry. News* 41 (33):9

Bloomfied, S.F. (2003): Home Hygiene: a risk approach. International journal of Hygiene and Environmental Health. 206:1-8

CAC (Codex Alimentarius). (1997a): Hazard Analysis and Critical Control Point (HACCP)-System and Guidelines fo rits Appliation. Codex Alinmentrus Commission CAC/RCP 1-1969, Rev. 3, Rome

De-Roever, C. (1999): Microbiologial safety evaluations and recommendations on fresh produe; *Food Control.* 9:321-347 UNU-Fisheries Training Programme 18. Samakupa

Espejo-Hermes (1998). Fish Processing Technology in the Tropics 50-54p

Eyo, A.A. (2001): Fish Processing Technology in the Tropics Pp 1-20

Frahm, E. and Obst, U.(2003): Appliation of the flouorogenic probe technique (TaqMan PCR)to the detection of Enterococcuss ssp. And *Escherichia coli* in water samples. *Journal of Microbilogial Methods.* 52: 123-131

Heggum, C. (2001): Trends in hygiene management the diary sector example: Food conttrol 12:241-246

Huss, H.H. (2003): Assessment and Management of seafood safety and quality. Food Agriculture Organization (FAO). Fisheries Technical Paper 444. Rome: FAO

Huss, H.H. (1997): Control of indigenous pathogenic bacteria in seafood. *Food Control.* 8:91-98

Huss, H,H (1985) Quality and quality changes in fresh fish. Food Agriculture Organisation (FAO). Fisheries Technical Paper 348. Rome FAO

Huss, H.H. (1994): Assurance of seafood quality. Food Agriculture Organisation (FAO) Fisheries Technical Paper. No 334. Rome: FAO

Ihuahi, J.A. and Omojowo, F.S. (2007): Anti-

Oxidative Effect of a Mixture of pepper and garlic specices on the quality of Hot smoked Catfish (*Synodontis Nigrita)* Biologial and Environmental Science Journal for the Tropics 5 (2) 104-109

International Commission on Microbilogial Specifications for Foods (ICMSF). (1986): Microorganisms in Foods 2: Sampling for Microbilogical Analysis: Principles and Specific Applications. ***Black well Scientific Publications:UNU***-Fisheries Training Programme 19 Samakupa

Ligia, V.A.S. (2002): Hazard Analysis Critical Control Point (HACCP) Microbial Safety, and Shelf life of smoked Blue Catfish *Ictalurus furcatus* M.Sc. Thesis 48-93p

Liston.J. (1980): Microbilogy in fishery science. Inst. Food Sci. Technol., Coll. Fish, University. Washinton. Seattle, WA, USA. *The Jubilee Conference of the Torry Research Station, Aberdeen* UK 23th July, 1979

Jay,J.M. (1992): Modern Food Microbilogy. Microbilogical Indicators of food safety and quality, Principles and "Quality control, andmicrobilogical criteria. New York: Van Nostrand Reinhold.

Kirby, R.M. ., Bartram, B., and Carr, (2003): Water in food production and processing-Quality and quality concerns. *Food Control,* 14:283-299

Kondro, W. (2000): E.coli outbreak deaths spark judicial inquiry in Canada. *The lancet.* 355:2058

Kramer, M.H. Herwalkt, B.L. Calderon, R. L. And Jurannek, D.D. (1996): Surveillance for waterborne-disease outbreaks-United States, 1993-1994. CDC surveillance Summaries MMWR Week Report. 45:1-33

Montiville, R., Chen. Y., and Schaffner, D.W. (2001): Determination of baccrial cross contamination rates from hand to food through a glove barrier. *Journal of Food Protection* 64:845-849

Morgan D.Newman, C.P. Hutchingson, D.N. Walker, A.M. Rowe, B. and Majid, F. (1993): Verotoxin producing of yoghurt. *Epidemilogy and infection.* 111:181-187

Mossel David, A. A. Corry Janet E.L. ., Stuijk Corry B., Baird Rosamund M. (1995): *Essentials of the Microbology of Foods;* A text book of advanced studies, London, John wiley & Sons, 1995.

Noble, R.T. Moore, D.F. Leecaster, M.K., McGee, C.D. and Weisberg, S.B. (2003); Comparison of total coliform, feacal cliform, and enterococcus bacterial indicator response for ocean recreational water quality testing, *Water Reserach.* 37:1637-1643 UNU-Fisheries Training Programme 20 Smakupa

Reij, M..W. Den Aantrekker, E.D. and ILSI Europe Risk Analysis in Microbilogy Task Force (2003): Recontamination as a source of pathogens in proceesed foods. *International Journal of Food Microbilogy.* Article in press

Shwean, J, M (1962): The bacterilogy of fresh and spoiling fish and some related chemical changes. In Hawthorn, J and Leitch, M. Eds *Recent advances in food science.* 1:167-193

Shuval HI, Yekutie Pl, Tattal B. (1986): Epidemilogical Evidnce for Helminth and Cholera Transmission by vegetables irrigated with waste-water-jerusalem – a case study. Water Sciene and Technology 17 (4-5): 433-442 1985