International Journal of Agriculture Innovations and Research
Volume 2, Issue 1, ISSN (Online) 2319-1473
Manuscript Processing Details (dd/mm/yyyy) :
Received : 18/06/2013 | Accepted on : 02/07/2013 | Published : 18/07/2013

Evaluation of Different Fish Processing Kits for Better Quality Preservation

Demeke Teklu
Email: demeketeklu@yahoo.com

Abstract – **There is no appropriate fish processing kit at all landing sites and processing area hence fish has been processed on the ground which results in poor quality of the product since fish is very perishable food stuff and these results in public/consumer health hazards due to the presence of pathogenic bacteria, moulds and yeasts. This research activity was initiated with the objective to evaluate the quality of fish processed on different processing kit. In this study the microbial load of four samples (fish fillet processed on the ground (S_4), plastic table (S_3), wood table(S_2), and stain less steel table (s_1)) was determined. 1 gram fish fillet was added to 9 ml peptone water and homogenized in stomacher bag. Then appropriate serial dilutions (10^{-1}, 10^{-2}, 10^{-3}, 10^{-4} & 10^{-5}) of all samples were prepared and then 0.1 ml of the odd power dilutions were taken and plated using spread and pour plate technique in duplicate by using a Standard Medias for each bacteria, mold and yeast. Finally, it was incubated and then number of colony was counted and colony forming units was calculated. The result indicate that aerobic bacterial count and Staphylococcus Species for S_1, S_2, S_3 left under moderate microbiological risk category while only S_4 shows the highest risk. Salmonella species and Shigella species didn't show any growth for all the samples. Despite S_4 which shows total coliform, E-coli and fecal coliform growth at the highest level of microbiological risk category S_1 didn't show any growth. The highest microbial load other than Salmonella and Shigella species cfu/g observed from fish fillet processed on ground could be due to human contact through air particles breathed, coughed or sneezed out during the course of work or from food handlers or from other sources in the air within the processing area. It was concluded that fish should not be processed on the ground to prevent contamination during post harvest handling and processing. Finally, further research work covering wider area, different fish species and large sample size should be done to identify problems and determine appropriate processing table.**

Keywords – **Fish, Food, Microbial Load, Processing Table, Quality.**

I. INTRODUCTION

Fish is the rich source of protein with an amino acid composition very well suited to human dietary requirements, comparing favorably with eggs, milk and meat in the nutritional value of its protein (Tanikawa., 1971). Lack of sufficient protein of high nutritional value is one of the most wide spread nutritional deficiencies being common place in many tropical countries (FAO, 1981). Although, the flesh of newly caught fish is sterile, the skin, gills and intestines tend to carry considerable microbial loads depending on the environment of the fish at the time of capture. At the death these micro-organisms starts to invade the tissues and this is favored by the struggle of the fish when caught and use up virtually all of the glycogen in their muscles, so little glycogen is left to be converted to lactic acid after death, thus, the preservative effect of muscle lactic acid to slow down bacterial, mould and yeast growth is limited (Shewan., 1977).

The characteristics and the technology of traditional fish fillet processing are made in general under primitive condition which results in low yield and poor quality of the product since fish is very perishable food stuff and these results in public/consumer health hazards due to the presence of pathogenic bacteria, moulds and yeasts (Kagan., 1970). Therefore, the microbial count in locally made fish fillet is the most reliable indication we have of its sanitary/ microbial quality. "FAO estimates for fisheries in some countries including Ethiopia place fish losses among the highest for all commodities". There is no doubt that the prevention of these losses would have an appreciable impact in increasing the supply of fish for human consumption in the country.

There is no appropriate fish processing kit at all landing sites and processing area and fish has been processed on the ground. Since, fish being an extremely perishable foodstuff needs careful treatment in handling and processing both from public health aspects and improvement of the well fare of fishing. Processing fish on table has several advantages such as prevention of physical damage, protecting fish from direct sun light as well as from bacterial contamination. Therefore, this research activity was initiated with the objective to evaluate the quality of fish processed on different processing kit.

II. MATERIALS AND METHOD

The processing kits were constructed at Melkasa agricultural research center. The tables were measuring 70 cm width and 1m long and they were portable. Their height from the ground was about 1m. Fish samples were collected from Wafiko and korokonch landing site of the lake Zeway during February to May, 2010. Sample was taken only once from Wafiko landing site where as samples were collected three times from korokonch landing site. Samples were cool transported using ice box to Zeway fisheries resources research center laboratory. Immediately after arrival, the collected fish were washed in clean water with hands and fillet was removed from both sides with sterilized knife. Fish was filleted as follows; filleting fish on the processing kit made from stainless steel (S_1), filleting fish on processing kit made from wood (S_2), filleting fish on processing kit made from plastic (S_3) and filleting fish on ground (S_4). The skin was separated from the flesh without touching the flesh with

teeth. Then, the filleted fish were packed in polyethylene bag hygienically and stored in the cold storage. Microbial load analysis was conducted at Adami Tulu Research Center twice and Ethiopian Health and Nutrition Research Institute twice. 1 gram fish fillet was added to 9 ml peptone water and homogenized in stomacher bag. Then appropriate serial dilutions (10^{-1}, 10^{-2}, 10^{-3}, 10^{-4} & 10^{-5}) of all samples were prepared and then 0.1 ml of the odd power dilutions were taken and plated using spread and pour plate technique in duplicate by using a Standard Medias for each bacteria, mold and yeast. Finally, it was incubated and then number of colony was counted and colony forming units was calculated by multiplying number of colony by its serial dilution factors.

Statistical analysis

Average colony forming units of microbial load was calculated using descriptive statistics of spread sheet Microsoft excel.

III. Result

Microbial load analysis was performed on fish fillet processed on four different fish processing and the following results were obtained. See Table 1

As it is shown on table 1, the total aerobic bacterial count for S_1, S_2, S_3 left under moderate microbiological risk category which indicate the potential for development of public health problems and of unacceptable risk, while only S_4 shows the highest risk. For Staphylococcus Species S_1, S_2, S_3 show the growth in between the moderate level where as S_4 shows the growth beyond the acceptable standard. Inspite of the other bacteria's growth Salmonella species and Shigella species didn't show any growth for all the samples. S_2, S_3 shows coliform growth that exceeds the acceptable level which means potentially injurious to health and/ or unfit for human consumption but there was no growth for E-coli and fecal coliform. Despite S_4 which shows coliform, E-coli and fecal coliform growth at the highest level of microbiological risk category S_1 didn't show any growth. The microbial load from S_2 shows progressive increment with respect to time while for the other samples left constant.

IV. Discussion

This study explored the effectiveness of fish processing tables made from stainless steel, wood, plastic and ground. The microorganisms tested were of seafood safety concern that included *Staphylococcus aureus (S. aureus), Escherichia coli* (*E. coli*) and Aerobic plate count (APC), *Salmonella, shigella, mould, yeast, fecal coliform, total coliform.* The highest *S.aurues* cfu/g observed from fish fillet processed on ground could be due to human contact through air particles breathed, coughed or sneezed out during the course of work or from food handlers or from other sources in the air within the processing area (Begani *et al*.,2012).

The highest aerobic plate count (> 10^6 cfu/g) recorded from fish processed on the ground is due to the existence of predominant microorganism (Health Protection Agency, 2009). The highest E.coli in fish fillet processed on the ground may attributed to fish fillets will hence become contaminated with Enterobacteriaceae like *E.coli* mainly during or after filleting, e.g. by contaminated fish skin. However, the main source must be the direct contact of fillets with contaminated surfaces, tools or hands (Van den Broek et al., 1984). The *Enterobacteriaceae*, (*Salmonella, Shigella, E. coli*) are all occurring on fish products as a result of contamination from the animal/human reservoir. This contamination has normally been associated with fecal contamination or pollution of natural waters or water environments, where these organisms may survive for a long time (months) or through direct contamination of products during processing (Huss, 1995). The presence of human enteric organisms on fish processed on ground products is clear evidence of contamination from a terrigenous source (ICMSF, 1986). The highest feacal coliform observed on fish fillet processed on the ground could be due to feacal contamination of the processing area (ground).

The appearance of mould on fish processed on wood and ground can explained as yeast and moulds are widely distributed in the environment and can enter food through inadequately sanitized equipment or as air borne contaminants (IOM, 1985). The occurrence of Yeast and mould in Nile Tilapia fillet has been reported by Begum et al., 2010 during the investigation of microbial assessment of five types of selected fish collected from four local market (TYC cfu/g 6.0×10^2 to 8.4×10^2 & TMC cfu/g 1.2×10^2 to 3.2×10^2) and four super shop (TYC cfu/g 1.5×10^2 to 4.6×10^2 & TMC cfu/g 0.8×10^2 to 4.8×10^2). The reason for lower yeast and mould counts in present study is due to short period of storage and / or storage at low temperature of sample (Van den Broek et al., 1984).

The absence of pathogenic bacteria like Salmonelle in Nile Tilapia fillet has been repeatedly reported by different researchers (Van den Broek et al., 1984; Boari et al., 2008). Seafood is a much less common vehicle for *Salmonella* than other foods, and fish and shellfish are responsible for only a small proportion of total number of *Salmonella* cases (Ahmed, 1991)

Progressive increment in microbial load from S_2 with respect to time may be attributed to fact that pathogens remain viable on dry processing surfaces and present a contamination hazard for considerable periods of time, dependent on type of pathogen (Kusumaningrum *et al*., 2003) .

V. Conclusion and Recommendation

Fish of good quality should have counts of total bacteria of less than 10 per gram faecal coliforms and total coliforms should not exceed 100/gm. Total coliform of Nile tilapia processed on S_2S_3in this study exceeded the acceptable limit recommended. Total coliform, faecal coliform and *E. coli* count of Nile tilapia processed the ground exceeded the acceptable limit recommended. This indicates human health risk due to consumption of tilapia processed on the ground. Therefore, precautions should be

taken to prevent contamination during post harvest handling and processing of fishes.

The microbial loads for all nine analyses that are found form the metal table sample were more or less left under the acceptable level that makes it the preferred table among the others. As the processing table made from wood shows progressive increment in its microbial load; it is not preferred for a permanent (long period) processing of fish. This particular study indicates that processing on the ground totally unacceptable as the result could potentially cause injury to human health and deplete the necessary nutrients to human dietary requirements.

Finally, further research work covering wider area and large sample size should be done to identify problems and determine appropriate processing table and set standards for production of fish fillet. The need of training and capacity building program for fishermen, fish processors and the fish vending communities have been suggested.

ACKNOWLEDGEMENT

The author is grateful to Oromia agricultural research institute for financing the project. The author is also indebted to Adamitullu agricultural research center and Ethiopian health and nutrition research institute which allowed me to use their microbiology laboratory. My sincerely gratitude also goes Ato Belete Shenkute who allowed and facilitated me to use animal feed and nutrition laboratory of ATARC to use free of charge. Lastly, I would like to express my heartfelt thanks to Mr. Alemu Lema editing the manuscript.

REFERENCES

[1] Alberth P. S. (2003). Hygiene indicators in a fish processing establishment: a case study in white fish processing establishment. UNU-Fisheries Training Program. University of Namibia.

[2] Begani R.K., Tombe B.,Polong T.(2012). Effectiveness of cleaning and sanitation of food contact surfaces in the PNG fish canning industry. *Contemporary PNG Studies: DWU Research Journal Volume 16.*

[3] Bagge-Ravn D, Ng Y, Hjelm M, Christiansen JN, Johansen C, Gram L. (2003). The microbial ecology of processing equipment in different fish industries-analysis of the micro-flora during processing and following cleaning and disinfection. International Journal of Food Microbiology. 1;87(3):239-50.

[4] Begum M., Abu Ahmed A., Das M. and Parveen .(2010). A Comparative Microbiological Assessment of Five Types of Selected Fishes Collected from Two Different Markets. *Advances in Biological Research* 4 (5): 259-265.

[5] Boyd, J.W. and Tarr H.L. (1955), Inhibition of mould and yeast development in fish products.

[6] Center for food safety (2007), Microbiological guideline for ready to eat food. Risk Assessment Section Centre for Food Safety. Food and Environmental Hygiene Department 43/F, Queensway Government Offices, 66 Queensway, Hong Kong.

[7] FAO. Food and Agricultural organization . (1981). The prevention of losses in cured fish. FAO. Fish.Tech.Papr., (219): 87 p.

[8] Health Protection Agency. (2009).Guidelines for Assessing the Microbiological Safety of Ready-to-Eat Foods. London: Health Protection Agency, November 2009.

[9] Huss, H.H. (1995). Quality and quality changes in fresh fish. FAO FISHERIES TECHNICAL PAPER – 348.

[10] ICMSF. (1986). International commission on microbiological specification for foods. In: MICROORGANISMS IN FOODS 2 Sampling for microbiological analysis: Principles and specific applications. Blackwell Scientific Publications.

[11] IOM. (1985). Institute of Medicine. An evaluation of the role of microbiological criteria for foods and food ingredients.

[12] Kagan B. (1970). Fish processing in Ghana. Possibilities of improving traditional processing. Food research and Developing Unit. Rome, FAO, ASG:SF/GHA 7 Working paper 3.`

[13] Kusumaningrum H.D., Riboldi G., Hazeleger W.C., Beumer R.R. (2003). Survival of foodborne pathogens on stainless steel surfaces and cross-contamination to foods. *International Journal of Food Microbiology* 85: 227– 236.

[14] Martha N. and Abraham S. (2012). Control of bacterial contamination during marine fish processing. Journal of Biology and Life Science. ISSN 2157-6076, Vol. 3, No. 1

[15] Poulter, R.G.(1980). Final report of work at institute of Fish Technology 1978-1980, Colombo, Sri Lanka. London, Tropical Products Institute, IFT/TPI report.

[16] Prabakaran P., Sendeesh K., Anand M. and Pradeepa.(2011). Microbiological quality assessment in a fish processing plant at Mandapam, Ramanathapuram District. Scholars Research Library . Archives of Applied Science Research, 3 (2):135-138

[17] Richardson G.H. (1985). Standard method for analysis of meat products. 15th edition. American public health association, Washington, D.C. USA.

[18] Shewan, J.M.(1949). The biological stability of captured fish. In: world fisheries year book 1949. London, British Continental Trade Press Ltd.,

[19] Tarr H.L. (1962). Changes in nutritive value through handling and processing. In: Fish as a food, edited by G. Borgstrom. New York, Acadamic press.

[20] Tanikawa E. (1971) . Marin products in Japan: size, technology and research. Tokyo, Koseisha Koseikaku Co., 507p.

[21] Van den Broek, M.J.M, Mossel D.A.A. and H. Mol (1984). Microbiological quality of retail fresh fish fillets in The Netherlands. *International Journal of Food Microbiology,* 1 (1984) 53-61.

[22] Zottola, E.(1997). Growth and survival of undesirable bacteria in seawater fish. In: P.F. Fox ed.

AUTHOR'S PROFILE

Demeke Teklu

The author born in Debre Birha Ethiopia in 18/01/1988G.C and hold BSc degree in food science and postharvest technology from Hawassa University Hawassa/Ethiopia in 2010G.C

He currently works as Fish Postharvest Technology Researcher at Oromia agricultural research institute, Zeway fishery resources research center Zeway/Ethiopia

Mr. Demeke is a member of Ethiopian fishery and aquatic science association, Ethiopian society of animal production, Ethiopian food science and nutrition association. He awarded 2000 Eth birr and certificate in 2012 and 2013 from Debre Birhan University for presenting a research papers on its third and fourth national research symposium, 2000 Eth birr and certificate in 2013 from Arba Minch University for presenting a research paper on its fourth national research symposium and 500 Eth birr and certificate in 2013 from Ambo University for presenting two research papers on International conference on Integrated Agriculture for Food Security and Adaptation to Climate Change which was held in Ambo University, Ambo from 4th to 6th June 2013.

International Journal of Agriculture Innovations and Research
Volume 2, Issue 1, ISSN (Online) 2319-1473

APPENDIX

Table 1: Average CFU/ gram of four different fish processing treatments

	Mold	Yeast	APC	Coliform	Fecal Coliform	E.coli	Staphylococcus Spp*	Salmonella Spp*	Shigella Spp*
S_1	$<1x10^1$	$<1x10^1$	$7.1x10^4$	$<1x10^1$	$<1x10^1$	$<1x10^1$	$1.6x10^2$	Not isolated	Not isolated
S_2	$1.2x10^2$	$<1x10^1$	$4.2x10^5$	$1.3x10^3$	$<1x10^1$	$<1x10^1$	$4.8x10^3$	Not isolated	Not isolated
S_3	$<1x10^1$	$<1x10^1$	$2.8x10^5$	$9.6x10^2$	$<1x10^1$	$<1x10^1$	$8x10^2$	Not isolated	Not isolated
S_4	$3x10^2$	$<1x10^1$	$3.6x10^6$	$5.2x10^3$	$3.2x10^2$	$1.1x10^2$	$1.2x10^4$	Not isolated	Not isolated

S_1-Fillet from stain less steel kit S_2- Fillet from Wood kit S_3- Fillet from Plastic kit S_4- Fillet from Ground

Table 2 Microbiological Limits for Assessment of Microbiological Quality

Hazard	Result	Micro-biological Risk Category	Interpretation	Likely Cause	Suggested Actions (Not exclusive) NB: Perform risk assessment before any further action
Escherichia coli O157 (and other Verocyto toxin producing *coliforms* (VTEC))	Detected	High	UNSATISFACTORY: Potentially injurious to health and/ or unfit for human consumption	Inadequate processing Cross contamination	Immediate investigation of: the food origin, production process and environment; take investigative food samples and consider environmental monitoring.
	Not detected	Low	SATISFACTORY		N/A
Salmonella spp.	Detected	High	UNSATISFACTORY: Potentially injurious to health and/ or unfit for human consumption	Inadequate processing Cross contamination	Immediate investigation of: the food origin, production process and environment; take investigative food samples and consider environmental monitoring.
	Not detected	Low	SATISFACTORY		N/A
Shigella spp.	Detected	High	UNSATISFACTORY: Potentially injurious to health and/ or unfit for human consumption	Cross contamination by food handler or fecal contamination of raw product	Immediate investigation of hygiene, cleaning and food handlers in outbreaks.
	Not detected	Low	SATISFACTORY		N/A
Yeast	$>10^4$	High	UNSATISFACTORY: Potentially injurious to health and/ or unfit for human consumption	Strong evidence for poor handling and temperature control or long	Immediately review food handling as well as temperature and time controls. Take investigative samples of food, food preparation environment and food

				storage period.	handlers. Risk will increase proportional to the
			BORDERLINE	Likely evidence for poor handling, process and temperature control and long storage period.	levels detected and the likelihood of subsequent growth in the absence of
	10^2- 10^4	Moderate			appropriate levels of control. Review handling as well as processing controls. Consider taking investigative samples of food, food preparation environment and food handlers.
	$<10^2$	Low	SATISFACTORY		N/A
*Staphylococcus Spp**	$>10^4$	High	UNSATISFACTORY: Potentially injurious to health and/ or unfit for human consumption	Strong evidence for poor handling and temperature control.	Immediately review food handling as well as temperature and time controls. Take investigative samples of food, food preparation environment and food handlers.
			BORDERLINE	Likely evidence for poor handling, process and temperature control.	Risk will increase proportional to the
	20 - ² 10^4	Moderate			levels detected and the likelihood of subsequent growth in the absence of
			SATISFACTORY		appropriate levels of control. Review handling as well as processing controls, especially if there opportunities for growth of staphylococci during processing or maturation of the product. Consider taking investigative samples of food, food preparation environment and food handlers.
	<20	Low			N/A
APC	$>10^5$	High	UNSATISFACTORY: Potentially injurious to health and/ or unfit for human consumption	Strong evidence for poor handling and temperature control.	Immediate investigation of hygiene, cleaning and food handlers in outbreaks.
	10^3- 10^5	Moderate	BORDERLINE	Likely evidence for poor handling, process and	Risk will increase proportional to the levels detected and the likelihood of subsequent growth in the absence of

				temperature control.	appropriate levels of control. Review handling as well as processing controls, especially if there opportunities for growth of staphylococci during processing or maturation of the product. Consider taking investigative samples of food, food preparation environment and food handlers.
	$<10^3$	Low	SATISFACTORY		N/A
Mould	$>10^3$	High	UNSATISFACTORY: Potentially injurious to health and/ or unfit for human consumption	Strong evidence for poor handling and temperature control or long storage period.	Immediately review food handling as well as temperature and time controls. Take investigative samples of food, food preparation environment and food handlers.
			BORDERLINE		
	10^2- 10^3	Moderate		Likely evidence for poor handling, process and temperature control and long storage period.	Risk will increase proportional to the levels detected and the likelihood of subsequent growth in the absence of appropriate levels of control. Review handling as well as processing controls. Consider taking investigative samples of food, food preparation environment and food handlers.
	$<10^2$	Low	SATISFACTORY		N/A

APC-aerobic bacterial plate count

Borderline – test results that are not unsatisfactory but are also not satisfactory, are on the upper limit of acceptability and which indicate the potential for development of public health problems and of unacceptable risk.

Foodborne outbreak - an incidence, observed under given circumstances, of two or more human cases of the same disease and/or infection, or a situation in which the observed number of cases exceeds the expected number and where the cases are linked, or are probably linked, to the same food source (Directive 2003/99/EC60).
Risk - a function of the probability of an adverse health effect and the severity of that effect, consequential to a hazard (Regulation (EC) No. 178/2002).