Case Study on the Microbial Quality of Fish Products and Contact Surfaces in Philippine Wet Market

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ABSTRACT

Assessment of microbial quality of fish and contacts surfaces in wet markets was carried out to provide baseline data for probabilities of policy making in public markets. A total of 24 samples were collected comprising 9 swab sample from contact surfaces (knife, chopping board and display area), and 15 product samples from fresh fish, dried, fermented, salted and canned fish collected from random stalls in the wet market. The microbial profile total viable count; this assessment primarily caters the consumer safety question on the microbial load. Chopping boards have the highest microbial load (7.1×10^6 cfu/cm^2) which was significantly higher among the contaminated contact surfaces. All of the fish and fishery product microbial results passed the FDA Circular No. 2022-012 guidelines on the microbiological requirements and assessment of food products. It was discovered that vendors find it difficult to clean regularly, and are aware of the chemical hazards of detergent, which also has a perceptible odor that customers may find it not acceptable. To maintain the long-term viability of the fishery sector in public markets in the Philippines, it is crucial to continuously monitor and regulate the microbiological quality of fishery products and their food contact surfaces.

Keywords: Contact Surfaces, Fish and Fishery Products, Microbial Load, Wet Market

INTRODUCTION

Fish and fishery products are of great concern for local and export earnings because of their higher nutritive value such as high protein content, with little to no carbohydrate and fat value. However, the microbial quality of fishery products and their food contact surfaces can pose a risk to public health. Fish and seafood are highly perishable and can quickly become contaminated with bacteria, viruses, and parasites quickly if not handled properly during the various stages of catch or harvest, storage, transport, handling, and processing.

The main daily control strategy for food contact surfaces, which are particularly significant as a possible source of contamination, is sanitation that's cleaning and disinfection (Holah and Thorpe, 2002). Raw materials, handlers, and processing instruments including fish basins, cutting boards, and knives, as well as storage leakage and insect and pest harborage, could all contribute to this contamination. In addition, the food contact surfaces

used to prepare, package, and sell fishery products can also harbor pathogenic microorganisms that can be transferred to the food.

The microbial quality of fishery products and their food contact surfaces is therefore an important public health concern. Contamination with pathogenic microorganisms such as *Salmo*nella, *Vibrio*, *Listeria*, and *E. coli* can cause serious illnesses, including food poisoning, sepsis, and even death. Consumption of this contaminated fish may result in infection or intoxication. Water and ice quality are also important factors in producing high-quality fish, because water and ice used in the processing of fish can contaminate the entire process. As a result, it is critical to determine the quality of fish to be consumed. Furthermore, the presence of spoilage bacteria can impair the sensory quality and shelf life of fishery products, resulting in economic losses for the industry and decreased consumer confidence.

This study generally aims to provide and determine microbial profile of the fish display area, cutting tool and the fish that are sold in the wet market; evaluate the microbial quality of dried, fermented, salted and canned fish in the market; and to discuss the effect of the processing method on the microbial quality of the processed fish. The microbial profile was limit only to the total viable count; this assessment primarily caters the consumer safety question on the microbial load. To maintain the long-term viability of the fisheries sector, it is crucial to continuously monitor and regulate the microbiological quality of fishery products and their food contact surfaces.

METHODOLOGY

The study was conducted at the Visayas State University, Baybay City, Leyte 6521 Philippines; samples were collected from the Baybay City Public Market specifically wet section located at latitude and longitude (10^o 41' 28.5" N, 124^o 47' 55.4" E).

A systematic random sampling method was used to assess the microbial quality of fishery products and its contact surfaces from various stalls. A total of 24 samples were collected comprising 9 swab sample, and 15 product samples collected from random stalls in the wet market. The conduct of microbial profile follows the method of ISO/TS 11133-1 General Guidelines on Quality Assurance for the Preparation of Culture Media in the Laboratory (2009) with slight modification. The swab samples were taken from contact surfaces such as chopping board, display area and knife with an area of 1 cm^2 using sterile cotton buds soaked into 0.1% saline solution. Each tube containing swab samples (10 mL of 0.1% saline water) was vortexed to ensure a mixture of the sample. Product samples were from fresh fish, dried fish, fermented fish, salted fish and canned fish. About twenty-five grams (25 g) of the product samples were weighed and transferred to a stomacher bag. The samples were then diluted to 10^{-1}, 10^{-3} and 10^{-5} using 225 mL peptone water and homogenized for 3 min using the Stomacher. Following homogenization, further serial dilutions were made using sterile peptone water. A tenfold serial dilution was prepared by transferring 1 mL of the homogenized sample (both meat and swab) to 9 mL diluents. Plate Count Agar (Merck, Germany) was used for the total viable count and all plates were incubated at 37^oC for 24 hrs. All data were expressed as log CFU/ml.

All statistical analysis was conducted using IBM SPSS Statistic Version 8.0. Data were analyzed using 1-sample T-test set at 95% confidence level to determine the differences in means with the FDA Circular 2022-012 on Guidelines on the Microbiological

Requirements and Assessment of Certain Prepackaged Processed Food Products and other reference standard for contact surfaces.

RESULTS

Table 1. Microbial count from contact surfaces such as chopping board, display area and knife expressed in log cfu/cm^2

CONTACT SURFACES	REFERENCE STANDARD	TOTAL PLATE COUNT cfu/cm^2	REMARKS
Chopping Board	<50 cfu/cm^2 Used maple wood chopping board after cleaning Ak, et al. (1994)	7.1 x 10^6	Failed*
Display Area	<10^3 cfu/cm^2 Swab from recently cleaned surfaces that are in use Little and Sagoo (2009)	6.1 x 10^6	Failed*
Knife	≤520 cfu/ml Standard for cookery and utensils in the USA, Public Health Service Collins et al. (2004)	5.1 x 10^6	Failed*

* Significantly different between the reference standard and the experimental result; however, remarks were still indicated with respect to reference standard.

Table 2. Microbial count of fish and fishery products in wet market

CONTACT SURFACES	REFERENCE STANDARD	TOTAL PLATE COUNT cfu/g	REMARKS
Fresh Fish	5 x 10^5 cfu/g Table 11 of the Philippine FDA Circular No. 2022-012	4.6 x 10^5	Passed
Dried Fish	10^5 cfu/g Table 11 of the Philippine FDA Circular No. 2022-012	770	Passed*
Fermented Fish	5 x 10^5 cfu/g Table 11 of the Philippine FDA Circular No. 2022-012	490	Passed*
Salted Fish	10^5 cfu/g Table of the Philippine FDA Circular No. 2022-012	<100 ESPC	Passed*
Canned Fish	Commercially Sterile Philippine FDA Circular No. 2022-012	<100 ESPC	Passed*

* Significantly different between the reference standard and the experimental result; however, remarks were still indicated with respect to reference standard.
ESPC – estimated plate count

DISCUSSION

The determination of the total viable aerobic count (TPC) by standard plate count method of swab samples from the display area, knife, chopping board and fish sold in the market, and evaluation of the quality of dried, fermented, salted and canned fish through standard plating. The resulted TPC indicates contamination that leads to spoilage and the presence of specific fish pathogens (which were not identified in this study). The TPC of the

food contact surfaces such knife, chopping board and the display area generates a result of <5,000,000 colony forming units.

Chopping board have the highest count of 7,100,00cfu/mL. Chopping board used in the fishery market is made of wood – a porous material that harbor dirt, fish debris/pieces and bacteria. This is in accordance to the findings of Zulfakar et.al (2018) wherein cutting boards has been identified as the most contaminated food contact surface due to its significantly higher numbers of total coliform as compared to other food-contact surfaces ($p < 0.05$).

Cleaning frequently may be exceedingly challenging for the fish vendors, although their common practice is limited to frequent wiping and washing of the boards with water, not following any other basic hygiene procedures. The processing of microbially contaminated fish on chopping boards cleaned using traditional practices leads to cross-contamination. According to Clayton et al. (2002), time is one of the contributing factors to poor hygiene practices. In this case and in consideration of wet market-setting, the fish vendors reported to having little time to properly wash their hands with soaps and sanitize contact surface often. The vendors are also aware that detergents can cause chemical hazard to consumers and also have perceptible odor masking the inherent fish odor; which is attributed to be not acceptable. Moreover, Burah (2022) reviewed and reported that when contaminated fish enter the body through the food chain and produce inhibition to various enzymes in the human body, thus reducing the body's immunity.

The display area is the major source of contamination as it is an open space made of tile surface. the TPC indicate a valid conclusion that the area was not cleaned and sanitized properly. One of the sources of microbiological contamination on the food contact surfaces in this study may be due to cross-contamination from contaminated raw food products onto the contact surfaces, as well as the people or costumer's money which contacts to the display area or fish itself. Last but not least on the food contact surface is a stainless-steel knife that is corrosion resistant, has a smooth bonded seam, and is easily cleanable. The resulting TPC is still high, which could be due to the knife being used during the sampling and probably not being properly washed.

On the fishery product itself, the fresh fish have the highest TPC of 460,000 – this is not the expected result because by the book and nature fresh fish is clean and of little microbial load inherent from marine waters but as of FDA Circular 2022-012 the result is on acceptable level of microorganism which limits at 500,000. Microorganisms play a crucial and unique role in fish and fish product safety. The presence of human pathogens and the formation of histamine caused by spoilage bacteria make the control of both pathogenic and spoilage microorganisms critical for fish product safety (Sheng and Wang, 2021). This result is could be due to transfer of handling and contamination from its food contact surfaces such fish boxes or "banyera", the display area, chopping board, knife, etc. and from the water and ice used. Microbial contamination on fish induced histamine that leads fast deterioration, and indicates inferior quality (Docan and Grecu, 2018; Sheng and Wang, 2021).

The dried fish still have a sizeable microbial load. This may be because of the handling practices in the market and from the processors, and transporter. The standard handling practice on fishery products is not thoroughly practiced – proper sanitation, clean storage and packaging such as wooded crates must be closed and paper used as linen must also clean and free from insects and pest. The fermented fish still harbor microbial load

which needs further investigation if the viable counts is free from pathogenic microorganisms. One thing must be pursued on fermented fish; it should not be displayed openly as contamination may occur especially the luring of flies, bottling is the best package for this product.

Lastly, the canned and salted fish is considered commercially sterile. This had been proven in the microbial result. All microbial result of the fishery products is passable as per FDA Circular 2022-012 on Revised Guidelines for the Assessment of Microbial Quality of Processed Foods.

CONCLUSION

It is concluded that wooded chopping board have the highest microbial load, a failing count for a food contact surface material, and all of the fishery product microbial result passes the FDA assessment of microbial quality of processed foods.

RECOMMENDATION

The food contact surfaces must be washed, cleaned and sanitized to prevent contamination, preserved the products and to avoid the latter case of foodborne illness. Fishery products microbial results passed the FDA microbial limit; however, it is still recommended to have proper storage for the fishery products to prevent cross-contamination, and decent secure packaging to ignite consumers to buy the products. Further investigation on the probable presence of pathogenic microorganisms, as well as its morphological and physiological classifications.

CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest regarding this paper.

AUTHORS' CONTRIBUTIONS

Judife N. Magallanes was involved in conception of the study, auditing of the area, acquisition of data, microbial evaluation, statistical analysis, interpretation of data, drafting of the work, and revision of work. Ma. Aezel M. Aguanza participated in conception, acquisition of data, microbial evaluation, interpretation of data, drafting of the work, and substantive revision of the work. The authors agreed to published this research article.

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