Detection of *Staphylococcus Aureus* from the Selected Dried Fishery Products

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ABSTRACT

Taboan Market in Cebu City, Philippines is the most famous source of dried *danggit*, *pusit* and *mangsi* which served as *pasalubong* for local and foreign tourists in Cebu City. The Cebu Technological University researchers visited the dried processing firms located near the coastal areas of Cebu City and Talisay City, Cebu. The study revealed that the processors were not aware of good manufacturing practices for fish drying. Samples of the top three best seller dried products at Taboan Market were analyzed as to bacterial and fungal total plate count with the detection of *Staphylococcus aureus*, in colony forming unit using 3M-Petrifilm and pour plate method. The pH and water activity levels of the products were determined. The dried *danggit*, *pusit* and *mangsi* had bacterial total plate count of $1.0 \times 10^4$ cfu/g, $2.5 \times 10^4$ cfu/g and $5.0 \times 10^4$ cfu/g, respectively; mold count of $2.3 \times 10^1$ cfu/g, $2.0 \times 10^1$ cfu/g, and $1.5 \times 10^1$ cfu/g. The *S. aureus* count of 30, 50 and 100 cfu/g sample for dried *danggit*, *pusit* and *mangsi*, were within the acceptable standards of Bureau of Food and Drug Administration. The pH level of dried fish samples was within 6.1 to 6.5, while the water activity of the dried products was 0.98 based on Lupin's water activity (Aw) mathematical calculation. Continuous studies on packaging and good manufacturing practices of dried fish products will be conducted to ensure microbial reduction.

Key words: Dried fish, *Staphylococcus aureus*, *Escherichia coli*, microbiology.

INTRODUCTION

The aerobic plate counts on fish and fishery products generally do not relate to food safety hazards, but sometimes can be useful in indicating quality, shelf life and post heat-processing contamination. A water activity of 0.85 or below will prevent the growth and toxin production of all pathogenic bacteria, including *Staphylococcus aureus*, and is critical for the safety of a shelf-stable dried product. *S. aureus* grows at a lower water activity than other pathogenic bacteria, and should, therefore, be considered the target pathogen for drying of shelf-stable products (http://seafood.ucdavis.edu/haccp/compendium/chapt09.htm).

The water activity of the selected dried fish can be calculated using the method as described by Doe et al. (1982) utilizing its moisture, fat and salt contents. The heat
of the sun and movement of air eliminates moisture and causes the fish to get dried. In order to prevent spoilage, the moisture content needs to be reduced to 25% or less. The percentage will depend on the oiliness of the fish and whether it has been salted [http://www.fao.org/WAIRdocs/x5434e/x5434e0f.htm].

The lower fat content observed in sundried method could be associated with the oxidation of fat during the period of sun drying (McGill et al., 1974; Akinneye et al., 2007). Hence, this study determined the safe quality of selected dried products displayed at Taboan Market in Cebu City based on microbiological and physico-chemical analyses.

Figure 1: Research site: A) Cebu map, B) Cebu City and C) Taboan market
particularly, total plate count and S. aureus count in colony forming unit per gram and its water activity.

MATERIALS AND METHODS

An experimental method of research on water activity determination and microbial analyses was conducted using the most saleable dried fish in Taboan market (Figure 1) particularly, boneless danggit, dried squid and sardines.

The aerobic plate count of bacteria in colony forming unit per gram was likewise determined with the detection and enumeration of S. aureus. The water activity was determined by analyzing salt, fat and moisture content of the dried fish using the calculation method of water activity determination.

RESULTS AND DISCUSSION

This study determined the quality of the selected dried product based on water activity using calculation method and microbial analyses particularly aerobic plate count and S. aureus count in colony forming unit per gram.

Salt content

In this study, boneless danggit had the highest salt content (1.14%), followed by dried squid and the least salt percentage was only 1.049 based on the laboratory analysis.

Fat content

In this study, dried mangsi had the highest fat content of 4.99% followed by danggit (2.11%) and squid (1.50%). The highest fat content (12.1% to 26.42%) was observed in fish samples that were sundried.

Moisture content

In this study, the dried mangsi had the highest moisture content of 41.68%, followed by dried squid with 20.68% and the lowest moisture content was dried boneless danggit which had 17.51%. Thus, dried boneless danggit and dried squid had the moisture content that prevent spoilage.

In this study, the water activity for dried boneless danggit is 0.84, followed by 0.9 for dried squid and 0.98 for dried mangsi. FDA Guidelines revealed that controlling pathogen growth and toxin formation by drying is best accomplished by scientifically establishing a drying process that reduces the water activity to 0.85 or below and if the product will be stored and distributed unrefrigerated (shelf-stable) and scientifically establishing a drying process that reduces the water activity to below 0.97.

This implies that dried boneless danggit and dried squid are free from the proliferation of pathogenic organism like S. aureus. (Figure 4).

Water activity

In this study, the water activity of selected dried products from Taboan Market, Cebu City was determined by calculation method based on the method described by Doe et al. (1982). This is based on salt, fat and moisture contents of the research sample. (Figure 5).

Microbial analyses results

In this study, the microbial analyses includes aerobic plate count, S. aureus count in colony forming unit per gram sample and mold count. This likewise considers the pH level of dried products.

Aerobic plate count

In this study, the aerobic plate count of the selected dried products as reflected in Figure 6 had $5.0 \times 10^4$ cfu/g for dried mangsi, $2.5 \times 10^4$ cfu/g for dried squid and $1.0 \times 10^4$ cfu/g for dried boneless danggit. This means that the bacterial count in terms of aerobic plate count is within the safe level since fresh fish and fishery products often have an APC of $10^4$ to $10^5$/g

Staphylococcus aureus count

In this study, the S. aureus of the selected dried products was detected and had a count of 100, 50, 30 and below. The counts of S. aureus of the products which is 100 cfu/g below are within the acceptable level of 20 to lower than 100 cfu/g (Gilbert, 2000). This indicated that there was a contamination of the product and an index reflecting as borderline limit of microbiological quality. (Figure 7).

Mold count

Yeasts and molds predominate in low pH foods where bacteria cannot compete. This survives at low water activity and low acid foods.

In this study, the yeasts and molds count of the selected dried fish were only 23, 20 and 15 cfu/g sample. Due to its low water activity the yeasts and molds proliferated, however at its minimal level. (Figure 8).
Figure 2: Percent salt content of selected dried products.

Figure 3: Percent fat content of selected dried products.

Figure 4: Percent moisture content of selected dried products.
Figure 5: The water activity of selected dried products.

Figure 6: Aerobic plate count of selected dried products in $10^4$ cfu/g sample.

Figure 7: *Staphylococcus aureus* count of selected dried products in cfu/g sample.
One of the numbers of strategies for the control of pathogenic bacteria in fish and fishery products is to control the pH in the product for shelf-stable acidified products. In this study, Figure 9 revealed the pH level of the selected dried products. This figure presents that the pH level of dried boneless danggit, dried squid and dried mangsi were pH 6.3, 6.5 and 6.1, respectively. This indicated that the pH belongs to the neutral pH lower limit leading to high acid foods. pH has a profound effect on the growth of micro-organisms. Most bacteria grow best at about pH 7 and grow poorly or not at all below pH 4 (aggie-horticulture.tamu.edu/commercial/food_processor/microbio.html).

Conclusion

Water activity of dried products like danggit (0.84) and pusit (0.90) which are top sellers dried products in Taboan, are safe for pathogens and mangsi with 0.98 are prone for pathogens. Thus, based on the findings the S. aureus levels are within its tolerable limit for human consumption.
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