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Enhancing the Safety and Quality of Fish Export: A Practical Approach for Seawater Treatment in Fish Preservation

Suzylawati Ismail* and Khor Seok Fern

School of Chemical Engineering, Universiti Sains Malaysia, Engineering Campus, 14300 Nibong Tebal, Penang, Malaysia

**(chsuzy@usm.my) Email of the corresponding author*

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Abstract – European Union Standards emphasise that fish imported from a select few countries is frequently polluted with contaminants. The seawater used for fish preservation is a significant source of contamination, thus aggressive steps must be made to treat it to ensure the safety of export fish. Using current techniques, seawater is settled overnight, however, this does not completely remove all pollutants. This problem has been addressed by applying a system comprised of microfiltration membrane and activated carbon to treat seawater used for fish preservation. Turbidity is effectively reduced by more than 98%, and total suspended solids (TSS) are efficiently reduced within the 70-90% range. Additionally, total organic carbon (TOC), which determines the concentration of organic pollutants, can be reduced by 85-90% through activated carbon adsorption. The design approach is appropriate since necessary salty compounds or ions either remain after treatment or experience only small reduction as proven by total dissolved solids (TDS) measurement.

Keywords – Fish Preservation, Membrane, Microfiltration, Adsorption, Seawater Treatment

I. INTRODUCTION

The fisheries sector is an important sub-sector in Malaysia and plays a significant role in the national economy. In 2021, the gross domestic product (GDP) from the entire Malaysian fishing industry was 11.22 billion Malaysia ringgit [1]. Apart from contributing to GDP, it is also a source of employment, foreign exchange, and a source of protein supply for the rural population in the country. However, in recent years, the industry has faced challenges due to concerns about food safety and quality, particularly in relation to fisheries exports to the European Union (EU) [2]. One of the main issues is the use of common practice fish preservation processes using chill seawater for export techniques that potentially lead to contamination and non-compliance with Eu standards.

Chill seawater is a commonly used method for preserving fish in Malaysia, particularly for species that are highly perishable and require rapid cooling to maintain their quality. This method involves immersing the fish in cold seawater that has been chilled to a temperature of between 0 – 4 degrees Celsius [3, 4]. The fish are then sored in insulated containers and transported to market or processing facilities. One of the advantages of chill seawater preservation is that it is a relatively simple and cost-effective method that requires minimal equipment or infrastructure. However, using seawater may result in contamination. Pollutants from the sea may

build in sediments and marine life, including heavy metals [5] and organochlorine chemicals [6,7], which can accumulate in fish and endanger consumer health. Imported seafood items must adhere to stringent requirements set forth by the EU in order to be sold on the market.

To address the issue of contamination, the fisheries industry needs to adopt more proactive measures to ensure that exported seafood products are safe and comply with EU standards. One approach is to treat the seawater used for fish preservation to reduce the risk of contamination. Microfiltration membrane technology and activated carbon adsorption are effective methods for removing pollutants from seawater and can help to ensure that the preserved fish are safe for consumption.

II. Materials and Method

A. *Materials*

The seawater samples are collected from three different states in Malaysia that are from Kuala Perlis in Perlis. Pulau Sayak in Kedah and Kuala Kurau in Perak. Their water quality was tested based on pH, turbidity, total suspended solid (TSS), total dissolve solid (TDS) and total organic compound (TOC). Acid nitric (HNO_3) from JT Baker (USA), Activated carbon (cocoa pod husk), Microfiltration membrane (cellulose nitrate, diameter 47μm, pore size 0.45μm).

B. *Experimental Procedures*

Each seawater samples were tested for pH, turbidity, total suspended solids (TSS), total dissolve solids (TDS) and total organic compound (TOC). The pH and turbidity of seawater samples were measured using pH meter 1500 and nephelometer or turbidimeter (TN-100 Oaklon). Total organic compound (TOC) was tested using *Total Organic Carbon* analyzers (Oaklon TN-100). After testing, the seawater sample is treated using the proposed design system. The proposed design system is based on laboratory scale.

The activated carbon used in this project is produced from cocoa pod husk. The contact time and carbon dosage were tested to obtain optimum value for the adsorption process. Then, the optimum time and carbon dosage were used to treat seawater samples. The particulate that escaped from the adsorption process was filtrated by microfiltration membrane. The characteristic of seawater after treated with activated carbon and membrane microfiltration was measured and compared with the parameter value before treatment. The result was analysed, and the suitability of the proposed design system is discussed.

III. RESULTS AND DISCUSSION

The practical approach incorporating membrane technology and activated carbon was proposed and tested to treat the seawater for fish preservation. In order to demonstrate the viability of the proposed treatment, the seawater samples were examined in the laboratory-scale experiment for pH, turbidity, total suspended solid (TSS), total organic compound (TOC), and total soluble solid (TDS) before and after treatment.

A. *pH*

The pH value of the seawater samples is shown in Table 1. The result for three samples before and after treatment shows that the pH is within the allowable range, this mean that the seawater pH is tolerable with the aquatic life and not polluted by acidic or alkaline compound. The pH value of the seawater can exist in several scales due to the chemical properties of the seawater, but seawater pH is limited within the range 7.5 to 8.4 [8]. If the seawater is too acidic or alkaline, it will damage the aquatic life and affect ecosystem.

Table 1. Results of pH for seawater samples

Seawater Samples	Before Treatment	After Treatment
Kuala Perlis	7.86	7.79
Pulau Sayak	7.77	7.77
Kuala Kurau	8.16	8.14

B. *Turbidity*

Figure 1 displays the results for the percentage reduction on several evaluated parameters after the seawater has been treated with a microfiltration system and activated carbon. For all the seawater samples, turbidity provided the highest reduction, at more than 98 %. This demonstrated there are not many suspended solids or unwanted particles after treatment that could contain harmful or polluting

substances [9]. It is believed that these substances, when presence in greater concentrations, could permeate into fleshy fish, contaminating it and harming anyone who eats it.

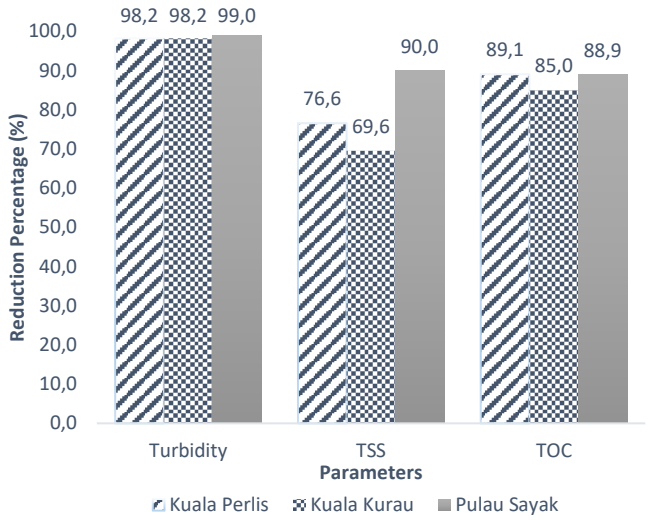

Fig. 1 Results for reduction percentage of turbidity, TSS and TOC on three seawater samples

C. *Total Suspended Solids (TSS)*

TSS provides an actual weight of the particulate material present in the water sample, which can be composed of various solids, silt, dead plant, and animal matter. When there is a significant amount of suspended solid in the seawater used for fish preservation, the organic material will deteriorate, causing the fish to smell and taste bad.

Figure 1 illustrates the TSS reduction percentage for three seawater samples. The TSS of all the samples that were taken decreases within the range of 77 to 90%. All seawater samples with TSS values slightly higher than 20 mg/l can be regarded as clean water. Overall, the TSS of seawater has been reduced to a level that is sufficient for the preservation of fish. The employed microfiltration membrane with pore size 0.47 μm able to remove most of the suspended solids [10]. The results demonstrate that the suggested approach could guarantee the least quantity of TSS in the fish preservation.

D. *Total Organic Compound (TOC)*

Figure 1 illustrates the TOC reduction percentage for three seawater samples. The TOC decrease is between 85% and 89% for the tested three seawater samples. TOC provides a rapid and practical technique to assess the level of organic contamination. These organic contaminants include natural organic substances, insecticides, herbicides, and other agricultural chemicals. A high organic content indicates a rise in the growth of bacteria that cause oxygen sources to deplete, contaminating the fish, or that the growth of microorganisms will accelerate and cause the fish to spoil [11]. The initial values of TOC for all 3 seawater samples are higher than 50 mg/l which can be considered sufficient for the contamination of fish and cause the toxicity when it is directly use in fish preservation.

The activated carbon treatment play significant role in reducing the colour and organic content in the seawater. Thus, the propose approach is effective to reduce the TOC content in seawater.

E. *Total Dissolve Solids (TDS)*

Total Dissolved Solids is a measure of the amount of material dissolved in water and it can pass through a filter. These materials can include carbonate, bicarbonate, chloride, sulphate, phosphate, nitrate, calcium, magnesium, sodium, organic ions, and other ions. A certain level of these ions in water is necessary for aquatic life. Changes in TDS concentrations can be harmful because the density of the water determines the flow of water into and out of an organism's cells. Seawater that used for fish preservation must have a significant TDS value [12].

Figure 2 demonstrates that the TDS gave the lowest percentage reduction, which was between 0 and 5%. To prevent the movement of water into and out of an organism's cells, which can lessen the freshness of the fish after treating the seawater, the TDS value should not be greatly affected. Hence, the propose design treatment is effective to maintain the necessary ions in the seawater.

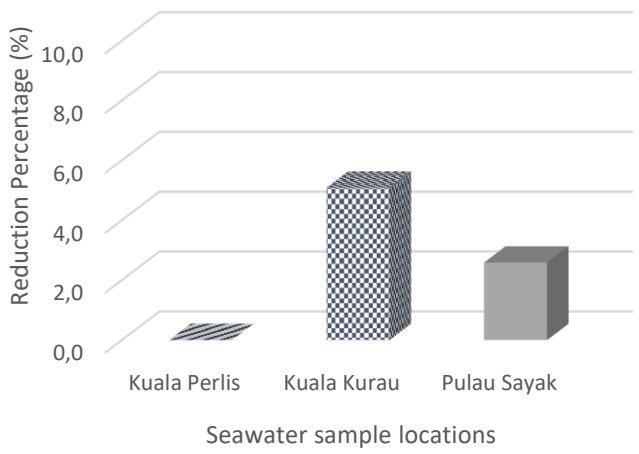

Fig. 2 Results for reduction percentage of TDS on three seawater samples

IV. CONCLUSION

The main conclusion of the study is to validate the possibility of adopting the propose practical approach using Microfiltration membrane technology and activated carbon adsorption. This approach is found effective in reducing turbidity (> 98%), total suspended solids (77-90%) and total organic compound (85-89%). While maintaining the pH and total dissolve solids within acceptable values.

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REFERENCES

[1] (2023) Statista Research Department [Online]. Available: http://www.statista.com/aboutus/our-research-committement

[2] J.L.C. Vivero, J.C.R. Mateos, F.D.C. David, J.B. Maria, C. Helena, K. Marian and J.M. Ewelina, "Food Security and Maritime Security: A new Challenge for the European Union's Ocean Policy", *Marine Policy*, vol. 108, 103640, 2019.

[3] Code of Practice for Fresh Fish, FAO Fisheries Circular No. 318, pp. 4.

[4] M. Pidwirny. (2006) Physical and Chemical Characteristics of Seawater, Fundamentals of Physical Geography. [Online] Available: http://www.physicalgeography.net/fundamentals/8p.html

[5] J. Norhazwani, A. Ahmad, M.M. Syafiq, M. Mazlan, H.Y. Abdul, and M.L. Azwan, "Occurrence, distribution and Characteristics of Microplastics in Gastrointestinal Tract and gills of Commercial Marine Fish from Malaysia", *Science of the Total Environment*, vol. 799, 149457, 2021

[6] L.O. Ana, G. Lautaro, V.R.V. Tatiana, C.R. Ana, E.M. Jorge, and H.A. Andres, "Occurrence, Behaviors and the Associated Health Risk of Organochlorine Pesticides in Sediments and Fish from Bahia Blanca Estuary, Argentina", *Marine Pollution Bulletin*, vol. 185, 114247, 2022.

[7] K.H. Leong, L.L. Benjamin Tan, and M.M. Ali, Contamination levels of Selected Organochlorine and Organophosphate Pesticides in the Selangor River, Malaysia between 2002 and 2003", *Chemosphere*, vol. 66, pp 1153 – 1158, 2007

[8] R. Chester and T.D. Jickells. Marine Geochemistry, 3rd Edition, Blackwell Publishing, 2012.

[9] S. Khemakhem, A. Larbot, and R. Ben Amar, "Study of Performance of Ceramic Microfiltration Membrane from Tunisian Clay Applied to Cuttlefish Effluents Treatment", *Desalination*, vol. 200 (1-3), pp 307-308, 2006.

[10] J.W. Chew, J. Kilduff, and G. Belfort, "The Behavior of Suspensions and Micromolecular Solutions in Crossflow Microfiltration: An Update", *Journal of Membrane Science*, vol. 601, 117865, 2020.

[11] A. Hassoun, A. Sahar, L. Lakhal, and A. Al-Kaddour, "Fluorenscence Spectroscopy as a Rapid and Non-destructive Method for Monitoring Quality and Authenticity of Fish and Meat Products: Impact of Different Preservation Conditions", *LWT-Food Science and Technology*, vol. 103, pp 279-292, 2019.

[12] E. Watts. Seafood Handling, Processing, and Packaging, Reference Module in Food Science, Elsevier, 2022.