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# Investigation of Microbial, Chemical and Color Changes of Fish Burgers in Different Storage Conditions Using Artificial Neural Network

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## Abstract

The aim of this study was to evaluate and predict changes in total viable count (TVC), *Pseudomonas*, Psychrotroph, *Enterobacteriaceae*, Lactic Acid bacteria and chemical parameters including volatile nitrogen bases (TVB-N) and malondialdehyde (MDA) in cooking silver carp burger at 45, 55, 65, 75 and 85 °C using artificial neural network. The cooking time was 20 and 30 min and the storage was 18 days. Cooking at 55 °C for 30 min had no effect on inactivating other groups, but it did affect Pseudomonas. Cooking at 65 °C for 20 min controlled Psychotrophs and *Enterobacteriaceae* and had no effect on other groups. The amount of *Pseudomonas* during cooking time of 20 min at 45 and 55 °C and Lactobacillus during cooking time of 20 min at 45 °C were not within the standard bacterial load and the results showed that fish burgers could be consumed in other treatments until the end of the storage period, except in these treatments. At both cooking times, the cooking temperature of 85 °C inactivated *Pseudomonas*, *Enterobacteriaceae* and Lactic Acid bacteria. Temperature had the most and time had the least effect on the model proposed for MDA. The burgers were within range of TVB-N during storage. By increasing the storage time, the color index L* was increased and the color of the burgers tended to be white. It can be said that the neural network (MLP) results are reliable and can be used to reduce the cost of experiments in the production industry of burger.

**Keywords:** Artificial neural network, Chemical changes, Fish burger, Microbial changes

## Introduction

Fish and fish products are susceptible to rapid spoilage, but due to their high nutritional value, they are a part of most diets around the world. Loss of freshness is caused by enzymatic and chemical reactions, along with microbial activity (Rico *et al.*, 2020).

Artificial neural network (ANN) is an information processing model established by imitating the biological nervous system, which has the characteristics of parallelism, self-adaption, and nonlinearity. With the rapid development of artificial intelligence, ANN have been widely used in the fields of mechanics, medicine, architecture (Arenas *et al.*, 2018). At present, some researchers pay attention to the combination of ANN and food industry (Ma *et al.*, 2019; Shi *et al.*, 2017). Therefore, predicting the quality of meat products with the help of ANN has a very ideal development space. In recent years, there have been studies on optimizing food processing parameters and predicting the shelf life of products with the help of ANN (Zhu *et al.*, 2021).

As a result, the main objective of this study was to analyze the effect of sous vide processing on the microbial quality of fish burger. The steps of this research were as follows:

(1) sous vide processing of fish burger at different process conditions; (2) analyzing the effect of process conditions on the microbial quality (*Enterobacteriaceae*, Pseudomonas, Psychrotrophs, lactic acid bacteria, and total viable count) of fish burger; (3) behavior of microbial growth in sous vide cooked fish during cold storage (21 days); (4) modeling and simulation of microbial count by artificial neural networks.

## Materials and methods

The fish burger was placed on the plate of a 28 cm diameter stainless steel steamer pot containing 1 L of purified water and covered with a lid to cook with water vapor (99.9 °C) for ten min under a standard atmospheric pressure. Microbial analysis was carried out on both control and treated samples at 0, 3, 7, 14, and 18 days of cold storage (-18 °C), (Hosseini *et al.*, 2021). The experimental data were used for developing ANNs where the independent variables were temperature (°C) and storage period (day) and the dependent variable was a microbial count (Log CFU $g^{-1}$).

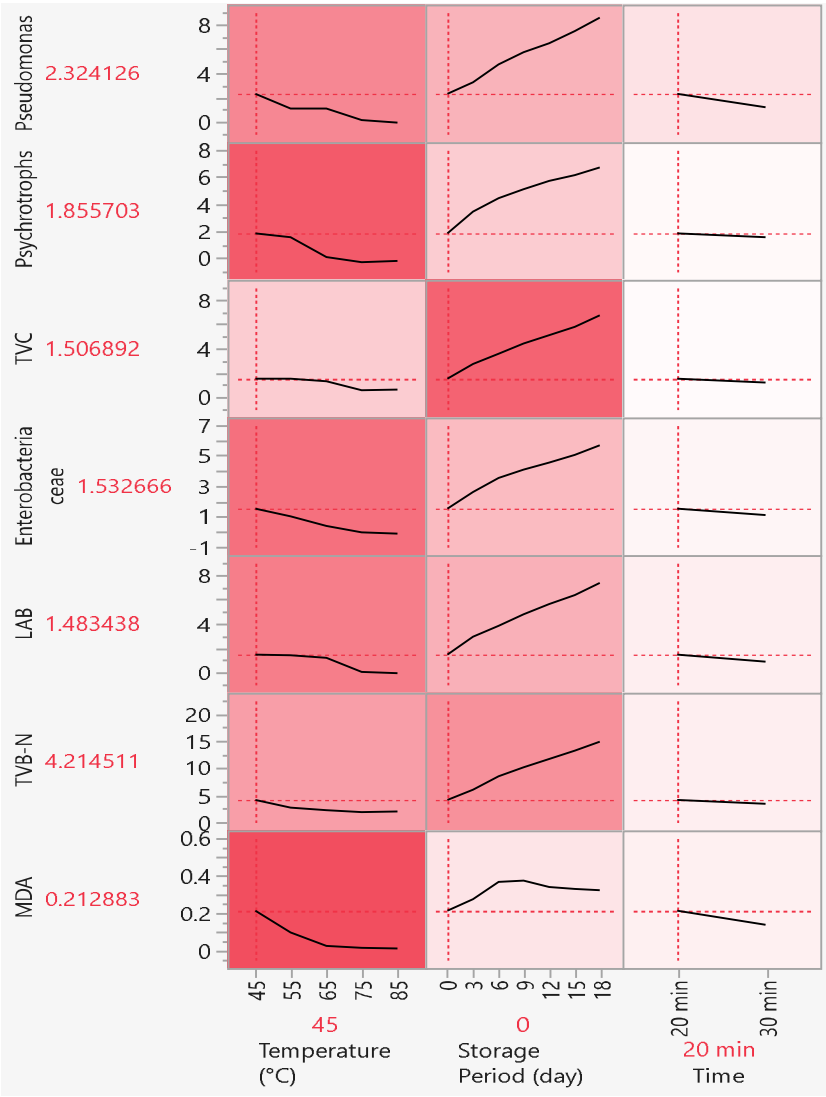


**Fig. 1.** The effect of the temperature, storage and time of cooking on the survival of microorganisms in fish burger

## Results and Discussions

The growth of TVC, psychrotrophs, pseudomonas, and *Enterobacteriaceae* at high heat-treated samples (75 °C) could be associated with the thermolabile characteristics of these bacteria (Li *et al.*, 2018). The overall results of microbial quality indicate that sous vide

processing of fish burger at 75 °C was adequate for assuring the microbial quality of samples (Fig. 1). Simulated results of ANN were used to generate the contour plots of microbial growth during storage. One of the important issues that should be considered in ANN modeling is that if it is obtained a specific result in the first run, it will not necessarily get the same result in the next replicate (Yin & Ding, 2009).

## Conclusions

This study reported the influence of cooking processing on the effects of storage and processing temperatures on the fish burger by analyzing the microbial load of LAB, psychrotrophs, pseudomonas, and *Enterobacteriaceae*. The results illustrated that sous vide processing at a higher temperature could significantly inhibit the microbial load of fish burger.



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