

Determining The Shelf Life of Tamban Fish Choux Pastry (*Sardinella Lemuru*) Using Aluminum Foil Packaging using The Aslt Method

Jumsurizal Jumsurizal^{1,*}, *R. Marwita Sari Putri*¹, *Sri Novalina Amrizal*¹, *Aidil Fadli Ilhamdy*¹, *Lily Viruly*¹, *Yulia Oktovia*¹, *Azwin Apriandi*¹, *Taufik Hidayat*², *Roslizawati Ab Lah*³, *Devi Nurhayati*¹

¹Fisheries Product Technology Study Program, Faculty of Marine and Fisheries Sciences, Raja Ali Haji Maritime University, 29111 Tanjungpinang, Indonesia

²Department of Aquatic Products Technology, Aquatic Products Technology, Faculty of Fisheries and Marine Sciences, IPB University Building (Bogor Agricultural Institute), Indonesia

³Faculty of Fisheries and Food Science, Malaysia Terengganu University, 21030 Kuala Terengganu, Terengganu, Malaysia

Abstract. Choux pastry is known as sus, which is defined as a cake that has a dry, hollow and light texture so that it can be filled with various variations. Tamban fish meat is less popular with the public because it has many spines, so it can be used as raw material for making choux pastry which is capable of containing quality, added product value and good nutritional content. Apart from that, it can produce products with a delicious taste. Aluminum foil type plastic packaging is one type of plastic that is widely used in making food because it is the best type of plastic which is able to prevent chemical reactions and has heat resistant properties. Aluminum foil type plastic packaging in the form of a standing pouch has excellent air and light barrier capabilities and has a locking clip. This method uses environmental conditions that can accelerate the reaction of decreasing product quality. The use of the Arrhenius model on dry products can predict the rate of chemical reactions resulting in damage or changes in product quality at various storage temperatures. My research used 3 different temperatures, namely, temperature 30, temperature 40 and temperature 50. The shelf life parameters used in my research are peroxide value, hedonic test, water content and total plate number. The data contained in the research carried out on day 0 is: Water content is the ratio between the weight of water contained in a product and the weight of dry ingredients. Water content can be used to determine the quality and shelf life of products and foam to determine humidity. The initial water content value on day 0 was 3.78.

* Corresponding author: jumsurizal@umrah.ac.id

1 Introduction

Choux pastry is known as sus, which is defined as a cake that has a dry, hollow and light texture so that it can be filled with various variations. The ingredients used in making dry choux pastry are almost the same as in general with baking powder added so that it expands optimally [1]. However, choux pastry has been developed by adding other raw materials to increase nutritional value, such as adding tamban fish to choux pastry [2]. Packaging is a container to protect food and non-food products from damage. Packaging selection can be based on the nature of the material, purpose and environmental conditions. The type of packaging used must meet food grade standards to maintain product durability. Aluminum foil type plastic packaging is one type of plastic that is widely used in making food because it is the best type of plastic which is able to prevent chemical reactions and has heat resistant properties. Aluminum foil type plastic packaging in the form of a standing pouch has the advantages of being thick, transparent and has a locking clip. This packaging can be used for packaging dry cakes because it can slow down the decline in product quality and extend the product's shelf life [2]. Therefore, it is necessary to carry out further research regarding the effect of using aluminum foil packaging in the form of a standing pouch on choux pastry products with the addition of tamban fish (*Sardinella lemuru*) to see whether there is a decrease in quality, both physical and chemical.

To maintain the quality and characteristics of a product, it is necessary to maintain a shelf life during the storage process. Shelf life is defined as the time span from the production process to the time the product is unfit for consumption. There are two ways to determine shelf life, namely empirical methods and mathematical models. Storing products under normal conditions until damage occurs is an empirical method. Meanwhile, storage by speeding up and paying attention to product critical points is mathematical modeling (Fauzia, 2023). There are two methods for determining shelf life, namely the Extended Storage Studies (ESS) method and the Accelerated Shelf Life Testing (ASLT) method. The Extended Storage Studies (ESS) method is a conventional method that determines expiry date by storing a product under normal conditions, then observing changes in quality and shelf life. Products that use the Accelerated Shelf Life Testing (ASLT) arrhenius model method use packaging, namely the shelf life of apple flavored drinks which has a shelf life of 1 year 2 months at a temperature of 25°C (Swadana and Yuwono, 2014), the shelf life of instant chocolate which has a shelf life of 140 days at a temperature of 40°C [4], the influence of packaging quality of snakehead fish choux pastry for 28 days at a temperature of 29 °C [5]. This research aims to determine the shelf life of tamban fish (*Sardinella lemuru*) choux pastry products using polypropylene packaging by knowing the water content, ALT test, hedonic test, and peroxide value using the Accelerated Shelf Life Testing (ASLT) arrhenius model method.

2 Method

2.1 Material

Tamban fish (*Sardinella lemuru*) is one of the main raw materials in making this choux pastry. Apart from that, there are also additional ingredients, including high protein wheat flour, eggs, baking powder and water.

2.2 Equipment

The equipment used in this research includes incubators, autoclaves, hot plates, Petri dish test tubes, beakers, measuring cylinders and colony counters.

2.3 Steps in making choux pastry with the addition of tamban fish (*Sardinella lemuru*)

Additional fish are taken at the Bintan Center market, then the fish are cleaned and all entrails removed and then washed thoroughly with running water. After that, the filleted fish is separated, taking only the flesh and the fish flesh is mashed using a blender [6].

To make choux pastry dough, mix high protein wheat flour, margarine and water then cook over medium heat. After the mixture is evenly mixed, let it cool for a while, then mix it with baking powder and eggs into the mixture and finally add the tamban fish that has been pureed earlier. The dough is formed using a Bintang syringe mold and placed in the oven for two ovens. The first baking was carried out for 20 minutes at a temperature of 200 OC aimed at making the eclairs skin and the second baking was carried out for 30 minutes at a temperature of 180 OC aimed at drying the eclairs. The formulation for making choux pastry can be seen in Table 1.

Table 1. Formulation for Making Choux Pastry Tamban Fish (*Sardinella lemuru*).

Material	Treatment (%)
	IK3
Ikan tamban	25
Tepung terigu	20
Telur	25
Margarin	20
Air	9
Baking powder	1
Total	100

2.4 Total Plate Count (TPC)

Determination of total plate number (ALT) based on SNI 2332.3:2015. Weigh the sample as much as 25 grams then put it in a beaker and add 225 ml of distilled water. Take 1 ml of the above suspension using a sterile pipette which is then put into 9 ml physiological solution then homogenize and produce a 10-1 dilution. Then 1 ml of 10-2, 10-3, 10-4 dilutions from each dilution above, taken using a pipette and put 15 ml of PCA into a sterile petri dish, 15 ml of PCA into each petri dish containing the sample solution.

2.5 Organoleptic test (SNI SNI 01-2346-2006)

Hedonic testing is a testing method that uses the five human senses as the main tool for assessing a product. This test is carried out to determine consumer satisfaction. This hedonic test used 80 untrained panelists. The hedonic test assessment includes four parameters, namely color, texture, aroma and taste. This test uses an assessment of the level of liking on a scale of 1 (dislike), 2 (neutral), and 3 (like) [7].

2.6 Peroxide Number Analysis

To determine the degree of damage to fat or oil caused by heating, a peroxide value test can be conducted. A 5-gram sample is weighed into a 250 ml Erlenmeyer flask and mixed with 30 ml of glacial acetic acid solvent and 20 ml of chloroform [8,10-15]. After mixing, 0.5 ml of clear potassium iodate solution is added and the mixture is allowed to stand for 1 minute, shaking occasionally. Then, 15 ml of aquaest is added and the solution is titrated with 0.1 N Na₂S₂O₃ (sodium thiosulfate) until the yellow color disappears. Finally, 0.5 ml of 1% starch

indicator is added and the titration continues until the blue color disappears. The peroxide value is calculated using a specific formula:

$$\text{Bilangan peroksida} = \frac{V_s \times N}{W} \times 100$$

Information:

V_s = Volume of $\text{Na}_2\text{S}_2\text{O}_3$ used for sample titration (mL)

N = Concentration of $\text{Na}_2\text{S}_2\text{O}_3$ (sodium thiosulfate)

W = Sample weight (g)

Peroxide number = (meq O_2 /kg sample)

2.7 Water Content

Water content was analyzed using the gravimetric method. The sample is weighed at 1-3 grams whose dry weight is known. Then the samples were dried in an oven at 105°C for 3 hours. After baking, cool in a desiccator for 15 minutes, then weigh and repeat until it reaches a constant weight. Calculation of water content can be calculated using the formula:

$$\text{Bilangan peroksida} = \frac{(A+B)-C}{(A+B)-A} \times 100$$

Information:

A = Weight of empty container (g)

B = Test portion weight (g)

C = Fixed weight of container + test portion after heating (g)

2.8 Determining the Shelf Life of Tamban Fish Choux Pastry (*Sardinella lemuru*)

To determine the shelf life of tamban fish choux pastry, an accelerated shelf-life test (ASLT) using the Arrhenius model was employed. This method involves subjecting the pastry to elevated temperatures (30°C , 40°C , and 50°C) to accelerate the deterioration process. Second, quality parameter measurements were carried out every 0, 10, 20 and 30 days of storage. The parameters tested on choux pastry products include analysis of peroxide numbers, water content, TPC test, and hedonic tests for color, aroma and texture. Third, determining quality parameters, critical parameters are determined by the criteria for quality changes with the lowest activity energy [9]. Fourth, determining the reaction order is carried out to observe quality parameters, namely color, aroma, texture and water content in choux pastry. Selection of the reaction method is carried out by grouping the average value of the quality parameters during storage. Fifth, by applying a zero-order kinetic equation, the estimated shelf life of the pastry under normal storage conditions was calculated.

$$t = \frac{(A_0 - A_t)}{k}$$

If the reaction rate follows first order then the formula is as follows:

$$t = \frac{(\ln A_0 - \ln A_t)}{k}$$

Information:
t = Shelf life temperature
A0 = Initial quality of the product
At = Final product quality
k = Quality compliance constant

2.8 Data Analysis

This data analysis uses SPSS version 26 and if it shows a real effect, Dunca will test it further and use Microsoft Excel 2010. Data analysis uses a Completely Randomized Design (RAL) with a mathematical model. The formula for a completely randomized design is as follows:

$$K=k_0 e^{-E/RT}$$

Information:
K= degradations rate constant
K₀ = constant
E = activation energy
R= gas constant 1,986 kal/mol

3 Results and Discussion

3.1 Total Plate Count (TPC)

The number of bacterial colonies that can be counted is 25-250 colonies. The number of bacteria that grow serves as an indicator of product suitability.

Based on the results of bacterial calculations using total plate number (ALT) testing, it can be seen that, in choux pastry samples of tamban fish (*Sardinella lemuru*) with storage temperatures of 30°C, 40°C, and 50°C and observations of 0, 10, 20, to 30 days have different numbers of colonies. Test values from days 0 to 30 days produce a number of colonies with an average value of 11,000-29,000 colonies.

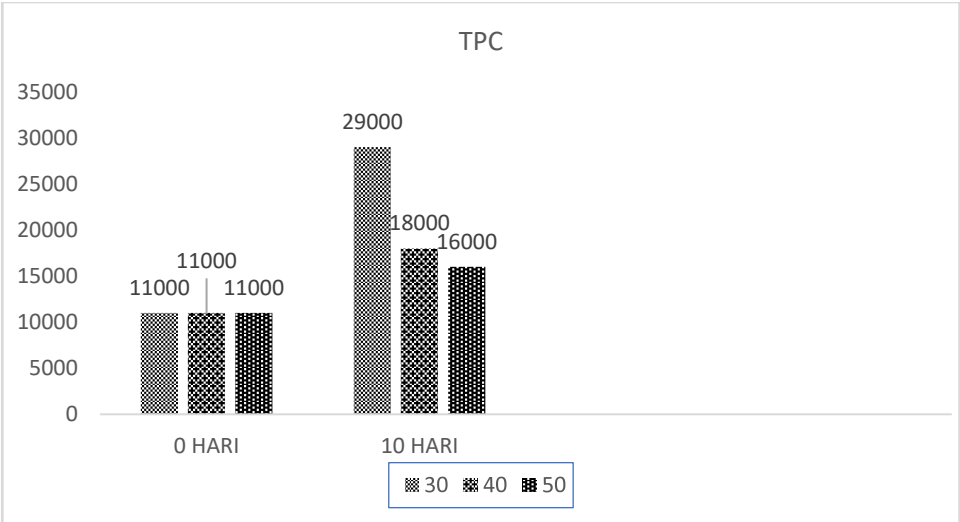


Fig. 1. Total Plate Count of Choux Pastry

3.2 Organoleptic Test

3.2.1. Color

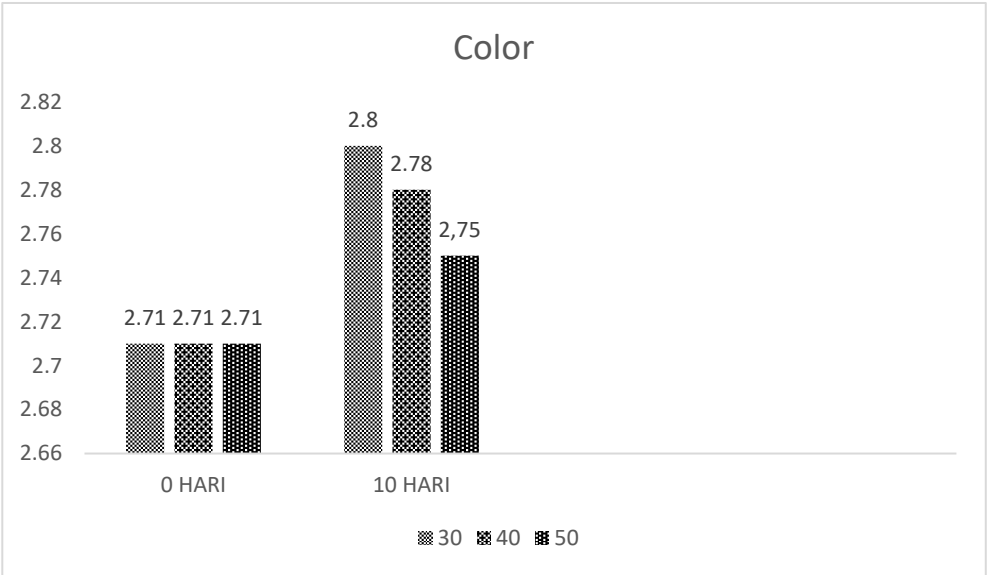


Fig. 2. Color Organoleptic Test Results

Color is one of the important factors seen by consumers when receiving food products. In assessing color using the sense of sight. Products that have attractive colors can increase consumers' desire to try them. Apart from that, a product can also have a good taste and good texture, but if the color is not attractive then the product will not be consumed by consumers. It can be seen in Figure 5 that the color of choux pastry has an average value of 2.21-2.80. The highest value was obtained on day 0 with a value of 2.71. The final color value of tamban fish choux pastry on the 10th day at a storage temperature of 30°C with a value of 2.80, a temperature of 40°C with a value of 2.35, and a temperature of 50°C with a value of 2.21.

3.2.2. Texture

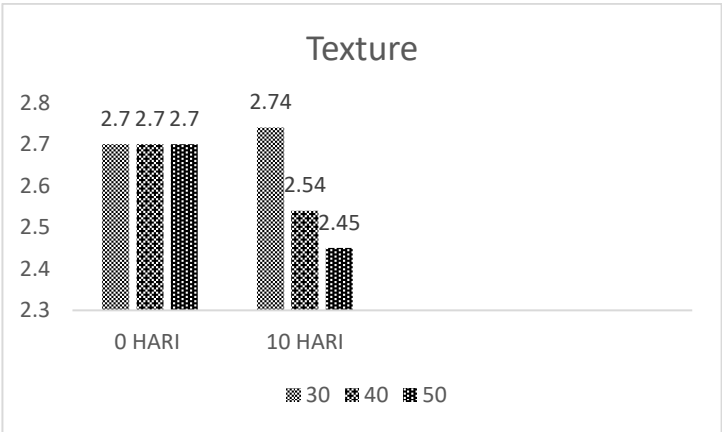


Fig. 3. Texture Organoleptic Test Results

Texture is one of the hedonic parameters which aims to see the shape of the choux pastry produced. This test uses the sense of touch. The crunchy texture will have an influence on the tamban fish choux pastry, the higher the temperature given, the harder the texture will be. It can be seen in the picture that the texture of tamban fish choux pastry has an average value of 2.06-2.70. The highest value was obtained on day 0 with a value of 2.70. The final texture value of tamban fish choux pastry on day 10 at a storage temperature of 30°C was 2.74, 40°C was 2.46, and 50°C was 2.06.

3.2.3. Aroma

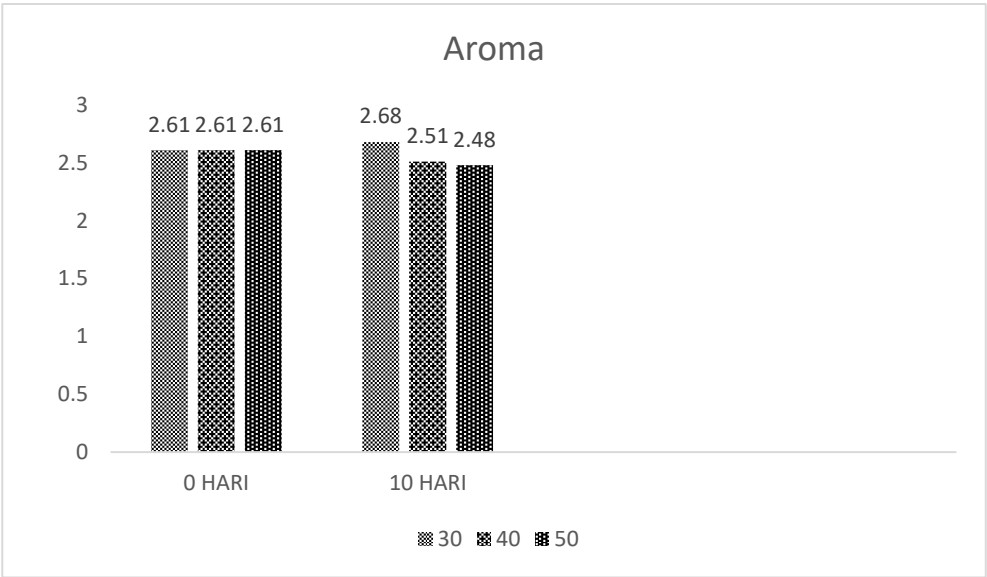


Fig. 4. Aroma Organoleptic Test Results

Scent Aroma is one of the test parameters used to determine the quality of a product being assessed. Aroma assessment is carried out by smelling and providing an aroma assessment based on the panelists level of preference for food products. In the ingredients and components added to the product, the sense of smell can feel the aroma of the product. It can be seen in Figure 4 that the aroma of tamban fish choux pastry has an average value of 1.93-2.68. The highest value was obtained on day 0 with a value of 2.61. The final aroma value of tamban fish choux pastry on day 10 at a storage temperature of 30 °C was 2.68, 40 °C was 2.51, and 50 °C was 2.25.

3.3. Water content

From Figure 5 it can be seen that the water content in tamban fish choux pastry experiences different changes at storage temperature, where from day 0 to day 30 it decreases. The initial value of water content on day 0 was 8.62%. The decrease in water content is caused by evaporation caused by temperature and storage time, thereby speeding up the evaporation process. The higher the storage temperature, the water content will decrease, thereby speeding up the evaporation process on the surface and inside the particles due to the difference in liquid vapor pressure

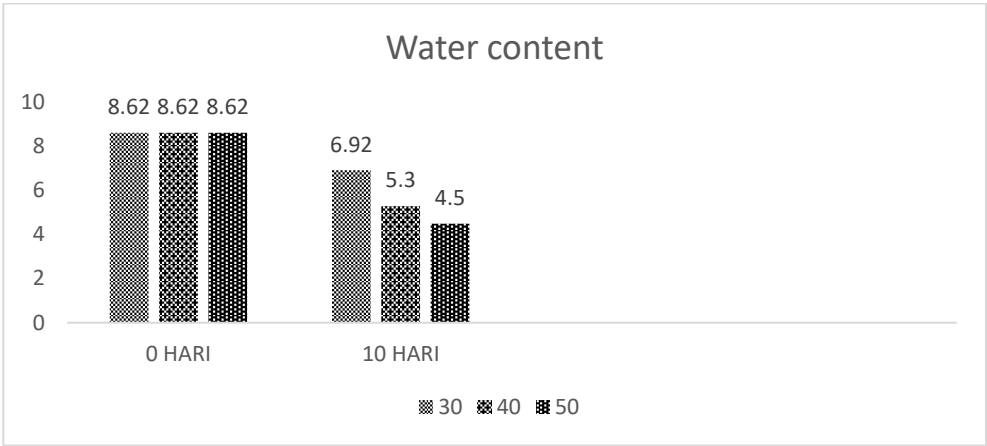


Fig. 5. Water Content Results

3.4. Peroxide Number Analysis

Based on Figure 6, the peroxide value increases every 10 days. The increase in peroxide value occurs due to high storage temperatures and long storage times. The highest value of peroxide value was obtained from a storage temperature of 50°C on day 30 with a value of 1.43 meq/kg and the lowest value was on day 0 with a value of 1.18 meq/kg.

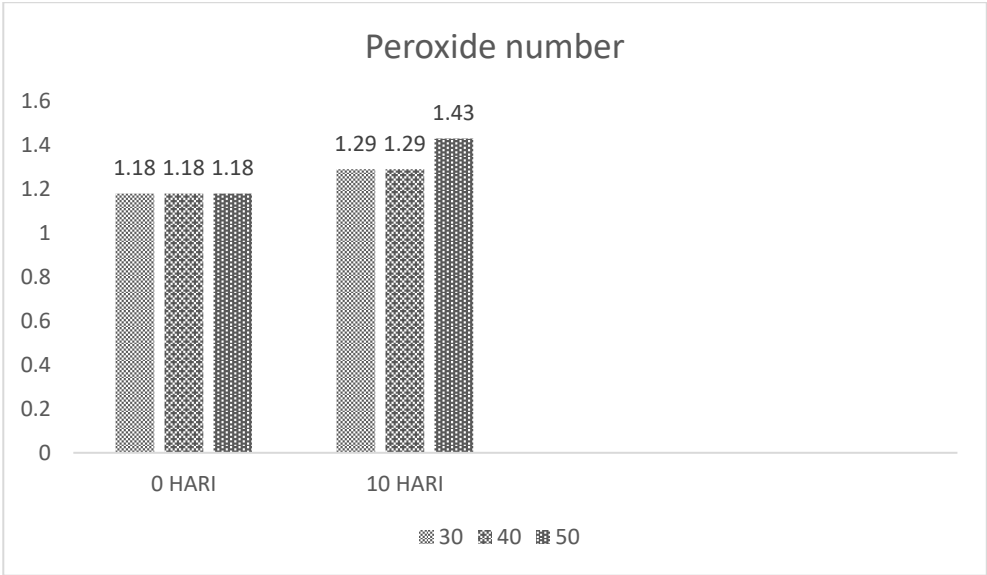


Fig. 6. Peroxide Number Results

4 Conclusion

Based on the TPC results obtained from day 0, the colony count was the same at 11,000. However, on day 10, the colony count decreased at 30°C with 29,000 colonies, 40°C with 18,000 colonies, and finally at 50°C with 16,000 colonies. Organoleptic test, there was a decrease on day 10 from 30°C to 50°C, as well as in the temperature and aroma parameters.

In the peroxide test, there was an increase on day 10 from 30 to 50 degrees Celsius (1.29-1.43).

References

1. N. Agustin, Penentuan umur simpan dengan metode accelerated shelf life testing (ASLT) dan analisis proksimat pada minuman rumput laut (Institut Teknologi Sepuluh November, 2018)
2. N. Fauzia, Kajian umur simpan keju cheddar olahan menggunakan metode accelerated shelf life test (ASLT) model arrhenius (Universitas Pasundan, 2023)
3. W.J. Ilahi, R.M.S. Putri, A. Apriandi, Pengaruh penambahan ikan tamban (*Sardinella lemuru*) terhadap pembuatan choux pastry (Universitas Maritim Raja Ali Haji, 2023)
4. F. Kusnandar, D.R. Adawiyah, M. Fitria, J. Tek dan Indus Pang. **21**(2), 117–122 (2010)
5. K.D. Sari, M. Adriani, A. Rahmadhani, J. Tat Bog. **6**(3), 15–23 (2021),
6. T. Tholhah, K. Purnawan, J. of Tropic. Agrifo. **1**(1), 36–40 (2019)
7. M.P. Wahyuningtyas, Y. Setiati, N. Riska, J. Tek Busan dan Bog. **8**(2), 114–120 (2020)
8. F.T. Short, F. Carruthers, W. Dennisa, M. Waycott, Exp. J. Mar. Biol. Ecol. **350**, 3–20 (2007)
9. I. Nugraha, N. Nurul, Food Res. J. **19**, 13–25 (2022), <https://doi.org/10.1007/food.2022.3456>
10. M. Kawaroe, A.H. Nugraha, J. Fish. Sci. **12**(3), 47–53 (2020)
11. F. Carpenter, H. Niem, J. Mar. Res. **7**(5), 16–27 (2019)
12. R. Suparman, J. Trop. Food Tech. **4**(2), 110–119 (2021)
13. K. Ramadhani, J. Food Safety **9**(1), 30–35 (2022), <https://doi.org/10.1098/food.2022.0987>
14. M. Nugraha, R. Putra, J. Agrifood. **23**(4), 25–32 (2021)
15. F. Susanti, J. Food Processing **15**, 98–103 (2023)