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Quality Control Through the Implementation of HACCP in the Process of Frozen Tuna Loin Processing at PT. Lintas Laut Samudera, Bungus, West Sumatra

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Abstract - In order to meet maximum export needs, PT. Lintas Laut Samudera has implemented the HACCP concept in implementing product quality requirement standards to strengthen its competitive share in export countries. The purpose of this research is to analyse the quality of frozen tuna loin products by conducting organoleptic tests, microbiological tests, and histamine chemistry, then reviewing the application of HACCP in the processing of tuna loin products produced at PT. Lintas Laut Samudera. The research was conducted from April to August 2024 at PT. Lintas Laut Samudera, Bungus, Padang City, using a quantitative descriptive research method. The test results obtained showed that this processing commodity was still within a safe range, and according to the results of the analysis of the application of HACCP in determining critical control points in the processing of fresh tuna at PT. Lintas Laut Samudera, there are 3 CCPs from all stages of the process, namely in receiving raw materials, packaging, and cold storage.

Keywords - Histamine; microbiological; organoleptic; Tuna.

I. INTRODUCTION

Indonesia is an archipelagic country with a manageable sea area of 6.4 million km2. This makes the maritime sector in Indonesia very strategic, and the fisheries sector is one of Indonesia's mainstay sectors in export activities [1]. One of the efforts to increase the main source of capital in development is by managing the potential for Indonesia's marine economic development innovatively and well, so that it can provide maximum good impacts on the country and the people of Indonesia [2].

Research by [3] stated that based on the characteristics of the habitat of fish, West Sumatra has the potential for promising large pelagic fish resources, including tuna, skipjack, mackerel, and mackerel. The high potential for tuna exports provides promising opportunities for Indonesia as a producer in exporting these products, both in terms of demand in the form of whole tuna, loin, steak, centre cube, and canned tuna as well as tuna diversification. As one of the countries that exports tuna in the world, Indonesia experiences obstacles and various cases of rejection[4].

Tuna fish is a commodity that must be managed well in order to survive in the face of competition in the international market, and the wealth of Indonesian waters can be utilised as well as possible to meet both domestic and foreign demand[5].

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Risearch by [6] stated that the lack of provision of safe food products for the community is a global problem that is growing faster over time. The significant risk to the community from diseases due to consuming low-quality and dangerous food products cannot be saved even with the most modern packaging . Implementing a quality assurance and food safety system for products so that the food produced meets the provisions that have been approved in each country is a requirement in the fishery processing industry[7].

PT. Lintas Laut Samudra is a fishery company engaged in the export of processed fish products and preservation, so that product quality assurance is needed. Based on the information obtained, PT. Lintas Laut Samudra has implemented the HACCP concept in the application of product quality requirement standards to strengthen market share in export countries, but the HACCP certificate obtained in the processing of frozen tuna loin is still Grade C. This shows that there are still deviations in the production process, and the implementation of HACCP is not yet appropriate. The purpose of the study was to analyze the quality of frozen tuna loin products by conducting organoleptic tests, microbiological tests, and histamine chemical tests, and then examine the application of HACCP in the processing of tuna loin products produced at PT. Ocean Crossing.

II. RESEARCH METHODOLOGY

The research was conducted from April to August 2024 at PT. Ocean Crossing, Bungus, Padang City. The method used is quantitative-descriptive. In the process of collecting data on the equipment needed, among others, are stationary, GMP, SSOP, and HACCP guidebooks, fresh fish score sheets, hazard analysis sheets, CCP identification sheets, activity forms and fish assessments from the factory, and questionnaires for the implementation of SSOP at PT. Ocean Crossing. The materials needed in the implementation of this study are 3 fresh tuna fish, carbon monoxide gas, ice cubes, and chemicals needed during the total plate number (ALT) test, namely: plate count agar (PCA), Butterfield's fhosphate buffered solution, and product quality testing media, namely PCA. The data obtained is in the form of primary and secondary data, after which data analysis is carried out based on qualitative and quantitative data.

Microbiological testing is carried out in the laboratory by following the standards applicable to PT. Ocean Crossing. The test will be carried out six times, and the test results will be obtained by adding all the colonies on all the calculated dishes divided by the number of dishes in the first and second dilutions multiplied by the first dilution used. Furthermore, the data was processed and presented in the form of a table and the average results of the Total Plate Number (ALT) test. Histamine data was obtained by analyzing samples and conducting tests using a tool, namely StatFax. The sample was put into the well by adding other helpful materials, namely aquadest, conjugate solution, substrate solution, diluent, and red stop solution.

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III. Prepare Your Paper Before Styling

1. Quality Analysis

1.1 Organoleptic Test

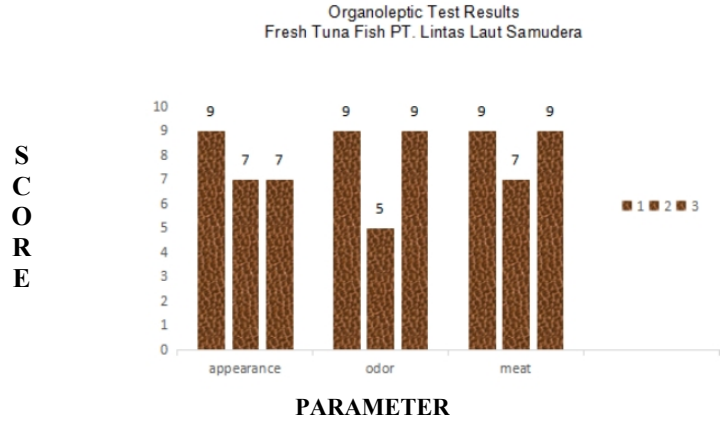

FIGURE 1. Histogram of organoleptic test results of fresh tuna fish.

Organoleptic test on fresh tuna raw materials at PT. Lintas Laut Samudera was conducted by one trained panelist, namely the Quality Control staff, so that organoleptic results were obtained with a histogram in the image above. The test results on the appearance parameters were in the range of 7-9, the odor parameters were in the range of 5-9, the meat parameters were in the range of 7-9.

a. Appearance

The appearance parameter is assessed based on the physical appearance of fresh tuna fish, which is the raw material for processing at PT. Lintas Laut Samudera. The assessment results of three samples obtained the highest score of 9 organoleptically having intact specifications, no defects, red gills, bright, tight skin, intact scales, protruding, and clear eyes. The lowest score obtained was 7 with intact specifications, no defects, red gills, bright, tight skin, damaged scales, and protruding eyes. This is because the raw materials received go through QC supervision and are adjusted to the company's needs and specifications.

Research by [8] stated that the monitoring procedure at the raw material receipt stage is by checking the temperature of the fish and testing the histamine content in each incoming raw material by Quality Control staff and requesting a letter of laboratory analysis results from the supplier explaining that the incoming raw materials are free from pathogenic bacteria and heavy metals.

b. Odour

From the test results on the odour parameter, the highest score was 9 with a very fresh odour specification. Based on this, the raw materials that enter and are processed by the processing unit are still classified as fresh and meet the requirements according to SNI 2346:2011 concerning the requirements for fresh tuna raw materials, namely 7. The lowest score was 5 with a neutral odour specification. This is due to the growth of spoilage microbes and the occurrence of biochemical reactions during the handling and storage process. The smell of fresh fish that characterises the specific smell of fish is caused by mercaptan, methyl mercaptan, and alcohol, while the unpleasant odour that indicates that the fish has started to rot is caused by compounds such as trimethylamine and ammonia. [2].

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c. Meat

The highest score in the organoleptic test of meat parameters is 9 with the specifications of pink rose meat cuts according to the type of very bright, meat muscles are very dense, elastic, fatty, and meat tissue does not break. Meanwhile, the lowest score is 7 with the specifications of red/pink rose meat cuts according to the type of very bright, meat muscles are dense, elastic, not fatty, and meat tissue does not break. This is because the fish is still fresh and gets the right handling so that it can delay the occurrence of rigor mortise in fish meat. Based on these results, fresh tuna raw materials are acceptable and under the quality standards set based on SNI 2346:2011 concerning the requirements for fresh tuna raw materials, namely 7.

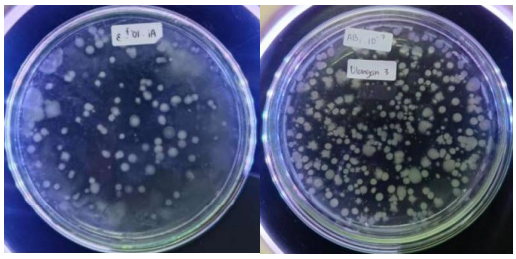
1.2 Microbiological Analysis (ALT)

Based on [9], the principle of ALT is to calculate the growth of mesophilic aerobic bacterial colonies after food samples are planted on appropriate media plates by pouring and then incubated for 24-48 hours at a temperature of 35-37 °C. The total plate count test was carried out on two tuna fish products, namely fresh tuna and frozen tuna. The total plate count test is a method commonly used to calculate the presence of bacteria in the preparations being examined. The total plate count is expressed as the number of bacterial colonies calculated multiplied by the dilution factor [10]. The results of bacterial counts in fresh and frozen tuna can be seen in Table 1.

TABLE 1. ALT test results for fresh and frozen tuna

Sample Type	Sample 1	Sample 2	Sample 3	Average (cfu/ml)
Fresh Tuna Fish	$8,7 \times 10^3$	$6,9 \times 10^3$	$1,1 \times 10^3$	$5,6 \times 10^3$
Frozen Tuna Fish	$16,8 \times 10^3$	$99,7 \times 10^3$	$43,3 \times 10^3$	$102,6 \times 10^3$

In table 1, it can be seen that the number of bacterial colonies in fresh tuna is 5.6 x 103 cfu/ml. While in frozen tuna there is an average number of bacterial colonies of 102.6 x 103 cfu/ml. From both products, it can be seen that the highest average number of bacterial colonies is in frozen tuna products. This happens because there are some bacteria that are still alive even at cold temperatures, and there is no addition of natural antibacterial ingredients that can inhibit or even kill bacteria in tuna[11]. However, there are also several other factors that affect bacterial growth, including product storage period, process preparation, and implementation of sanitation and hygiene that are not in accordance with standards. [4] added that the optimum environment for increasing the number of bacteria can grow optimally due to the long storage time. The image of the tuna fish bacterial colony can be seen in Figure 2.



(a) (b)

Figure 2. Microbiological test results of fresh tuna bacterial colonies (a) and frozen tuna bacterial colonies (b).

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The total plate count in fresh or frozen tuna products is still below the maximum limit of tuna loin quality requirements, which is 5.0 x 10^5 cfu/g. This means that tuna products are still suitable and safe for public consumption (SNI 2729:2021).

1.3 Histamine Level Analysis

TABLE 2. Frozen tuna loin product test results

Sample Code	Test Results (ppm)
A1.0082.K	1,2
A2.0083.K	2,7
A3.0084.K	1,0
Average	1,6

Histamine testing was conducted by the Food and Drug Monitoring Agency (BPOM) in Padang by sending 3 samples of frozen tuna pieces; each sample was given the codes A1, A2, and A3. The test results showed that the histamine content of frozen tuna loin products at PT. Lintas Laut Samudera was obtained at an average of 1.6 ppm, which means it is still included in the safe category for consumption. The maximum histamine content allowed in fish meat is said to be suitable for consumption according to the SNI 7530.1:2009 standard with a histamine level limit of 100 mg/kg.

Tuna is very easy to rot because it is included in the category of high-perishable food [12]. This fish is also a group of scombridae fish that have the ability to produce scombrotoxin compounds. The presence of scombrotoxin compounds in fish that exceed the standard will cause poisoning if consumed by humans.Histamine levels are an indicator of the quality and safety of tuna food products, because high histamine causes poisoning effects in people who consume it. Histamine is the source of scombroid poisoning [13].

2. Analysis of HACCP Implementation in Frozen Tuna Processing at PT. Lintas Laut Samudera.

2.1. Hazard Analysis

Research by [14] stated the results of the hazard analysis found that there are three types of potential hazards that can occur in frozen products, namely biological hazards (the presence of bacteria, mould, yeast, and parasites), chemical hazards (the presence of toxins or contamination with chemicals that are not suitable for consumption), and physical hazards (the presence of pieces of gravel, sand, hair, insects, pieces of metal, damage to the texture of fish meat, and so on). Furthermore, a hazard analysis is carried out to determine significant hazards in the production process, which are analysed based on the risk and severity ranging from very low to high.

2.2. Identify Critical Control Points (CCP)

The frozen tuna loin processing flow at PT. Lintas Laut Samudera can be seen in Figure 3.

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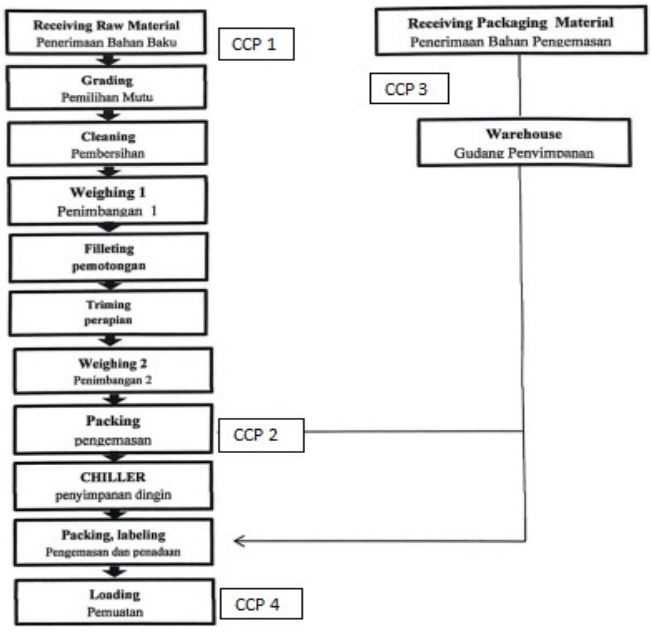

FIGURE 3. Identification of Critical Control Points based on process flow.

Based on the decision tree, it was identified that the critical control points in frozen tuna loin processing at PT. Lintas Laut Samudera are located at several stages of the process. Identification of critical control points can be seen in Table 4.

TABLE 4. Identification of Critical Control Points

Process Step	Signification Hazard	SSOP & GMP Y/N	Q1 Y/N	Q2 Y/N	Q3 Y/N	Q4 Y/N	CCP
Receiving Raw Material	Histamine Mikrobiologi	N	Y	N	Y	N	CCP
Packing	Allergen	N	Y	Y	-	-	CCP
Chiller	Histamine	N	Y	Y	-	-	CCP

a. Receiving Raw Materials

The raw material receiving stage is carried out by QC staff and supervised by the Head of Production. After being received and quality checked, sorting is carried out based on the size and total weight of the fish. Damage during raw material receipt can cause biological, chemical and physical hazards. The real danger that occurs due to chemical damage is the formation of histamine. The formation of histamine is caused by an increase in fish temperature and heavy metal content accumulating in the body of the fish originating from the waters where the fish are caught. Therefore, organoleptic tests and histamine content in the fish are carried out at each raw material receipt stage. Chemical hazards at the raw material receipt stage are included in CCP. According to [15], the formation of histamine is caused by the presence of exogenous decarboxylase enzymes produced by microbes in the fish's body.

b. Packing

Packaging activities are designated as CCP based on company guidelines, and preventive and control measures are needed by examining components in the packaging. Research by [14], stated that at this stage, only process improvements need to be made in the form of how to store packaging materials and adjust them to GMP, as well as adjusting labels to label requirement standards.At the packaging stage, errors that may occur include writing labels and allergens contained in the product, which can cause losses to consumers.

c. Cool Storage

The next critical control point is in cold storage. At this stage, histamine levels can increase due to the influence of poorly controlled temperatures and result in increased histamine levels in frozen tuna loin products. The product is stored in frozen storage at a temperature of ±-25℃. Incoming products are arranged according to type and production date. This frozen storage system uses the FIFO (First In, First Out) system, or is known as the goods that come in first will come out first, so that there are no products that have a shelf life that is too long in cold storage [16].

IV. CONCLUSION

The results of the study show that the fish produced at PT Lintas Laut Samudra meets the quality standards in accordance with the applicable SNI, and this processed commodity is still within a safe range.

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