East Asian Journal of Multidisciplinary Research (EAJMR)
Vol. 3, No. 7 . 2024 : 2611 - 2630

The Implementation Of GMP, SSOP, and HACCP in the Processing of Frozen Yellowfin Tuna (Thunnus Albacares) at UD Damena.

I Made Ryan Prinata[1*], Ni Made Darmadi[2], I Made Kawan[3]
Universitas Warmadewa
Corresponding Author: I Made Ryan Prinata Gusryan40@gmail.com

A R T I C L E I N F O

Keywords: HACCP, Implementation, Handling

Received : 01, May
Revised :12, June
Accepted: 11, July

A B S T R A C T

The purpose of the study was to identify and analyze the implementation of GMP, SSOP, and HACCP. The method used in this research was a descriptive research method, to understand the implementation of GMP, SSOP, HACCP in the handling of frozen yellowfin tuna (Thunnus albacares) at UD Damena. Data collection techniques used in the research were observation, interviews, participation, and documentation. Based on the research results, it was found that UD Damena had met the basic requirements in the form of GMP and SSOP in accordance with Minister of Marine Affairs and Fisheries Regulation Number 17 of 2019. UD Damena also implemented the five steps and seven principles of HACCP well in accordance with SNI 01-4852-1998 as a form of consumer protection in consuming fishery products, so that export activities ran effectively and efficiently without any cases of product rejection in the destination countries. The implementation of GMP and SSOP systems at UD Damena had been carried out well and optimally. The implementation of HACCP in UD Damena had been applied well, by coordinating with the HACCP team.

INTRODUCTION

Indonesian marine waters had a coastline length of up to 95,181 km2, with an area of waters totaling 5.8 million km2 consisting of territorial seas covering 0.3 million km2, island waters covering 2.8 million km2, and an Exclusive Economic Zone (EEZ) covering 2.7 million km2. Indonesia had abundant marine resources, making it one of the world's largest fish producers given its expansive market. Tuna was one of Indonesia's main potential marine fish. Tuna lived in deep seas, especially in Indonesia's vast waters, such as the Makassar Sea, Banda Sea, Maluku Sea, Sulawesi Sea, Arafura Sea, and Papua Sea (Yuniar, 2019). The type of tuna frequently found in Indonesian waters was yellowfin tuna (Thunnus albacares). One of the main characteristics of yellowfin tuna was the yellow line along both sides of the fish, which would become apparent when exposed to light. Yellowfin tuna (Thunnus albacares) was one of the economically important fish for consumption. Tuna could be processed into products such as tuna loin, steak, and tuna saku. Its high protein content and delicious taste made tuna highly sought after by the public. Fish contained essential amino acids such as lysine, tryptophan, and methionine. Therefore, to maintain the freshness of fish, proper post-harvest fish handling was necessary. One of the approaches used to ensure food safety and product quality in the fish processing industry was the implementation of Good Manufacturing Practices (GMP), Sanitation Standard Operating Procedures (SSOP), and Hazard Analysis and Critical Control Point (HACCP).

THEORITICAL REVIEW

The approach used to ensure food safety and product quality in the fish processing industry is to implement Good Manufacturing Practices (GMP), Sanitation Standard Operating Procedures (SSOP), and Hazard Analysis and Critical Control Point (HACCP) (Abdulah and Tangke, 2020). Regulation Number 17 of 2019 and implementing the five steps and seven principles of HACCP in accordance with SNI 01-4852-1998. Implementation of the scope of GMP includes selection of raw materials, handling and processing, handling and use of additional materials, auxiliary materials and chemicals, packaging and storage. Implementation of the scope of SSOP includes water and ice safety, clean conditions of facilities/infrastructure in direct contact with products, prevention of cross-contamination, maintenance of sanitation/handwashing/toilet facilities, protection from contaminants, labelling, storage and use of hazardous chemicals, health control employees and controlling nuisance animals (Guntur et al., 2020). Implementation of the five steps of HACCP is a form of consumer protection in the consumption of fishery products through food safety quality control throughout the production process so that export activities run effectively and efficiently without any cases of product rejection.

Vol. 3, No. 7, 2024 : 2611 - 2630

METHODOLOGY

The Time and Location Of The Research

This research was conducted from November 28, 2023, to January 15, 2024, at UD. Damena, located at Jalan By Pass Ngurah Rai Gg. Mina Utama Jl. Pesanggaran No.8, Sesetan, South Denpasar, Denpasar City, Bali 80222.

Research Tools and Materials

Table 1. Research Tools

No	Tools	Function
1	Camera	To document activities and record data in the form of images
2	Pen and paper	To record data in the field
3	Personal Protective Equipment	As a tool to ptotect oneself while in the production room, to keep the room clean
4	Thermometer	As a tool to measure the temperature of meat
5	Checker	As a tool to measure the quality of tuna fish meat

Table 2. Research Materials

No	Materials	Function
1	Tuna fish	As the raw material being observed
2	Water and ice	As an auxiliary material for the product being observed
3	Styrofoam box	As a packaging material for the observed product
4	Product label	As a source of information on the product being observed
5	Facilities and infrastucture UPI	As a supporting factor in the implementation of the production of the observed product

Data types and Source

Methods of collecting information data were obtained through:

1. Observation: The observation technique involved collecting data by observing and systematically recording. The observation activities conducted involved collecting data related to the Implementation of GMP, SSOP, HACCP, in the process of freezing yellowfin tuna (Thunnus albacares) by following each production process.

2. Interview: The interview technique was the process of obtaining information or goals through face-to-face question-and-answer sessions. Interviews were conducted by asking questions directly to employees and company staff.
3. Participation: Active participation technique involved observation where observations were actively involved in the activities being carried out or observed. Active participation in the freezing process of yellowfin tuna (Thunnus albacares) in loin form included activities such as raw material acceptance, weighing, washing, sorting, cutting, wrapping, leveling, freezing, packaging, storage, and distribution.
4. Documentation: The documentation technique was a method used to trace historical data. The document review used as a tool to assist the writer in collecting data or information involved reading the intended documents, such as personal documents, official documents, references, photos, letters, announcements, and written statements of specific policies. Documentation was used to complement interview and observation data. The results of document review were expected to provide an overview of how far a condition or fact in the company met the existing criteria.

Research Procedure:

1. Research Preparation: Research preparation began by preparing a clear and formal request letter to request permission to conduct research at the relevant institution and location. Materials and tools used included paper, pen, sample request letters, research proposals, reference letters, and clear contact information. Next, an introduction to UD. Damena was made to gain direct insight into the company's operations and business practices. Preparation for this visit involved preparing agreements or letters of agreement in advance, as well as preparing written materials such as lists of questions to be asked to UD. Damena, notes, and other documentation tools.
2. Research Implementation: The research implementation included several important stages in the tuna processing industry, ranging from raw material acceptance to the final packing and distribution stage, supplemented by interviews as additional information. The process began with raw material acceptance and went through processing stages involving various tools such as stainless steel knives, CO machines, and vacuum machines. During the production process, the implementation of Good Manufacturing Practices (GMP), Sanitation Standard Operating Procedures (SSOP), and Hazard Analysis and Critical Control Points (HACCP) was identified to ensure product quality and safety. Deviation identification was also done using tools such as checklists or assessment forms. In the distribution stage, evaluation was conducted on the distributed products using tools such as direct observation and sales data analysis to identify potential product rejection cases. By combining analysis methods and using appropriate tools, a comprehensive

understanding of the tuna production process and evaluation of the quality of the products produced could be obtained.

Data Analysis:

1. Editing: Editing involved checking or correcting collected data because the incoming data or collected data might be illogical and doubtful. The processed data results were presented in the form of sentences, numbers, percentages, tables, and graphs to facilitate explanation.
2. Tabulation: Tabulation involved presenting data in tabular form that had been coded according to the required analysis. Data that had been collected and was still in raw form needed further processing in the form of scientific writing and processed using Microsoft Excel, presented in the form of tables and graphs.

RESULTS AND DISCUSSION

Implementation of GMP and SSOP in the Processing of Frozen Yellowfin Tuna (Thunnus albacares)

The processing of yellowfin tuna (Thunnus albacares) at UD. Damena employs freezing methods for preservation. The purpose of freezing is one preservation method with low temperatures aimed at inhibiting or halting the activities of substances and microorganisms that can cause deterioration (Quality degradation) and damage, encompassing stages such as raw material acceptance, temporary storage, weighing I, washing, cleaning, loin formation, trimming, and skinning, arrangement in PE vacuum, weighing II, CO gas filling, chilling, CO gas disposal, final trimming, filling into vacuum plastic, vacuum process, weighing III, vacuum sealing, freezing in ABF, weighing IV, packaging and labeling, storage in cold storage, and stuffing. The processing flow of tuna at UD. Damena aligns with the processing flow outlined in SNI 01-4104.2-2006 for frozen tuna loin. Below is the processing flow of yellowfin tuna (Thunnus albacares).

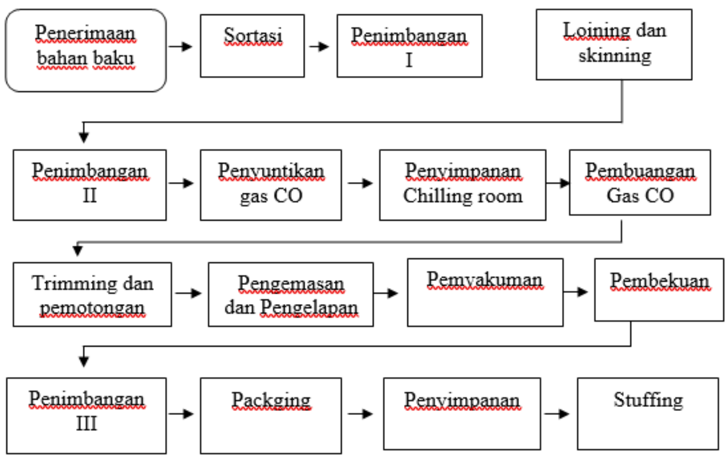

Figure 1. Process Flow Diagram

Good Manufacturing Practices (GMP)

The production methods applied at UD. Damena were carried out properly and in accordance with Industrial Regulation number 75/M – IND/ PER/7/2010, implemented from the raw material acceptance process to the distribution process. This is consistent with the statement by Antriandarti et al. (2023), where GMP implementation is an initial requirement seen from three aspects: building conditions, facilities, and environment.

Raw Material Selection

Fish raw materials are generally received by the company at the receiving section either frozen or fresh. The raw materials of yellowfin tuna (Thunnus albacares) come from the Indian Ocean and the Banda Sea. The raw materials are received in fresh whole condition, transported by box trucks, and accompanied by bulk ice to maintain the fish temperature at 0 - 4°C. During the acceptance of tuna raw materials at UD. Damena, the QC team oversees the physical quality, organoleptic properties, and cleanliness of the received raw materials. UD. Damena utilizes tools such as a thermometer to check the temperature of raw materials and a checker to assess the quality of tuna meat, ensuring that the acceptance of raw materials complies with the SNI 01-2712-1992 as described above. Bulk raw materials are usually stored in the chilling room and temporary storage while awaiting further processing.

Fish Handling and Processing

Fish handling at UD. Damena considers a combination of temperature, precision, sanitation, and process speed to meet product specifications according to the required standards. According to Sumartini et al. (2020), the tuna cutting process begins with head removal and skin scraping, followed by cutting into four pieces using a knife to obtain skinless meat. The crucial aspects of handling and processing are building and facilities to produce high-quality products (Antriandarti et al., 2023). These buildings and facilities are as follows:

Processing Unit Location

UD. Damena has a good location aspect, with the factory located far from residential areas and accessible via paved roads, thus free from pollution and contamination. Additionally, the factory location is not in a flood-prone area. The design, construction, and layout are in line with the process flow, with the initial operation close to receiving and the final operation close to shipping. This is in accordance with SNI- 75/M-IND/PER/7/2010, where the existing building location is free from floodwater, free from garbage pollution, not densely populated, with dust-free roads, and open factory spaces not used in the production process.

Entrance Door

The entrance door to the processing area is made of glass, which is fine material, waterproof, easily cleaned with an outward-opening design, can be closed properly, and always kept closed. The entrance to the processing area is equipped with a foot wash basin equipped with disinfection (200 ppm chlorine), plastic curtains to prevent dust and air from entering, and insect killers as insect repellents. The entrance for raw materials and finished products is separated to prevent cross-contamination between raw materials and finished products.

Floor

The floor in the processing area uses ceramic material with smooth characteristics, crack-free, easy to clean and disinfect, waterproof, salt-resistant, acid-resistant, alkali-resistant, and resistant to other chemicals, as well as not easily breakable. The floor construction has sufficient slope and is designed to facilitate water drainage, preventing water pooling. Sanitation and disinfection activities on the floor in the processing area use 100 ppm chlorine to prevent contamination.

Walls

The wall surfaces of the processing area have sturdy construction, bright white color, and coated with waterproof paint, making them waterproof, resistant to peeling, smooth, even, crack-free, without crevices, mold-free, and easy to clean and disinfect. The junctions between walls and floors are designed not to form dead angles, making them easy to clean.

Roof/Ceiling

The roof/ceiling of UD. Damena's processing area is designed to prevent dirt accumulation and fungal growth, with a smooth surface that is easy to clean. The roof/ceiling is clean, leak-free, crack-free, and gap-free. The roof/ceiling has a height of 4 meters measured from the processing area floor.

Lighting

The lighting available at UD. Damena is sanitary and adequate in all processing areas. The lighting used is bright white neon lights equipped with guards to prevent product contamination in case of broken lights.

Drainage Channels

The drainage channels available at UD. Damena have a depth of ± 30cm with adequate conditions to channel liquid waste to the wastewater treatment plant (WWTP). The drainage channels are equipped with covers to prevent pests from entering the processing area. Solid waste handling in the processing area includes providing covered trash bins with a step system lined with polybags, and during each production process, waste is directly disposed of into large trash bins and then handed over to third parties.

Wastewater Treatment Plant (WWTP)

The WWTP facility owned by UD. Damena is very adequate and can prevent environmental pollution. The available WWTP uses a septic tank principle. When the WWTP is full, it will be pumped out by third parties. The condition of the WWTP is checked every six months.

Handling and Addition of Additives, Aids, and Chemicals

The chemicals used during the handling and/or processing of yellowfin tuna (Thunnus albacares) include 70% alcohol, chlorine, liquid soap, and carbon monoxide (CO) gas. Injecting CO gas during tuna meat handling is an important step to extend shelf life and maintain product quality. According to Perdana et al. (2019), the purpose of CO gas injection is to create an anaerobic environment so that aerobic bacteria cannot grow. The loin temperature is always monitored to be <3.3°C to prevent anaerobic bacteria growth within 7 days. Meanwhile, the aids used during handling and/or processing of yellowfin tuna (Thunnus albacares) are water and ice tested in external laboratories once a year.

Packaging

Tuna loin products are packaged using polyethylene (PE) plastic because it can reduce moisture content, maintain protein content, lower pH value, suppress total bacterial colonies, and reduce cooking loss percentage (Mulyawan et al., 2019). After packaging, the products undergo vacuuming to eliminate air inside the packaging before sealing or pressing. The next process involves freezing the products and then packing them in boxes during the packing process. According to Siahaan et al. (2022), final packaging is done using master cartons. The final packaging involves placing loins that have been packaged using plastic into cartons according to the order quantity from buyers. The outside of the carton is labeled with product type, date, and weight.

Storage

Packed loins are then stored in cold storage before shipment. The usual temperature used in the cold storage room is around -18°C to -25°C, which can maintain the fish temperature at a minimum of -18°C. The ambient temperature should be maintained at a low temperature, ideally reaching 0°C, to preserve the freshness and quality of the products before shipment. Raw material storage is not combined with finished product storage to prevent contamination, and materials used for products are not stored together with materials not intended for products (Salsabila, 2019). Storage is done according to the First In First Out (FIFO) principle, where the first product stored is the first product to be taken out, to regulate the storage cycle. Storage is also equipped with documentation related to product type, production code, supplier, and storage date to facilitate traceability systems.

Implementation of Sanitation Standard Operating Procedures (SSOP)

The Directorate General of Fisheries (2000) states that Sanitation Standard Operating Procedures (SSOP) are one of the eligibility requirements intended to supervise environmental conditions to prevent contamination of the produced products. The environment refers to the room, equipment, workers, water, and so on.

Ice and Water Safety

The ice and water used at UD. Damena are good and meet standards. The water source comes from the local water company (PDAM) with characteristics of being colorless (clear, tasteless). Besides PDAM water, UD. Damena also uses other water sources such as drilled wells. PDAM water is only used for processing, and drilled well water is used for factory facilities such as toilets. Based on the checklist, there are no deviations in water safety at UD. Damena. The water pipe installation used for processing is not easily corroded, and water is used in all processes. Water safety at UD. Damena complies with SNI 01-3553-2006 for drinking water quality requirements, which should be odorless. Ice is obtained from registered suppliers and complies with SNI 01-3553-2006 standards, where ice testing is conducted following the water standard, ensuring no bacterial contamination and meeting the microbiological quality standard of 0 microbiological colonies.

Table 3. One Year Water And Ice Test Results From UD. Damena Bali

Sample Type	Test Field	Test Parameters	Quality Standart	Test Results
Water	Mikrobiologi	E-Coli	0 koloni/100ml	0
		Enterococcus faecalais	0 koloni/100ml	0
		Total plate count	0 koloni/100ml	0
		Coliform	0 koloni/100ml	0
	Kimia	Timbal (Pb)	-	0.0002
		Kadmium (Cd)	-	0.0001
		Merkuri (Hg)	-	0.0002
		Arsen (As)	-	0.0002
		Timah (Sn)	-	0.1002
Ice	Mikrbiologi	E-Coli	0 koloni/100ml	0
		Enterococcus faecalais	0 koloni/100ml	0
		Coliform	0 koloni/100ml	0

Based on table 3, it was explained that water was tested for microbiological and chemical parameters. However, only microbiological testing was conducted for ice. The microbiological testing results for E-coli, Esterococcus faecalais, Total plate count, and coliform indicated that each parameter met the applicable quality standard, which was 0. Similarly, microbiological testing for ice was conducted for E-coli, Esterococcus faecalais, and coliform, and the table showed that each parameter also met the applicable quality standard.

Condition of Surfaces in Direct Contact with Products

The condition and cleanliness of surfaces in direct contact with fish at UD. Damena were well maintained. Tables were cleaned before and after use, ensuring no cross-contamination between products. The surfaces of vacuum machines were regularly cleaned with 70% alcohol solution and dried with foam. The surfaces in contact with fine raw materials were smooth, non-perforated, non-peeling, and rust-free. This was in accordance with SNI-75/M-IND/PER/7/2010, which mandates cleaning with alcohol before and after use, and prompt replacement of corroded or rusty equipment. Equipment washing used 100 ppm chlorine, while product washing used 5 ppm chlorine. All equipment underwent regular checks and replacement when necessary.

Cross-Contamination Prevention

UD. Damena met the requirements for cross-contamination prevention, with employees maintaining personal hygiene, using appropriate protective gear, and separating raw material reception, handling, and product processing areas. Processed products were stored separately and clearly labeled. Workers handling tuna fillets were healthy, with no open wounds or skin diseases, wearing clean clothes, washing hands before and after processing, and avoiding unhygienic practices.

Handwashing and Toilet Facilities

Handwashing facilities at UD. Damena were good, using liquid soap containing antibacterial agents. The company did not use solid soap to avoid contamination, and there were no hand drying towels/tissues in the toilet or handwashing area. UD. Damena had written procedures for handwashing. Toilet facilities were separate from production areas, with an adequate number of toilets for the number of employees according to standards.

Protection of Food from Contamination

The production area was easily cleaned and disinfected, free from dust/soil, and free from non-food items with potential for adulteration. Food and sanitation materials were stored separately, and waste bins were kept clear and close to production areas.

Storage Labeling Requirements

UD. Damena's labeling complied with SNI 01-2696.3-2006, including product type, complete processing unit name and address, production date, expiration date, product name, and net weight. Tuna loin products were temporarily stored in chilling boxes at 0°C, while tuna products were stored in cold storage at -17° to -19°C. Products in cold storage were placed in labeled baskets with bottoms and labeled. Toxic substances were labeled with clear usage instructions and met applicable quality standards.

Employee Health Monitoring

Employees at UD. Damena understood the importance of hygiene, and those with external wounds were advised to cover them with bandages to prevent contamination. Sick employees with contagious illnesses were given leave until they recovered, in accordance with SNI-75/M-IND/PER/7/2010, which prohibits employees at risk of contaminating products from participating in production processes.

Pest Control

Pest control at UD. Damena was effective, with no pests entering the production area. Pest killers were used in raw material reception areas and filleting production areas, in line with SNI-75/M-IND/PER/7/2010 requirements for pest control to prevent pests from entering production areas and contaminating products.

Implementation of Hazard Analysis Critical Control Point (HACCP) in the Processing of Frozen Yellowfin Tuna (Thunnus albacares) Fins at UD. Damena

In the HACCP concept, there are 12 implementation steps, including 5 initial planning stages consisting of forming an HACCP team, product description, identification of product users, flowchart development, flowchart verification in the field, and 7 HACCP principles consisting of hazard analysis, identification of critical control points (CCPs), determination of critical limits, establishment of monitoring procedures, determination of corrective actions, establishment of verification procedures, and recording and documentation. The implementation of HACCP in the processing of frozen yellowfin tuna (Thunnus albacares) at UD. Damena included forming an HACCP team to plan and create an HACCP manual, ensuring proper implementation resulting in safe products for consumption. The HACCP team at UD. Damena included various personnel from different fields and experiences, with the team leader chosen based on experience and educational background. The main task of the HACCP team at UD. Damena was to define and document food safety policies. The structure of the HACCP team at UD. Damena is attached in table 4.

Table 4. UD Damena HACCP Team

No	Name	Position	Competence	Duties and Responsibilities
1	I Kadek Yuliastawa	Plant Manager (HACCP Team Leader)	A Management graduate, certified in HACCP, and with experience in the fisheries industry.	1. Responsible for company organization and policies. 2. Responsible for coordinating company management. 3. Reviewing the HACCP plan with all HACCP team members.
2	Amira Rofiatin	Quality Control 1 (Member)	A graduate in D3 Fisheries Product Processing Engineering, certified in HACCP, and also	1. Responsible for what has been produced and providing effective controls to measure or ensure the quality of the products. 2. Reviewing or examining

			certified in SPI (Seafood Processing Industry).	records and documents from QC regarding the production process.
3	Nova Yantisari N	Quality Control 2 (Member)	A graduate in Fisheries (S1), certified in HACCP and SPI (Seafood Processing Industry), with experience working in the fisheries industry.	1. Responsible for controlling the production process of frozen products.
4	Kadek Dita Darmiasih	Quality Control 3 (Member)	A graduate in Marine Product Processing (D3), certified in HACCP and SPI (Seafood Processing Industry).	1. Responsible for controlling the production process of fresh products.
5	Gede Arya	Supervisor (Member)	Having 16 years of experience in the fisheries industry, attended HACCP and GMP training.	1. Responsible for monitoring the performance of employees in the processing area.
6	Nyoman Karniti	Staff Sanitation (Member)	A high school graduate with experience in the fisheries industry, attended HACCP and GMP training.	1. Responsible for maintaining cleanliness in the processing area. 2. Responsible for ensuring cleanliness of the equipment used in the production process.
7	Suharyadi	Teknisi	A high school graduate in Mechanical	1. Responsible for the machines and maintenance of facilities used in the

Vol. 3, No. 7, 2024 : 2611 - 2630

		(Member)	Engineering, with 10 years of experience in the fisheries industry and HACCP training.	production process as well as within the company. 2. Responsible for ensuring the availability of machinery, equipment, electricity, and water for the smooth production process.
8	Pandu Widarto	Warehouse (Member)	Experienced in the fisheries industry for 5 years, with HACCP and GMP training.	1. Responsible for the storage of items needed in the production process. 2. Checking the quality and condition of items received from suppliers. 3. Recording the inflow and outflow of items in the warehouse.

Product Description

The next step in implementing HACCP is product description. At UD. Damena, the purpose of creating a product description is to fully understand a product produced and the raw materials used. According to Pratidina et al. (2019), a product description contains comprehensive explanations of various products that must be made, including information about composition, storage conditions, shelf life, and distribution methods. The product description for frozen tuna is attached in the table 5 below.

Table 5. Product Description

No	Specification	Explanation
1	Product Name	Frozen Tuna Loin
2	Species Name	Tuna Fish (*Thunnus albacares*)
3	Origin of Raw Materials	The capture areas in the Indian Ocean (WPP573) and the Banda Sea (WPP 714) utilize longline fishing gear.
4	How Raw Materials Are Received	The raw materials are received in fresh intact condition, transported by refrigerated trucks, and ice packs are used to maintain the temperature of the fish at 0-4°C.
5	The Final Product	Frozen Tuna Loin
6	Additive	Gas CO (Clear Smoke)

7	Process Stage	Raw material reception, Sorting, Weighing 1, Loinning and Skinning, Weighing 2, CO gas injection, Chilling room storage, CO gas disposal, Trimming and cutting, Pressing and draining, Vacuum, Freezing, Weighing 3, Packing, Cold Storage storage, Stuffing.
8	Packaging	Plastic and master carton
9	Storage Condition	Freze
10	Shelf life	For 12 months, the temperature should be maintained at 20°C (±20°C) or lower.
11	Labeling	Product name/species, net weight, destination country, production date, storage temperature, expiration date, lot code, product type, net weight.
12	Distribution Method	Using Container Refrigration
13	Intended Use	All groups except for toddlers, pregnant women, and those allergic to tuna meat.
14	Distribution Goal	USA and Australia
15	Customer Purpose	Distributor

Identification of Product Users

The identification of product users aims to clarify how the product is used and for whom it is intended, thus requiring identification of its consumer segments (Hermansyah et al., 2013). Additionally, the identification of product users also includes information on how the product is served. The identification of product users is attached in table 6 below.

Table 6. Identification Of Product Use

No	Specification	Explanation
1	Product Name	Frozen Tuna Loin Skin Off
2	Self life	1 Year
3	Storage	Stored at a temperature of 20°C (±20°C) or lower.
4	Usage Instructions	Cook thoroughly before consumption.

5	Customer	USA, Australia
6	Target Customers	General public, except for toddlers, pregnant women, elderly individuals, and allergy sufferers.

Flowchart Development

A flowchart illustrates the entire sequence of process steps that occur from the receipt of raw materials to the distribution of the final product. According to Pudjirahaju (2018), the process flow should explain the raw materials, processing and packaging stages, and include the necessary data for hazard analysis, including information on possible contamination. This is in line with SNI 01-4852-1998, where the flowchart must include all process stages in production operations. The flowchart must be clear, accurate, and detailed to provide the basis for identifying potential hazards.

Flowchart Verification

Verification is a process of direct checking according to references or guidelines with the process conducted in the field. According to Perdana (2018), to ensure that the process flowchart is more complete and corresponds to the implementation in the field, the HACCP team must review its operations to test and demonstrate the accuracy and completeness of the process flowchart. After the preparation of the Frozen Tuna Loin process flowchart, the HACCP team will verify the prepared flowchart. Verification is conducted to recheck the flow of production processes while production activities are ongoing in the production area.

Hazard Analysis

Hazard is a biological, chemical, or physical factor that is likely to cause foodborne illness or injury in the absence of control (Utari, 2016). To minimize hazards, hazard analysis is required. Hazard identification is essential at each process stage. The HACCP team conducts hazard analysis by identifying every production process flow and searching for and tracing the causes of hazards and all potentialities that could result in hazards. According to Munarso and Miskiyah (2014), the potential hazard level is distinguished based on its origin, either from equipment or from raw materials or foodstuffs. Based on the HACCP manual in the frozen tuna loin production process at UD. Damena, hazards identified as significant hazards occur during the raw material reception, metal detection, and labeling stages. To determine significant hazards, the hazard analysis values are calculated in the hazard analysis table, where the value of L (Low) = 10, M (Medium) = 100, and H (High) = 1000. If the hazard analysis result shows that the risk is L and the severity is M, then the value L (10) x M (100) = 1000. If the calculated result does not exceed the value of one thousand, then the hazard can be considered insignificant. A hazard is considered significant if the risk and severity exceed a value of 1000. The hazards arising at each stage can be seen in the appendix. The following table shows several stages with significant hazards.

Table 7. Significant Danger

No	Process	Potential Danger	Reason
1	The acceptance of raw materials	Biologically: Growth of Coliform bacteria, E. coli, Salmonella, Vibrio Cholera, Parahaemolyticus bacteria. Chemically: Histamine, heavy metal contamination.	Contamination of capture areas and temperature increases. Handling on board the ship.
2	*Metal detecting*	Physique: Metal Fragment	Metal fragments.
3	Packing and Labeling	Physique: Labeling error (cause of allergy)	Human error

Determination of Critical Control Points (CCP)

Determination of Critical Control Points (CCP) is the next step after hazard analysis. This step aims to identify hazards categorized as significant hazards and determine whether they can be considered as CCPs. Identifying critical control points (CCPs) in the process flow is done to facilitate control of critical points against identified hazards. At UD. Damena, the determination of CCPs is done using a decision tree diagram. Based on the decision tree diagram at UD. Damena, in determining CCPs, there are three critical control points considered as CCPs in the frozen tuna loin handling process flow, namely at the raw material reception stage, metal detection, and labeling. The identified critical control points are then controlled by determining systematic and comprehensive monitoring or surveillance actions at each CCP.

Determination of Critical Limits

After all CCPs and related control parameters for each CCP have been indicated, the HACCP team proceeds to determine critical limits for each CCP. Critical limits are tolerance limits acceptable to secure hazards, allowing control points to precisely and effectively manage health hazards. These established critical limits must not be violated or exceeded because exceeding a critical limit can lead to the loss of control over critical control points, potentially endangering consumer health. According to Dewanti and Hariyadi (2010), critical limits separate safe from unsafe conditions. In determining critical limits, the HACCP team at UD. Damena establishes the following:

Raw Material Reception

From the CCP determination conducted, there is a CCP at the raw material reception stage, namely the hazard of histamine increase. The critical limit for histamine at the raw material reception CCP is set at 50 ppm. UD. Damena establishes this histamine standard to ensure food safety, which aligns with SNI 4110:2014 stating that the maximum histamine level in tuna products should not exceed 100 ppm. Setting the histamine standard at 50 ppm is a proactive measure by the company to maximize food safety.

Metal Detection

At the metal fragment checking stage in products, metal fragments can pose a potential hazard if there are errors in the machinery. Monitoring is conducted on the sensitivity of the metal detector machine, with adjustments made to the machine if discrepancies are found, and calibration performed with test pieces with standard ferrous: 1.5 mm, SS: 3.0 mm, and aluminum: 2.0 mm. Metal fragment inspection is performed using a metal detector machine, and machine condition checks are done by QC. Product condition checks on the machine are continuous, with machine condition checks conducted every hour using test pieces on the metal detector machine.

Packing and Labeling

In the packing and labeling stage, labeling errors can pose potential hazards to consumers. Supervision and label checks during packaging are monitoring procedures to prevent labeling errors. The monitoring action at this stage involves QC visually checking the labels on final product packaging and rechecking the labels on the final product to ensure that frozen tuna labels contain frozen tuna products. The label must state that the product can be consumed by everyone except infants, pregnant women, and individuals allergic to tuna meat to ensure consumer safety.

Monitoring Procedure

After the third HACCP principle with the determination of critical limits for all CCPs, the HACCP team must establish monitoring requirements for each CCP. Thus, a monitoring procedure is developed for these processes to be controlled and not exceed the established critical limits. The monitoring procedure includes several pieces of information related to the 4W+1H questions. Monitoring activities encompass:

Histamine Monitoring

Monitoring at the raw material reception stage involves histamine hazard monitoring. The procedure involves histamine testing in the laboratory, conducted by laboratory analysts, ensuring the histamine content in samples does not exceed the permissible level of 50 ppm set by UD. Damena.

Histamine Increase

Monitoring of histamine increase at the raw material reception stage involves checking the temperature of received fish. QC checks the temperature of fish from the supplier to ensure it does not exceed -40°C, as higher temperatures can trigger histamine level increases. Temperature checks are performed using calibrated thermometers to ensure accurate results. Temperature checks and organoleptic tests are conducted on received raw materials to determine the fish grade.

Metal Detector

Monitoring at the metal fragment checking stage involves checking the sensitivity of the metal detector machine. Any discrepancies found are rectified, and the machine is calibrated using test pieces with standard sizes. Metal fragment inspection involves using a metal detector machine, and machine condition checks are performed every hour using test pieces.

Packing and Labeling

Monitoring at the packing and labeling stage involves label supervision to prevent labeling errors. QC visually inspects labels on final product packaging and rechecks them to ensure accuracy, specifically verifying that frozen tuna labels match frozen tuna products.

Corrective Actions

The fourth principle involves implementing corrective actions if deviations from the established critical limits occur. Although the HACCP system is designed to recognize potential health-related hazards and establish preventive strategies, unexpected deviations can still occur. Therefore, if monitoring reveals any deviations or non-conformities with CCPs and their critical limits, corrective actions are taken. UD. Damena determines corrective actions for critical limit breaches where control cannot be maintained.

Verification Actions

Verification in the HACCP plan involves activities to determine and declare that the operating system complies with the plan. Internal verification at UD. Damena is performed by the HACCP team to ensure that processes align with the HACCP design, while external verification is usually conducted by certification bodies. Verification activities aim to ensure compliance with procedures and obtain accurate results. UD. Damena conducts verification by allocating time for verification activities.

Development of Recording and Data Bookkeeping Systems

Recordkeeping and documentation are managed by the document control department, responsible for controlling documents and records. Document records are stored in accessible locations for easy storage and retrieval. Recordkeeping is essential for monitoring or supervision during the production process. The recording or bookkeeping procedure at UD. Damena aims to identify field deviations and track corrective actions to ensure that the products produced are safe and suitable for consumption.

Yellowfin Tuna (Thunnus albacares) Test Results

UD. Damena periodically conducts testing on fresh tuna products every three months at an accredited external laboratory, BKIPM Denpasar. The products tested in November 2023 met the following standards: Organoleptic test results, including appearance, smell, and texture, scored 9, meeting the standard set at 7 according to SNI 2346:2011. Microbiological test results for ALT, E-coli, Salmonella, Vibrio cholerae, and Vibrio parahaemolyticus were within the specified standards, as per SNI 2332.3-2015 for ALT testing, SNI 2332.1-2015 for E-coli and coliform testing, SNI 6579:2015 for Salmonella testing, and SNI 2332:2006 for Vibrio cholerae and Vibrio parahaemolyticus testing. Chemical test results for histamine ELISA, Pb, Cd, and Hg also met the quality requirements specified by SNI 2353:2011.

CONCLUSIONS AND RECOMMENDATIONS

The implementation of GMP, SSOP, and HACCP systems at UD. Damena has been carried out well and optimally, in accordance with the basic requirements which include the 5 principles of GMP implementation and the 8 principles of SSOP, as well as the application of the 7 principles of HACCP. This was in accordance with Ministerial Regulation No. 17 of 2019.

FURTHER STUDY

The implementation of GMP, SSOP, HACCP requires supervision from the relevant agencies so that food safety guarantees from industry can be achieved. Achieving the goal of providing safe food will be achieved by carrying out ongoing socialization and counseling from the relevant agencies. Industries related to food supply should comply with existing regulations, so that the Government and business actors can run in harmony.

THANK YOU

Thanks to the Almighty God for His blessings, grace, and guidance, which have facilitated the completion of this thesis. The author would also like to express gratitude to:

1. Ms. Ir. Ni Made Darmadi, M.Si, and Mr. Ir. I Made Kawan, M.P., as the first and second thesis advisors, as well as the Head of the Fisheries Resources Management Study Program, who provided the opportunity, guidance, and support throughout the thesis writing process.

2. The parents and all those who have assisted the author in pursuing studies at Warmadewa University.

Hopefully, this thesis can be beneficial and contribute to the development of knowledge in the field of tuna processing.

REFERENCES

Antriyandarti, E., Barokah, U., Anandito, R., Rahayu, W., Ramadani, A, dan Madina, A. 2023. Pemberdayaan Ekonomi Masyarakat Pesisir Pantai Sadeng Gunung Kidul Melalui Pengolahan Ikan Tuna. Jurnal Warta LPM. e-ISSN2549-5631. Vo. 26. No.1. Hal 79-80.

[BSN] Badan Standarisasi Nasional. 1998. *Analisa Bahaya dan Pengendalian Titik Kritis. SNI 01-4852-1998*. Jakarta : Badan Standarisasi Nasional

[BSN] Badan Standarisasi Nasional. 2009. *Tuna Loin Segar-Bagian 1: Spesifikasi. SNI 7530.1:2009.* Jakarta : Badan Standarisasi Nasional.

Hermansyah M, Pratikto, Soenoko R, Setyanto N. 2013. *Hazard analysis and critical control point* (HACCP) produksi maltosa dengan pendekatan *good manufacturing practice* (GMP). 1(1) : 14-19.

Perdana, G. M. R., Sumiyanto, W., & Sipahutar, Y. H. (2019). Penetapan dan pengendalian titik kendali kritis histamin pada pengolahan tuna steak beku (Thunnus sp.) di PT. Permata Marindo Jaya Muara Baru-Jakarta Utara. *Buletin Jalanidhitah Sarva Jivitam*, *1*(1), 1-13.

Salsabila, L. 2019. Analisis Penerapan Sistem HACCP Pada Produk Kecap Manis PT. X. (Skripsi). Jakarta: Universitas Islam Negeri Syarif Hidayatullah.

Siahaan, I. C. M., Nugraha, B. R., Rajab, R. A., & Rasdam, R. (2022). Penerapan *Good Manufacturing Practices* (GMP) dan *Sanitation Standard Operating Prosedure* (SSOP) pada Proses Pengolahan Tuna Loin (Thunnus sp) di Unit Pengolahan Ikan di Nusa Tenggara Timur. *Jurnal Vokasi Ilmu-Ilmu Perikanan (Jvip)*, *3*(1), 13-17.

Sumartini, S., Harahap, K. S., & Sthevany, S. (2020). Kajian Pengendalian Mutu Produk Tuna Loin Precooked Frozen Menggunakan Metode Skala Likert Di Perusahaan Pembekuan Tuna. *Aurelia Journal*, *2*(1), 29-38.

Utari S. 2016. Penerapan HACCP (*hazard analysis critical control point*) pada produksi surimi beku ikan kurisi (*Nemipterus nematophorus*) di PT. Bintang Karya Laut Remabang, Jawa Tengah. [Laporan Praktek Kerja Lapang]. Surabaya : Universitas Airlangga.

Yuniar., Z. Anna, I. Riyantini, dan Asep. A. H Suryana., (2019). Analisis nilai tambah industri pengolahan ikan tuna di Kawasan Pelabuhan Perikanan Samudera (PPS) Nizam Zachman Jakarta. Jurnal Perikanan dan Kelautan., 10(2): 9-1