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Implementation of hazard analysis critical control point (HACCP) on pan–seared butter fish with herb cream sauce in PT AF

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ABSTRACT
Hazard Analysis Critical Control Point (HACCP) is a quality assurance, food safety, and risk management system with a preventive approach to ensure food safety for consumers. Food served during in–flight travel is provided by in–flight catering. Airline food has very high standards regarding food quality and safety. The purpose of this study is to analyze the application of HACCP to aviation food products by identifying potential hazards and applying Critical Control Points (CCP). The method used in this study is Critical Control Point (CCP) observations, carried out at the receiving (CCP 1), chiller and freezer (Storage) (CCP 2), cooking (CCP 3), blast chilling (CCP 4), and serving (CCP 5) stages. The company has created a HACCP plan as a guide for all processes that occur within the company. All are organized based on HACCP principles for the entire process.

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INTRODUCTION

In the aviation industry, food safety is paramount, particularly when it comes to providing meals for passengers. PT AF, as a renowned airline catering company, is committed to delivering safe and high–quality food. In food processing, food safety is prioritized by emphasizing product quality, the raw materials used, the equipment employed, and the processing procedures. Quality in food products is the primary priority in providing food service. Therefore, food products have specific requirements and conditions for consumption. These must be implemented to ensure that products are protected from potential hazards (Sari et al., 2022). Quality assurance and food safety systems identify critical points in the production process and strive to prevent problems. By identifying physical, chemical, and microbiological hazards that pose risks at certain stages of food production but can be controlled, the HACCP system is useful for ensuring product quality and has received international recognition. HACCP plays a crucial role in monitoring and establishing official food safety standards in global market trade. Moreover, HACCP serves as a system to guarantee food safety and can ensure the performance of food product exports produced by the processed food sector (Arisandi et al., 2019).

HACCP is used to classify risks and determine preventive control mechanisms. Anticipating risks and identifying control points that prioritize preventive actions rather than relying solely on end–product evaluation are essential components of HACCP (Soon et al., 2011). The HACCP system is not a zero–risk food safety guarantee system, but it aims to reduce food safety hazards. The food supply chain can use HACCP, starting from the primary producers of food raw materials (agriculture) and continuing through handling, processing, distribution, and marketing to the end consumer. Since HACCP is considered an effective system for ensuring food safety, food assurance companies will be able to assure customers of the safety guarantees implemented by adopting HACCP. This will also

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create a positive impression that the concerned food industry meets strong and professional commitments to ensuring food safety (Trijayanto & Abdulrahim, 2023).

A previous study by (Lutfi et al., 2019), which conducted research on potential hazards and monitoring critical points of airline food products, found that the implementation of CCP (Critical Control Point) exists in five places: receiving, storage, cooking, blast chilling, and portioning. PT AF establishes CCP at each stage of its production process. CCP or critical control points are actions taken to determine whether stages in food processing can reduce hazards to acceptable levels. Issues that could harm the industry or consumers can be addressed early by identifying CCPs (Awangsih & Juwitaningtyas, 2021).

Pan–seared butter fish with herb cream sauce is one of the food menu items produced by PT AF. To ensure that this product is safe for consumption even during long–haul flights, pan–seared butter fish with herb cream sauce is prepared and packaged with careful attention to food safety. Meat (fish, beef, chicken, lamb) is a product easily contaminated by physical, chemical, and microbiological risks, making it a high–risk source of disease and poisoning (Latifah et al., 2025). This situation has led to the implementation of food quality and catering control systems, or HACCP, by airline catering (Sari, 2019). Moreover, studies in Indonesia further support the importance of hygiene, sanitation, and food safety awareness. For instance, research on household food handlers highlighted that knowledge, attitude, and behavior influence the safe use of food additives, emphasizing the importance of education in chemical hazard prevention. Similarly, sanitation and hygiene evaluations in small–scale noodle production emphasized the role of employee practices in reducing contamination risks (Primayandi & Khairi, 2022). Several studies in Indonesia have also confirmed the effectiveness of HACCP in controlling hazards in different food industries, such as canteen–based traditional fish products (Yollanda, 2023), tempe production (Widiatmaja et al., 2020), and shrimp processing (Sari et al., 2022). These findings reinforce the importance of implementing HACCP in the airline catering industry to ensure both safety and consumer trust.

The objectives of this research are to identify hazards in the production process of pan–seared butter fish with herb cream sauce. Additionally, this research aims to determine the critical temperature points for the product. Finally, this research evaluates the effectiveness of HACCP implementation in the production process at PT AF.

RESEARCH METHOD

Materials

The materials used in this research include a variety of raw ingredients essential for the preparation of pan–seared butterfish with herb cream sauce. Key ingredients consist of fresh snapper fish, which serves as the main protein, complemented by a rich and flavorful herb cream sauce. Accompanying the main dish are side components such as pasta, which adds a carbohydrate element, and vegetables like pumpkin and snowpeas, which contribute additional texture, color, and nutritional value to the meal. These ingredients were carefully selected to ensure the final product meets high standards of taste and quality, aligning with the safety and quality protocols established by PT AF.

Methods

The literature review was conducted to obtain secondary data related to the topic of HACCP. Secondary data was gathered through various Internet sources, including scholarly articles, industry reports, and official publications. Additionally, the HACCP guidelines provided by PT AF offered valuable insights into the specific practices and standards followed by the company. This comprehensive review of existing literature ensured a robust understanding of HACCP principles and their application in the food industry, particularly in airline catering (Widiatmaja et al., 2020).

Observations were carried out to understand the implementation of HACCP by directly observing the production site at PT AF. This hands–on approach involved detailed monitoring of the production processes, from the receipt of raw materials to the final packaging of the pan–seared butterfish with herb cream sauce. The observation aimed to identify critical control points and assess how effectively HACCP principles were being applied in real–time operations. By witnessing the day–to–day practices

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and protocols, the study aimed to evaluate the practical challenges and successes of HACCP implementation in ensuring food safety and quality.

Data Analysis

Data analysis was conducted in detail by identifying potential hazards that may arise at each stage of production, determining critical points in the production process, establishing critical limits for each CCP, and monitoring to ensure that each CCP remains within the established critical limits. The detailed data analysis began with a thorough identification of potential hazards at each production stage, including biological, chemical, and physical risks. Following this, critical control points (CCPs) were determined where control measures are essential to prevent or eliminate hazards or reduce them to acceptable levels. For each CCP, critical limits were established to define the boundaries that must not be exceeded to ensure food safety. Continuous monitoring procedures were implemented to ensure that each CCP consistently operates within the critical limits, thereby guaranteeing the safety and quality of the pan–seared butterfish with herb cream sauce produced by PT AF. This rigorous approach ensures that any deviations from the established standards are promptly addressed, maintaining the integrity of the HACCP system throughout the production process (Vatria, 2022).

RESULT AND DISCUSSION

Development of Halal Literacy Indicators

PT AF has obtained the ISO 22000:2005 certification from the International Organization for Standardization (ISO), demonstrating its commitment to food safety management. This certification, combined with the implementation of Hazard Analysis and Critical Control Points (HACCP), ensures that the company adheres to global food safety standards. ISO 22000:2005 provides guidelines that integrate HACCP principles into a comprehensive food safety management system, aligning with international best practices in the food industry. ISO 22000:2005 outlines a structured approach to food safety by incorporating risk–based thinking, preventive measures, and continuous improvement. Compared to other food safety frameworks, such as the BRC Global Standard and SQF (Safe Quality Food), ISO 22000:2005 emphasizes a process–driven methodology that includes documentation, hazard analysis, and traceability. According to Codex Alimentarius, HACCP principles are universally accepted as the foundation for food safety programs, and their integration into ISO 22000 ensures compliance with both regulatory and consumer safety expectations (Food and Agriculture Organization & World Health Organization, 2023). Furthermore, research has shown that integrating HACCP and ISO 22000 can improve consumer trust and product safety in the catering industry (Khairi et al., 2020).

One of the dishes offered by PT AF airline catering is pan–seared butter fish with herb cream sauce, made from filleted snapper fish grilled with butter. The company employs a blast chilling process post–cooking to minimize microbial growth and preserve food quality. The chilling process lasts approximately four hours before portioning, and all portioning activities must be completed within 45 minutes under strict temperature control (15°C for surface temperature, 15 – 21°C for room temperature) (Duanassurya, 2020). Similar findings were reported in a study of halal food production, where strict time–temperature controls were critical to ensuring safety and compliance (Primayandi & Khairi, 2022).

Hazard identification is used to determine potential hazards from raw materials and throughout the production process until the final product. Identified hazards are compiled into a HACCP PLAN table, including the causes of hazards, risk levels, preventive measures, and the determination of CCPs. Each process activity, including the HACCP system, can be managed within the framework of a quality management system (Yuniarti et al., 2015). Hazard Identification for Pan–Seared Butter Fish Sauteed with Herbal Cream Sauce can be seen in Table 1. The goal of HACCP is to ensure the safety and quality of food products. PT AF's implementation of ISO 22000:2005 and HACCP demonstrates a strong commitment to food safety and quality assurance. When compared to global food safety regulations, the company's practices align with industry standards, ensuring compliance and consumer protection. The integration of hazard identification and CCPs within its food safety management system showcases an effective approach to mitigating risks and maintaining product integrity. Continuous monitoring and adaptation to updated ISO standards, such as the transition from ISO 22000:2005 to ISO 22000:2018,

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will further enhance PT AF's food safety framework and competitiveness in the industry. In line with this, studies in Indonesian food industries highlight that HACCP–based hazard identification significantly reduces contamination risks and improves compliance (Trijayanto & Abdulrahim, 2023).

Table 1. Hazard identification for pan–seared butter fish with herb cream sauce.

Stage	Hazard Identification		Cause
	Type	Hazard	
Acceptance of dry goods	Physical	Foreign objects (stones, dust, gravel)	Poor handling
	Chemical	Foreign objects (stones, dust, gravel)	Supplier's vehicle
	Biological	C. botulinum	Improper sterilization process
Acceptance of frozen items	Physical	Foreign objects (stones, dust, gravel)	Improper Handling
	Chemical	Exhaust smoke	Supplier
	Biological	Pathogenic microbial growth	Non–standard storage
Acceptance of chilled items	Physical	Foreign objects (stones, dust, gravel)	Improper Handling
	Chemical	Exhaust smoke	Supplier
	Biological	Pathogenic microbial growth	Non–standard storage
Storage–frozen	Physical	–	–
	Chemical	–	–
	Biological	Pathogenic microbial growth	Non–standard storage
Storage–dry goods	Physical	Insect and animal contaminants	Environment
	Chemical	Contamination from cleaning chemicals	Non–standard storage
	Biological	Animal waste	Animal
Storage–chilled	Physical	–	–
	Chemical	–	–
	Biological	Pathogenic microbial growth	Non–standard storage temperature
Pre–cut	Physical	Stones, insects/worms	Environment, Material
	Chemical	–	–
	Biological	Pathogenic microbial growth	Environment
Wash and sanitizing fruits & vegetables	Physical	Stones, insects, or worms	Contamination during washing and due to inappropriate cleaning agents
	Chemical	Chemical contamination	Contamination during washing and due to inappropriate cleaning agents
	Biological	Pathogen microbes' survival	Inappropriate cleaning
Thawing	Physical	–	–
	Chemical	–	–
	Biological	Pathogen microbes' growth	Non–standard thawing temperature and time
Cooking	Physical	Foreign objects	Packaging materials and equipment
	Chemical	–	–
	Biological	Pathogen microbes growth, such as Salmonella, E.coli, Listeria monocytogenes	Inappropriate cooking temperature (undercooking) and cross–contamination from equipment and workers

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Stage	Hazard Identification		Cause
	Type	Hazard	
Blast Chilling	Physical	–	–
	Chemical	–	–
	Biological	Pathogen microbes' growth	Non–standard blast chill temperature and time
Storage–cooked food	Physical	–	–
	Chemical	–	–
	Biological	Pathogen microbes' growth	Non–standard storage temperature
Dishing/portioning	Physical	Unidentified Object	Worker Contamination
	Chemical	Cleaning chemicals (hand sanitizer, NH_4^+, chlorine)	Improper placement or labeling of sanitizing materials
	Biological	Pathogen microbes' growth	Increase in room temperature
Meal Tray Set Up	Physical	Unidentified Object	Worker Contamination
	Chemical	Cleaning chemicals (hand sanitizer, NH_4^+, chlorine)	Improper placement or labeling of sanitizing materials
	Biological	Pathogen microbes' growth	Increase in room temperature
Storage Final Holding	Physical	–	–
	Chemical	–	–
	Biological	Pathogen microbes' growth	Non–standard storage temperature

After identifying the hazards, the next step is to determine the Critical Control Points (CCPs). This step aims to reduce or eliminate the identified hazards. CCPs are control points at each stage of the production process where, if not properly monitored, there is a possibility that the food may become unsafe, spoiled, and pose an economic risk to the institution. The CCP decision tree is used to determine CCPs. The CCP decision tree consists of questions that address each hazard. The answers to these questions can indicate whether the hazard is truly important to control or not (Awangsih & Juwitaningtyas, 2021).

Then, the next step is to determine the critical limits for those hazards. Critical limits are established based on references or observations by the HACCP team. Critical limits must not be exceeded, as these limits represent the tolerances that ensure the hazards can be controlled. Commonly used critical limits include temperature and time. Critical limits distinguish between safe and unsafe products. These limits must not be violated to ensure that the CCPs effectively control biological, chemical, and physical hazards. Critical Control Point (CCP) Limits and Observation Data can be seen in Table 2. Moreover, compliance with critical limits has been emphasized as a key success factor in halal–certified food industries in Indonesia, underscoring the importance of CCP monitoring (Yollanda, 2023).

Table 2. Critical Control Point (CCP) limits and observational data.

Process	Critical Control Point (CCP) Limits	Observational Data
CCP 1 Receiving	The temperature of frozen products should be ≤ –8°C, or they should be hard with no signs of thawing. Vegetables should meet standard conditions: not too young or not too mature, and must be free from insect contamination. Dry goods should be in undamaged packaging and free from insects	Temperature of frozen fish product: –8.2°C Pasta meets the standards Pumpkin and snowpeas meet the standards

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CCP 2 Storage	Freezer temperature: –18°C, chiller temperature: 0 – 5°C	Freezer temperature: –18°C, chiller temperature: 5°C
CCP 3 Cooking	Fish should be cooked to a minimum temperature of 74˚C Pasta and vegetables should be cooked according to the product's base	Core temperature of cooked fish: 87˚C Cooked pasta temperature: 68˚C Cooked pumpkin and snowpeas temperature: 70˚C
CCP4 Blast Chilling	The core temperature of food must be reduced to at least 10˚C within a maximum of 4 hours.	Temperature after blast chilling fish: 7.4˚C Temperature after blast chilling pasta: 8.8˚C Temperature after blast chilling pumpkin and snowpeas: 8.8˚C
CCP 5 Dishing/portioning	The maximum room temperature should be 21˚C, with food exposure time not exceeding 45 minutes and the food surface temperature not exceeding 15˚C.	Finished portioning temperature of fish: 9.6˚C Finished portioning temperature of pasta: 11.4˚C Finished portioning temperature of pumpkin and snowpeas: 11.4˚C

CCP–1 (Receiving)

Receiving is a crucial part of the goods acceptance process, serving as the main entry point for ordered items according to the company's needs. Therefore, the quantity, quality, and price of goods must match the purchase order. At PT AF, several conditions must be met for receiving goods in terms of quality and delivery. During the receipt of goods, delivery personnel are required to wear work uniforms, hairnets, and safety shoes, and ensure that the transport vehicle is clean, with the storage boxes neatly closed (Tarn et al., 2003).

The vehicle transporting frozen items must maintain a temperature of –18˚C, and the product temperature must not exceed –8˚C, showing no signs of thawing. If the vehicle temperature is not met, but the product temperature is within range, the product is accepted. These requirements are in line with the Codex Alimentarius standards, which emphasize the importance of maintaining proper cold chain management to ensure food safety (Food and Agriculture Organization & World Health Organization, 2023). Similar findings were reported by Bura et al. (2024), who noted that temperature deviations in frozen food distribution increase microbial contamination risks.

For frozen items, the acceptance standards can be seen in Figure 1. Dry goods have specific standards as well, including intact packaging without damage, dents, tears, swelling, or leaks, and must be free from insects and physical or chemical contamination. Vegetables must meet standards for uniform size, proper ripeness, no mold or bruising, and be free from insect contamination. Handling procedures ensure that products do not come into direct contact with the floor, using the provided plastic pallets. The receiving area door is opened only after the vendor has offloaded the goods. All received products must have an expiration date that complies with company requirements..

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Figure 1. Material acceptance.

CCP–2 (Storage)

At PT AF, the storage area for raw materials must be closed, spaced out, clean, and labeled. The storage of raw materials is categorized into several types: items that need to be stored in a chiller at a temperature of 0 – 5˚C for chilled products, a freezer at –18˚C for items like meat and seafood, and dry goods at 25˚C for storing dry raw materials such as flour, pasta, sugar, and cooking oil. The FEFO (First Expired First Out) and FIFO (First In First Out) system is implemented, meaning the first items that enter the storage room must be the first to be used, or those nearing their expiration date should be used first. This system is widely recommended in food safety management to reduce waste and prevent the distribution of expired products (Ayunda et al., 2024).

For frozen items like snapper fish, storage is maintained at –18˚C, and upon receipt, these items are placed into the freezer, as shown in Figure 2. Freezing meat is intended to suppress the activity of microorganisms, enzymatic reactions, chemical reactions, and physical damage. When the fish is to be used, it first undergoes a thawing process to refresh it, which is done in a chiller at a temperature of 0 – 5˚C (Dewi et al., 2016). According to Park & Kim (2024), thawing in controlled refrigeration prevents microbial growth and maintains product quality better than room–temperature thawing. Similarly, recent studies emphasize that strict temperature monitoring during storage and thawing is essential to comply with HACCP principles and international food safety standards.

Figure 2. Storage (freezer).

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CCP–3 (Cooking)

Cooking is a critical stage in the processing of raw materials. The cooking temperature for snapper fish is 87.3˚C, as shown in Figure 3; for pasta, it is 68˚C, and for vegetables, it is 70˚C. This indicates that the critical temperature limit for cooking snapper fish, according to CCP–3, is at least 74˚C. Pasta and vegetables are cooked according to their respective product requirements. If the cooking temperature does not meet the critical limit, re–cooking is necessary to prevent the growth or development of microorganisms. However, if the cooking temperature exceeds the standard, the quality of the food must be monitored. Potential microorganisms in fish products include *Salmonella, S. aureus*, and *E. Coli*. There is also a risk of physical contaminants, such as packaging materials and equipment (Puspitasari et al., 2015). Fish and meat products must reach a minimum internal temperature of 74˚C to effectively inactivate pathogens, while vegetables require at least 70˚C to reduce microbial risks (Paulsen et al., 2022).

In CCP–3, which is cooking, food preparation is done in the production section, specifically in the hot kitchen. The hot kitchen is responsible for cooking the main meals for airlines. Employees wear work uniforms, plastic aprons, masks, safety shoes, and cooking hats. The hot kitchen environment is quite warm due to the continuous cooking process. After the food is cooked, quality control measures the food temperature and visually inspects the food to ensure it complies with the HACCP plan. The results are then recorded in the CCP–3 report. Non–compliance could relate to aspects like cooking hygiene and sanitation that are not monitored within the CCP framework. Thus, it can be concluded that the implementation of CCP–3 is in accordance with the standards. Studies also emphasize that continuous monitoring of cooking temperature and hygiene practices plays a significant role in reducing the risks of foodborne illness in airline catering (Yusoff et al., 2022).

Figure 3. Fish core temperature.

CCP–4 (Blast Chilling)

After cooking, the product is placed into blast chilling, which aims to quickly reduce the food temperature to below 10˚C within a maximum of 4 hours. Snapper fish, which reaches a cooking temperature of 87.3˚C, is placed in the blast chiller for approximately two hours until the temperature drops to 7.4˚C. Pasta and vegetables are chilled until they reach a temperature of 8.8˚C. If the blast chilling temperature and time are not met, the product must be discarded. The blast chilling process is depicted in Figure 4. The purpose of blast chilling is to kill bacteria that can survive both cold and hot temperatures before they multiply further (Wicaksani & Adriyani, 2018).

Products that do not meet the CCP–4 standards must be discarded because they pose a risk of bacterial contamination that can be hazardous to health if consumed. Furthermore, HACCP–based monitoring of chilling parameters has been identified as an effective preventive measure in airline catering and mass food production, ensuring that safety standards are consistently achieved (Soon et al., 2011).

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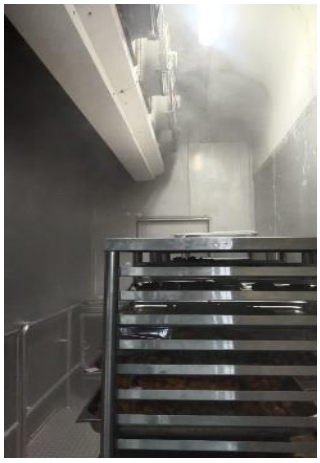

Figure 4. Blast chiller.

CCP–5 (Dishing/Portioning)

CCP–5 involves dishing or portioning with the stage of sorting food that has been stored in blast chilling to avoid foreign objects or contaminants that might arise. The portioning process can be seen in Figure 5. Food that meets the specifications of the menu, including the quantity, composition, and weight as set by the airline, undergoes portioning. Portioning is carried out using a golden sample as a reference to ensure that employees serve the food according to the menu specifications and presentation (Sahrevi et al., 2023).

The portioning process is performed with the time and room temperature as specified by the HACCP plan standards, which stipulate a maximum product temperature of 15°C, and room temperature ≤ 21°C. Portioning should be completed within 45 minutes; if the temperature does not meet these standards, the food must be discarded. Observations showed that the fish snapper had a temperature of 9.6°C, and pasta and vegetables reached a temperature of 11.4°C. Temperature control must be conducted meticulously, as temperature affects the final product quality and safety. This ensures the quality of the food is maintained and prevents bacterial contamination. According to (Vanany et al., 2020), strict time–temperature control during portioning is essential to prevent pathogen growth, especially *Listeria monocytogenes*.

Finished products are stored in a holding room at less than 10°C for at least 2 hours before the aircraft departure. The prepared products are then collected by the staff responsible for preparing them for loading onto the aircraft. Portioning staff wear work uniforms, plastic aprons, masks, gloves, hairnets, and safety shoes. Research indicates that proper hygiene practices among food handlers play a significant role in reducing cross–contamination risks during portioning. Furthermore, studies on airline catering highlight that portioning is one of the most sensitive CCPs, requiring continuous monitoring to comply with international HACCP–based safety standards (Kharisma, 2019).

Figure 5. Portioning.

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CONCLUSION

The observations and analyses conducted to identify various potential hazards have been thoroughly evaluated and found to meet established food safety standards. The company has demonstrated a strong commitment to food safety by implementing rigorous procedures for monitoring temperatures at each critical stage of production. These procedures ensure that temperature control is consistently maintained, thereby preventing potential safety issues. Furthermore, the observations confirm that the company's practices align with the highest industry standards. The evaluation of HACCP implementation shows that it effectively safeguards food safety and quality. Overall, the results indicate successful adherence to both safety protocols and quality standards, reflecting the company's dedication to excellence in food handling and preparation.

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