



Assessment of Personal Hygiene, Sanitation, and Operational Practices of a Smoked Fish Production Facility in Science City of Muñoz, Nueva Ecija, Philippines

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

This study evaluated the personal hygiene, sanitation, and operational practices of a smoked fish production facility in the Science City of Muñoz, Nueva Ecija, Philippines, aiming to enhance food safety standards and promote better worker health within the facility. A survey and face-to-face interview were conducted to gather the needed information. The facility demonstrated strong knowledge of food safety principles, including personal hygiene and sanitation, specifically on the use of protective gear, with 5 level of agreement or strongly agree on the answered statements. However, the study found that the facility's practices fell short in several areas, including infrequent handwashing among workers, inadequate handwashing stations, inconsistent documentation, insufficient temperature control, and a lack of formal sanitation documentation. The facility also needs to improve its training program to ensure that workers are up-to-date on best practices. The study provided recommendations for improvement, including investing in reliable temperature monitoring systems, conducting regular training sessions for workers on HACCP principles, implementing a system for maintaining detailed records of production and maintenance, encouraging employees to wash their hands frequently during shifts, installing traps and implementing a regular pest control program, and ensuring that all finished products are properly labeled with accurate product information and nutritional content.

Keywords: Personal hygiene; post-harvest; sanitation; smoked fish.

1. INTRODUCTION

Fish is one of the most popular and cost-effective sources of animal protein worldwide (Allam et al., 2020). It supplies essential nutrients, such as high-quality proteins and fats (macronutrients), as well as vital vitamins and minerals (micronutrients), which contribute considerably to global food and nutrition security (Food and Agriculture Organization, 2020). Fish is less expensive than other types of animal protein, making it more accessible, especially in poorer communities. Additionally, fish is highly perishable after harvest, necessitating appropriate preservation and storage methods to extend its shelf life (Maulu et al., 2021). The most common techniques for preserving and processing fish include freezing, smoking, and drying. However, in the local community of the Science City of Muñoz, Nueva Ecija, Philippines, fish processors typically produce smoked fish product. Through this method, it can preserve the fish, enhance its flavor and improve its appearance. The technique is easy and simple and does not require expensive equipment. The raw ingredients are readily available locally and the products are widely accepted (Guevara & Camu, 2019).

The fish processing sector creates jobs for more than a million Filipinos in addition to meeting the need for the required animal protein (Guevara & Camu, 2019). It has a great deal of development potential and is also a significant source of

foreign exchange earnings (Guevara & Camu, 2019). Fish processing plants improve food security by boosting the availability and affordability of fish products in local communities, ensuring that everyone has access to nutritional foods. They promote better nutrition and more sustainable food habits by providing affordable fish. However, personal hygiene and sanitation are equally important in these procedures (Guevara & Camu, 2019). The food processing plant industries are a highly regulated sector which needs a strict hygiene and sanitation standards in order to ensure customer safety (Kaizen Network News, 2023). Food enterprises must maintain the highest hygiene and sanitation standards to protect those who buy their products and their business' reputation. By maintaining those, it can avoid contamination and guarantee that the products produced is safe and of high-quality (Kaizen Network News, 2023).

Hygiene encompasses practices aimed at preventing the spread of disease-causing microorganisms. This involves thorough handwashing, the use of protective gear like gloves and aprons, and maintaining clean surfaces. Proper hygiene also entails regularly sanitizing tools and surfaces with approved cleaning products (Guevara & Camu, 2019). Sanitation, on the other hand, is concerned with preventing contamination by dangerous substances such as bacteria, viruses, parasites, chemicals, and other pollutants. Key sanitation

practices include storing food at appropriate temperatures, disposing of waste in designated areas, using separate cutting boards for raw meat, washing hands between tasks, and consistently cleaning equipment and surfaces with approved sanitizing agents (Guevara & Camu, 2019).

Hygiene and sanitation measures, including good manufacturing practices (GMPs), sanitization methods, and consistent inspections, are essential for the safety and quality of processed foods as well as for the protection of public health (Girsang et al., 2023). These practices help facilities that handle food including fish processing plant facilities are free of infection and maintain stringent hygiene standards (Dalimunthe, 2022). GMPs are the basic environmental and operational standards for producing safe food (Walia et al., 2022). They are essential for both economic viability and regulatory clearance, and they coordinate all aspects of the institution to ensure food safety (Al-Obaidi & Dawood, 2022). Maintaining proper sanitation and hygiene during food preparation and storage is also necessary to reduce the risk factors for food contamination (Alonso et al., 2024). Poor hygiene standards can result in foodborne infections, microbial resistance to sanitizers, and financial losses. Thus, maintaining food safety and quality in the food processing business requires the implementation and observance of appropriate sanitary hygiene measures (Megavitory et al., 2024).

The general objective of this study was to document the various personal hygiene, sanitation, and operational practices of a local smoked fish facility in the Science City of Muñoz, Nueva Ecija, Philippines. This study aimed to contribute to a higher standards of food safety and worker health inside the facility by evaluating their practices and recommending necessary improvements.

2. MATERIALS AND METHODS

2.1 Study Area

The survey was conducted in a smoked fish processing facility located in Catalanacan, Science City of Muñoz, Nueva Ecija, Philippines (latitude 15.7128, longitude 120.8862). Only one small-scale smoked fish processing facility was selected and served as a model for the assessment of personal hygiene, sanitation, and

operational practices. The researchers also secured a permission of the respondent by having an initial conversation before the survey. Actual visit and survey of the facility was conducted to ensure accuracy of generated data.

2.2 Data Collection

A survey questionnaire was prepared by the students and reviewed by their professor to ensure clarity of questions. The questionnaire was validated first before used in the interview. The first part of the questionnaire was composed of several sections: (a) Personal hygiene practices, (b) Hand hygiene, (c) Protective gear and clothing, (d) Sanitation practices, (e) Training and protocols, and (f) Challenges and suggestions. For sections a to e, the interviewees were asked with several statements in order to indicate the level of agreement using a five-point likert scale where 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree. The second part was composed of 17 sections and within each section contained three statements that document the operational procedures of the smoked fish production facility.

2.3 Data Analysis

The data collected from the survey and interview were systematically organized and analyzed through qualitative methods. The findings were then critically discussed to interpret their implications, draw meaningful conclusions, and provide context-specific recommendations for improving practices within the smoked fish production facility. The qualitative approach allowed for a deeper understanding of the challenges and strengths in personal hygiene, sanitation, and operational processes.

3. RESULTS AND DISCUSSION

3.1 Personal Hygiene Practices

The respondents strongly emphasized the importance of personal hygiene practices in a smoked fish production facility as indicated by a constant level of agreement of 5 (Strongly Agree) across all statements (Table 1), highlighting their role in maintaining safety, product quality, and operational efficiency. This viewpoint was supported by the article, "How to Ensure Quality Control in Fish Processing," which emphasizes

the perishable nature of fish and the potential for spoilage, bacterial growth, and contamination if proper hygiene practices are not followed during processing, handling, and storage. The article highlights the importance of GMPs, Hazard Analysis and Critical Control Points (HACCP), traceability, and temperature control as essential elements of quality control in fish processing. The article further discusses the importance of training and education for all workers involved in fish processing to ensure that they are aware of potential hazards and equipped with the necessary skills to prevent contamination and maintain product quality (Freshbyte, 2023). Lack of hygiene can also affect a person's work and social life. Some companies have a hygiene policy in place for the protection of employees and company image, especially if there is a public-facing role (World Health Organization, 2024). According to the World Health Organization (WHO), training in personal hygiene is essential in food production environments to prevent contamination and ensure food safety. This training enables employees to understand the critical role of hygiene in reducing the risk of foodborne illnesses and maintaining the safety and quality of seafood products. Additionally, there is a need to conduct daily hygiene compliance checks, which aligns with guidelines from the Food and Agriculture Organization (FAO) on maintaining a high level of hygiene control (Food and Agriculture Organization, 2024). Daily checks allow management to monitor hygiene practices closely and immediately address any deficiencies, thus, ensuring a consistent level of cleanliness throughout production. However, during the facility visit, a significant gap was identified in the availability of hygiene facilities and supplies. Employees reported a lack of sufficient handwashing stations and protective clothing, which are essential for effective hygiene maintenance.

3.2 Hand Hygiene

The respondents' statement that employees rarely wash their hands during shifts, only washing before starting work, was concerning. This practice could significantly increase the risk of contamination because of a low rate of compliance with hand hygiene practices in food preparation environments (Hoelzl et al., 2013; Maughan et al., 2016; Nikos-Rose, 2014; United States Department of Agriculture within Food

Safety and Inspection Service, 2018). The WHO, Centers for Disease Control and Prevention (CDC), and other agencies involved in protecting consumers' health agree that handwashing is crucial in preventing foodborne illnesses and should be performed before and after handling food, after using the restroom, and after touching contaminated surfaces (Ujjwala & Bhatia, 2017; Centers for Disease Control and Prevention, 2020; World Health Organization, 2006). While the respondent acknowledged the importance of handwashing facilities and believed that the employees were well-trained in proper handwashing techniques, the infrequent handwashing during shifts raises concerns about the effectiveness of these practices. The respondents' statement that they do not experience skin irritation from infrequent handwashing suggests that they may not be using soap or sanitizers effectively. Additionally, the respondents' perception that the frequency of hygiene checks was adequate and that they were given enough time to wash their hands thoroughly may not reflect the reality of the situation. Further investigation is needed to understand the actual frequency of handwashing and the effectiveness of hand hygiene practices within the facility.

3.3 Personal Protective Equipment (PPE)

The respondents' strong agreement with all statements in Table 2 indicates a strong commitment to safety and hygiene through the consistent use of protective gear and clothing in the facility's operations. This commitment is commendable, as proper PPE use was crucial for both worker safety and food quality. The respondents' emphasis on regular inspection of PPE, designated storage areas, and on-going training for workers demonstrates a proactive approach to risk prevention. These practices align with WHO guidelines, which stress the importance of PPE in controlling hazards and ensuring safe food production (World Health Organization, 2020). Without these resources, employees may face challenges in maintaining hygiene standards, potentially increasing the risk of microbial contamination of seafood products. Addressing this gap by installing additional handwashing stations and providing sufficient protective clothing would strengthen the facility's hygiene practices and support a cleaner, safer environment for employees (World Health Organization, 2020).

Table 1. Questions and their corresponding level of agreements of the visited smoked fish production facility regarding personal hygiene practices

No.	Statements	Level of Agreement
1	Having an awareness about the importance of personal hygiene in a smoked fish production facility can improve operational practices.	5
2	Thorough washing of hands before starting work prevents contamination.	5
3	Wearing clean and appropriate protective clothing is important for safety and healthy operation.	5
4	Removing jewelry and accessories before entering the fish processing area is important for hygiene and safety.	5
5	Having short and clean nails prevents contamination.	5
6	Washing and sanitizing of hands after touching any potentially contaminated surfaces is important.	5
7	Avoiding eating, drinking, or smoking in the fish processing area are important for maintaining hygiene and safety	5
8	Familiarizing oneself with the company's personal hygiene policy and following it strictly is important for ensuring a safe work environment.	5
9	Frequently changing of gloves prevent cross-contamination between tasks.	5
10	Regularly inspecting protective gear for cleanliness and damage is crucial for safety.	5
11	Covering cuts, wounds, or abrasions with waterproof dressings before working is important for safety.	5
12	Avoiding coming to work if experiencing any symptoms of illness is important for the health of everyone.	5
13	Keeping the work area clean and organized reduces contamination risks.	5
14	Following correct hand washing procedures, including scrubbing for the recommended duration is an important practice.	5
15	Understanding the role of personal hygiene maintains product safety and quality.	5

Table 2. Statements and their corresponding level of agreements of the visited smoked fish production facility regarding protective gear and clothing

No.	Statements	Level of Agreement
1	Consistently wearing recommended PPE plays an important role in the smoked fish production facility.	5
2	Ensuring that clothing and PPE are clean and in good condition before starting work is important for maintaining safety.	5
3	Removing any jewelry or accessories that could pose a contamination risk before entering the work area is important	5
4	Regular inspecting of PPE for signs of wear or damage is necessary.	5
5	Understanding how to properly put on, adjust, and remove PPE avoids contamination.	5
6	Storing PPE in a designated area can maintain its cleanliness and avoid cross-contamination.	5
7	Wearing appropriate footwear that is clean and safe for the processing area is important.	5
8	Changing of PPE or clothing immediately if it becomes contaminated during work is necessary.	5
9	PPE provided by the company should be of high quality and should fit for purpose.	5
10	PPE and protective clothing should be comfortable and do not hinder the ability to perform tasks.	5
11	Workers should receive regular training on the proper use and maintenance of PPE	5
12	Management should enforce the consistent use of PPE in the workplace.	5
13	Being aware on the importance of using PPE prevents contamination and ensures food safety.	5

Table 3. Statements and their corresponding level of agreements of the visited smoked fish production facility regarding sanitation practices

No.	Statements	Level of Agreement
1	The processing equipment and work surfaces should be regularly cleaned and sanitized.	5
2	Cleaning supplies (detergents, sanitizers) should be easily accessible in the work area.	5
3	The staff should understand and follow the proper procedures for waste disposal.	5
4	The frequency of cleaning and sanitizing in the fish processing area should be sufficient.	5
5	Receiving adequate training on how to properly clean and sanitize the work area and equipment is important.	5
6	The staff should have an awareness of and following the company's sanitation schedule.	5
7	Waste and by-products should be disposed of promptly and in accordance with hygiene standards.	5
8	The staff should use appropriate cleaning methods to avoid cross-contamination between raw and processed fish.	5
9	The cleaning equipment (brushes, mops, etc.) should be regularly replaced or sanitized to ensure effectiveness and safety.	5
10	The staff should follow the correct procedure for handling and storing cleaning chemicals.	5
11	Reporting should be immediately done to management if any sanitation issues, such as spills or equipment malfunctions happened	5
12	Overall sanitation practices in the facility can effectively reduce the risk of contamination.	5
13	The facility's ventilation and drainage systems contribute to maintaining a clean and sanitary environment	5

Table 4. Statements and their corresponding level of agreements of the visited smoked fish production facility regarding training protocols

No.	Statements	Level of Agreement
1	The staff should receive proper training on sanitation procedures and protocols.	5
2	There should be a clear protocol for handling waste and disposing it safely.	5
3	The staff should effectively follow sanitation protocols	5
4	Receiving regular updates or refresher training on hygiene and safety protocols is important.	5
5	The training should include clear instructions on how to prevent contamination in the fish processing area.	5
6	The staff should know who to contact if questions or concerns about sanitation protocols happens.	5
7	Familiarizing with the emergency protocols should be done in case of sanitation failures or contamination incidents.	5
8	The staff should be trained to identify potential hazards and contamination risks in the work environment.	5
9	There should be clear guidelines for handling and storing used chemicals in smoked fish production facility.	5
10	Training on PPE usage should be thorough and easy to understand.	5
11	Management should have awareness about the consequences of not adhering to hygiene and safety protocols.	5
12	Management should provide feedback on adherence to sanitation protocols during regular reviews.	5
13	The training materials provided should be comprehensive and easy to follow.	5

3.4 Sanitation Practices

Based on the result of the survey, all statements listed in Table 3 were given a perfect score of 5, suggesting that the interviewees were knowledgeable in terms of sanitation practices in their processing facility. People have the right to expect the food they eat to be safe and suitable for consumption (Food and Agriculture Organization/World Health Organization, 2009). Sanitation is essential to food safety and quality and is the key point in all food safety programs. Food sanitation could be defined as the creation and maintenance of hygiene and healthy conditions in food processing, or even more simply as the protection of food from contamination. Unhygienic processing practices and poor maintenance and sanitation of facilities contribute to fish product contamination with *Listeria monocytogenes* (Smulders et al., 2004; Blatter et al., 2010). Representative places for *L. monocytogenes* contamination in fish processing plants include processing machinery, surfaces, transporters, utensils, brine, floors, drains, and personnel work clothing (DiCiccio et al., 2012; Lundén et al., 2003; Miettinen et al., 2001; Thimothe et al., 2004; Rørvik et al., 1997; Nakamura et al., 2006).

3.5 Training Protocols

The respondents' strong agreement with all statements in Table 4, which discussed sanitary practices and training protocols, suggests that the facility recognizes the importance of sanitation and training in maintaining a clean and safe workplace. This viewpoint is supported by the article, "The Importance of Safety and Sanitation Training - Restobiz," which emphasizes the importance of training in reducing foodborne illnesses. The article highlights the need for employees to understand the risk factors and cleanliness standards required to prevent contamination of food and kitchen equipment, and recommends working with a cleaning supplier to create a successful sanitation plan (Furgala, 2018).

3.6 Challenges and Suggestions

The respondents identified the lack of time and training as challenges to maintaining personal hygiene. The suggestions for improvement include regular maintenance and cleaning of facilities, a good water source for cleaning, better ventilation systems, improved access to hygiene facilities, and hands-on training sessions (Zuur et

al., 2009; FAO Biosecurity Toolkit, 2007). These suggestions are valid and demonstrate an understanding of the importance of a clean and safe work environment. The respondents' belief that management provides sufficient support in ensuring adherence to hygiene and sanitation standards was encouraging. However, the lack of documentation and reporting processes for sanitation protocols, as well as the challenges in understanding current sanitation protocols, indicate a need for further improvement in communication and training.

3.7 Maintaining a Clean Working Environment

In maintaining hygiene and sanitation within a smoked fish production facility, keeping the facility itself clean is fundamental. Cleanliness not only ensure product quality but also promotes worker health and safety. Proper sanitation procedures are necessary to prevent contamination, which could lead to foodborne illnesses, spoilage, and potential economic losses due to product recalls (Timmerman, 2014).

To achieve optimal hygiene, a comprehensive approach is required that addresses the four key elements such as food, people, facilities, and vermin control (Amjadi et al., 2005). The food itself must be handled with care, ensuring it remains uncontaminated throughout production. Personnel must practice good personal hygiene, maintain a clean working environment, and follow established sanitation protocols.

Hand washing is a critical step in contamination prevention (Green et al., 2007). Workers should be encouraged, or even required, to wash their hands before and after handling products, as well as after using the restroom, eating, or coming into contact with any contaminants. Proper handwashing helps remove bacteria, viruses, and other potential contaminants that could transfer to the product, thereby upholding food safety standards. In addition to personal hygiene, the physical facility itself must be maintained in a clean and sanitary condition (Green et al., 2007).

Providing visible signage about hygiene and sanitation should be strategically placed around the facility. These signs serve as constant reminders for workers to adhere to strict cleanliness protocols (Olatunji & Thanny, 2020). They can include guidelines for personal hygiene, proper handwashing techniques, and

instructions on safely handling food products. Signage should be clear, understandable, and placed in areas where workers frequently pass or spend time, such as near handwashing stations, processing areas, and break rooms (Olatunji & Thanny, 2020).

Lastly, maintaining a clean working environment involves regular checks of the surroundings. Workers should routinely inspect their areas for any signs of contamination or disorder, as an unclean workspace can harbor bacteria and pose risks to the products and employees alike. This continuous monitoring ensures that any potential sanitation issues are identified and addressed promptly, supporting a culture of cleanliness and accountability within the facility (Olatunji & Thanny, 2020; Synergy Insurance, 2023).

3.8 Receiving and Inspection

The respondents consistently check the quality and freshness of fish during the raw material inspection process, with 5 level of agreement. Receiving and inspection help maintain the freshness of the fish by ensuring that they are handled properly and stored at the correct temperature. This is particularly important for perishable products like fish, which can quickly spoil if not handled properly (Freshbyte, 2023). To streamline documentation, a digital system is recommended for recording the inspection of incoming shipments. The most common reason for rejecting raw materials is poor quality, which may include factors such as lack of freshness, physical damage, or improper handling during transportation (Freshbyte, 2023).

3.9 Temperature Control

The respondents indicated that they do not monitor temperatures continuously at each stage of processing, storage, and transportation. Instead, temperature readings were recorded once per shift. Using temperature controls minimizes the potential for harmful bacterial growth and toxin formation in food. Temperature controls either keep food entirely out of the danger zone or pass food through the danger zone as quickly as possible (Minnesota Department of Health, 2019). The primary challenge in maintaining appropriate temperatures throughout the processing chain is equipment malfunction, which can compromise temperature consistency. This issue poses a significant risk to product quality and safety, as deviations from optimal temperature conditions

may lead to spoilage or contamination (Minnesota Department of Health, 2019).

3.10 Hazard Analysis and Critical Control Points (HACCP)

HACCP is a crucial food safety system that employs systematic preventive measures to protect consumers from chemical, physical, and biological hazards throughout production and post-production processes. However, concerns arise from employees' lack of familiarity with HACCP principles, which is essential for identifying potential hazards, and the need for a more systematic approach to reviewing and updating the HACCP plan, despite regular documentation practices. To enhance HACCP effectiveness, organizations should conduct regular training sessions for staff, implement a review schedule for the HACCP plan, and foster a culture of safety that encourages active participation in food safety initiatives (Awuchi, 2023; Morya et al., 2022).

3.11 Sanitation Plan

A sanitation plan is crucial in food service preparation areas, ensuring regular cleaning of surfaces to minimize the risk of transferring bacteria or pathogens. It should identify equipment that requires cleaning in place, and all equipment must be routinely cleaned and inspected. The facility demonstrates impressive practices by cleaning work areas after each shift and employees consistently follow cleaning schedules, reflecting effective training in sanitation protocols. However, the lack of formal cleaning records presents a gap in accountability and traceability that should be addressed to enhance overall sanitation practices (Morya et al., 2022).

3.12 Cross-Contamination Prevention

The facility's procedures to prevent contact between raw and cooked seafood products, the use of a color-coding system for equipment and utensils, and the monthly review of cross-contamination prevention procedures demonstrate a proactive commitment to food safety. These practices align with WHO and FAO recommendations for reducing contamination risks in food handling and processing. The facility's commitment to maintaining a safe environment, reducing cross-contamination risks, and protecting consumer health is commendable (World Health Organization, 2024). Additionally, the facility uses a color-coding system for

equipment and utensils, a recognized method to minimize cross-contamination risks effectively. Color-coded tools and utensils provide a simple and effective visual reminder, helping employees to use appropriate equipment for each type of food product. This system, supported by the CDC as a preventive measure, reduces the likelihood of cross-contamination and safeguards food safety (Centers for Disease Control and Prevention, 2024). The facility also reviews its cross-contamination prevention procedures on a monthly basis, indicating a proactive commitment to food safety. According to the FAO, regular reviews of safety procedures are crucial for identifying and addressing emerging risks, especially in dynamic food production environments (Food and Agriculture Organization, 2024). By conducting monthly reviews, the plant can assess the effectiveness of its measures, make updates, and align with evolving best practices and regulatory requirements. This review process reflects a strong commitment to maintaining a safe environment, reducing cross-contamination risks, and ultimately protecting consumer health.

3.13 Quality Control

With respect to quality control, the respondents stated that they inspect the finished product in each batch to identify high-quality from the poor-quality products. They also dispersed the discarded products. There are numerous food safety criteria and quality control restrictions enforced by legislation or by large retailers/chains operating in the food industry. The most popular quality standard is HACCP, which was developed to address food safety by analyzing and controlling biological or physical threats across the supply chain. In addition, there is a need to implement and adhere to GMP throughout the food supply chain (HQTS, 2023).

3.14 Pest Control

The respondents undertake weekly pest inspections and believe that the procedures they take to ensure food safety vary in effectiveness. In their facility, the researchers failed to see any traps that could help control the presence of nuisance. The food industry is one of the most vulnerable segments, relying heavily on pest management to maintain high levels of food safety. Pests carry a vast range of pathogenic bacteria, viruses, and other species. They endanger the health of food processors and handlers, as well as customers (Termite, 2024).

3.15 Product Traceability

Maintaining product traceability through paper records is recommended. According to HACCP, the quality of food traceability records can impact the ability of the food business to quickly and correctly recall product from the marketplace. Additionally, having a good traceability system helps the manufacturer to improve quality, reduce costs, optimize processes, and ultimately improve the time-to-customer throughout the supply chain (Van Der, 2011; Cajo, 2024). The most common reason for losing traceability are nonfunctional marking systems and non-permanent markings or even the lack of any marking system. The facility records the ins and outs of their product, and conducts monthly test of the traceability system, which demonstrate a proactive approach towards quality assurance.

3.16 Food Allergen

Food allergy is the term used to describe an adverse immune response to food (Miettinen et al., 2001). The adverse immune response may take the form of, for example, a rash, vomiting, asthma, or, in severe cases, a fatal anaphylactic shock (Summa et al., 2016; Autio & Korkeala, 2004; Johansson et al., 2003). Based on the survey, they managed their allergic ingredients by proper labeling and storing. The effective management of hazards posed by allergens can only be achieved when designed into food manufacturing processes in particular, and overall food safety management systems in general (Sicherer, 2011). Manufacturers are required to list the ingredients used in their products in accordance with the law (Crevel, 2012).

3.17 Waste Management

Worldwide, approximately 1.3 billion metric tons of solid waste is being generated nowadays. This amount is nearly twice of that were being generated a decade before. It is estimated that solid waste generation will be doubled by 2025 (Ortolani & Pastorello, 2006). The amount of waste has been steadily increasing due to the increasing human population and urbanization. So, in the results, waste segregation and disposal procedures were clearly defined by the owner. Modern western waste management systems have rebuilt recycling rates over the last 20 years (Wilson et al., 2009; Siddique & Kaur, 2008). Disposal options can be categorized environmental impacts into six levels, from low to

high; namely, reduce, reuse, recycle, compost, incinerate and landfill (NIOSH, 2022).

3.18 Regulatory Compliance

In the regulatory compliance, the facility was aware of local, national and international regulations governing food safety and fish processing. Regulatory compliance checks were performed monthly ensuring that fish and fishery products are safe, wholesome, properly labeled, and of uniform quality. According to FAO, regulatory competent authority is in-charge of certifying fish plants and establishments, approving and monitoring HACCP-based in plant quality control programme, and certifying fish and fishery products before distribution. They ensure that all operations adhere to required safety standards and regulations. They agree the operating procedures are updated and reflected changes in regulations. By adhering to these practices, the facility demonstrates its commitment to regulatory compliance and the safety of its food products, thereby ensuring the trust of consumers and stakeholders alike (Ababouch et al., 2005).

3.19 Emergency Response

The respondents indicated that the facility conducts monthly emergency drills to assess employees' familiarity with emergency response plans. Regularly scheduled drills are essential for reinforcing preparedness and ensuring employees can respond effectively to emergencies. However, the inconsistent documentation practices, with options for either paper or digital records, suggest an area for improvement. Consistent documentation is important for accountability and reviewing past incidents to improve future responses (Johnson & Lee, 2021).

3.20 Training

The survey also examined the frequency and effectiveness of training on food safety, hygiene, and operational procedures among the working staff of the facility. The responses indicated that training was rarely conducted, therefore, the training's effectiveness may be low. Researches suggest that infrequent and ineffective training compromises safety and quality standards, as employees may lack updated knowledge and skills for best practices (Brown et al., 2019). Overall, these findings suggest a need for more consistent training sessions to enhance

workplace safety and operational compliance (Salawu et al., 2023).

3.21 Maintenance and Equipment Care

The survey revealed that the facility always maintains their equipment and machinery in good condition. Keeping machines reliable is essential for reducing downtime and production losses, improving operational effectiveness, guaranteeing worker safety, and prolonging equipment life. Routine maintenance procedures such as cleaning, lubrication, and calibration support reliable operation and steady performance. The survey found out that the facility addresses equipment issues immediately. This immediate action is more likely a form of predictive maintenance. Predictive maintenance is a modern preventive maintenance method that aims to improve equipment life expectancy, operational management, and manufacturing efficiency. Predicting failures can reduce downtime and unnecessary stops, while also lowering repair costs (Salawu et al., 2023). However, the survey also revealed that the facility does not document their equipment maintenance. Record-keeping is an important component of functional safety at all stages of a product's lifecycle. While design files and manufacturer's operation manuals are essential, it is also critical to retain records of all interactions with the machine during its use to maintain adequate functional safety in the long run (Wrinch & Keeler, 2020).

3.22 Environmental Monitoring

The facility conducts monitoring of air and water quality. Monitoring the food production environment is crucial for improving food safety and quality, as well as limiting the possibility of pathogen transmission. Cleaning and sanitation techniques are designed to target the food processing environment and equipment, which are often identified as the underlying cause of many foodborne illness outbreaks. Cleaning and sanitizing food production areas are critical preventive measures for lowering the risk of foodborne illness from contaminated food. Many foodborne outbreaks have been linked to cross-contamination from food-contact surfaces in food manufacturing facilities. Food spoilage microorganisms can negatively affect product quality by causing off-odors, off-flavors, or deterioration in food texture, resulting in reduced product shelf life (Washington DC, 1991). However, the facility also stated that they do not record their environmental safety monitoring.

3.23 Record Keeping

The respondents' statement about the lack of consistent record keeping aligns with the challenges highlighted in the article, "How to Ensure Quality Control in Fish Processing." The article emphasizes the importance of traceability, which is the ability to track the movement of fish products from the source to the final destination. It states that traceability is essential for product recall in case of contamination or quality issues. This suggests that without proper record keeping, it would be difficult to trace the origin of a contaminated product, potentially leading to a wider and more dangerous recall. The article also mentions that "Quality is difficult to define since it means different things to different people." This implies that relying solely on memory for quality control practices can lead to inconsistencies and a lack of standardized documentation, making it challenging to assess and improve quality over time (Freshbyte, 2023). The records, if properly maintained, can help employers, workers, and Occupational Safety and Health Administration evaluate the safety of a workplace, understand industry hazards, and implement worker protections to reduce and eliminate hazards, thus, preventing future workplace injuries and illnesses (Food and Agriculture Organization, 2024).

3.24 Areas for Inspection in the Visited Facility

Areas for inspection in a fish processing facility presents a comprehensive overview of key areas for inspection, highlighting both the description of each area and the remarks made by the inspectors (US Food and Drug, 2022). Analyzing the results revealed both strengths and weaknesses in the facility's operations. The facility demonstrated a commitment to ensure the quality and freshness of incoming fish batches through rigorous inspection upon arrival, emphasize hygiene practices in storage facilities and along the processing line, in place HACCP plan, implement quality control measures, aware of and adhere to local and national regulations governing food safety and fish processing, and in place emergency response plans. However, the facility needs to improve its practices in several areas. The lack of consistent documentation, the insufficient temperature control, and the inadequate handwashing practices are particularly concerning. These issues could potentially lead to foodborne illnesses, product

recalls, and compliance issues. To improve its food safety practices and protect the health of its employees and consumers, the facility should prioritize addressing these issues by investing in reliable temperature monitoring systems, conducting regular training sessions for staff on HACCP principles, implementing a system for maintaining detailed records of production and maintenance, encouraging employees to wash their hands frequently during shifts, installing traps and implementing a regular pest control program, and ensuring that all finished products are properly labeled with accurate product information, nutritional content, and any required regulatory statements (US Food and Drug, 2022).

4. CONCLUSION

The survey showed that the smoked fish production facility was committed to hygiene, safety, and quality control but faces some key challenges. While personal hygiene and PPE use are prioritized, the lack of adequate handwashing stations and infrequent handwashing among workers are concerning and need attention to reduce contamination risks. The facility does consider temperature control, pest management, and product traceability, but issues like equipment malfunctions, inconsistent record-keeping, and the absence of formal sanitation documentation remain. Training on food safety and hygiene was infrequent, and more regular, effective sessions are needed to ensure workers are up to date on best practices. To improve this study, it was recommended to document a larger number of smoked fish production facilities to ensure a more comprehensive representation of the existing establishments in the area.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Authors hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during the writing or editing of manuscripts.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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