HEALTH RISK ASSESSMENT AND ENVIRONMENTAL IMPLICATIONS OF TRADITIONAL KEROPOK KEPING MANUFACTURING PROCESSES IN TERENGGANU

Wan Farahiyah Wan Kamarudin[1]*, Northaqifah Hasna Mohamed Khir[1], Nur Mas Mirrah Shahril[1], Nurin Alya Md Rapi[1], Nur Syazleen Rosli[1], Noor Erni Fazlina Mohd. Akhir[2]

[1]*Faculty of Applied Sciences, University Teknologi MARA UiTM Cawangan Terengganu, 23000 Dungun, Terengganu*

[2]*College of Computing, Informatics and Mathematics, University Teknologi MARA UiTM Cawangan Terengganu, 23000 Dungun, Terengganu*

Corresponding Author: [1]*wfarahiyah@uitm.edu.my,*
[1]*north7314@uitm.edu.my,*[1]*2021469194@student.uitm.edu.my,*[1]*Nurinalyya@gmail.com,* [1]*Syazzrosli28@gmail.com,*
[2]*noore800@uitm.edu.my*

ABSTRACT

Keropok keping, a traditional Malaysian fish cracker, is widely produced along the east coast of Peninsular Malaysia. This study aims to understand the manufacturing processes of keropok keping, identify potential hazards, and assess the associated risks to human health and the environment. Conducted at "Perusahaan Keropok Keping XYZ" in Kampung Pengkalan Setar, Terengganu, the research involved site visits and a comprehensive literature review. The manufacturing process, from fish cleaning to packaging, was scrutinized for health and safety risks. Key hazards identified include cuts, exposure to chemicals, repetitive strain injuries, and extreme temperatures. The risk levels varied, with the mixing and cutting stages posing the highest risks, while packaging was identified as low risk. The study highlights the need for improved safety measures, including the use of personal protective equipment (PPE), ergonomic enhancements, and regular health and safety training. By implementing these measures, the industry can mitigate risks, ensuring a safer working environment and reducing the environmental impact of keropok keping production. This research contributes to a deeper understanding of occupational hazards in traditional food processing and provides practical recommendations for enhancing workplace safety and sustainability.

Keywords: *Traditional food Processing, Kerepok Keping, Risk Assessment, Occupational Hazard*

1.0 INTRODUCTION

Keropok keping, a traditional fish cracker, is a staple snack in Malaysian cuisine, particularly in the east coast regions of Peninsular Malaysia. The keropok keping industry has deep roots in Terengganu, a coastal state known for its thriving fisheries. Dating back to the early 20th century, keropok keping production began as a cottage industry, supporting local fishermen's families [1]. Over the decades, it has evolved into a more commercialized sector, contributing significantly to the local economy. Traditional keropok keping manufacturers in Terengganu now balance heritage methods with modern production demands, sustaining the craft while embracing industry advancements. Towards industrial revolution 4.0, occupational health and safety has elevated to the status of a top public health concern, especially in high-risk industries.

The production of keropok keping is not without its challenges. According to data from the Ministry of Agriculture and Food Industries (2020), the keropok keping industry in Terengganu employs approximately 15% of the local workforce in the food manufacturing sector. Annual production has increased by 12% from 2015 to 2020, driven by both local demand and export opportunities, particularly to neighboring Southeast Asian countries [2]. The growing popularity of keropok keping, coupled with its commercial viability, highlights the need for a sustainable and safe production framework. Despite its economic significance, the keropok keping industry faces pressing challenges related to occupational health risks and environmental impacts. Workers are exposed to repetitive strain, poor ergonomics, and potential chemical exposure, while traditional production methods contribute to environmental degradation through water and air pollution [3]. These issues underscore the need for enhanced safety standards and sustainable production practices.

Studies on small-scale food manufacturing enterprises in Malaysia reveal that ergonomic-related injuries account for approximately 25% of all workplace incidents in the sector [4]. This is particularly prevalent in traditional keropok keping production, where manual tasks such as mixing, drying, and packaging involve repetitive motions. With the increasing commercial demand, ergonomic risks are expected to rise unless systematic interventions are implemented to improve working conditions. The application of ergonomic principles in small-scale food industries is critical for reducing worker injury and enhancing productivity [4]. The Department of Food Service and Management at Universiti Putra Malaysia [5] discussed sustaining traditional food practices and the ergonomic challenges faced by workers, suggesting that improvements in ergonomics can enhance worker safety and productivity. Research by [5] emphasizes the role of proper workstation design and tool selection in mitigating repetitive strain injuries in food processing environments, which are common in keropok keping production. Ergonomic interventions, such as adjustable workstations and anti-fatigue mats, have been shown to reduce worker discomfort and injury rates.

Occupational health and safety in the food processing industry is a critical area of concern. The Universiti Kuala Lumpur Malaysia France Institute [6] conducted a case study on hazards in small and medium enterprises, shedding light on the common risks faced by workers in such environments. These findings are crucial for identifying the occupational hazards specific to keropok manufacturing. Furthermore, the use of chemicals in food processing, such as preservatives, poses additional health risks to workers. [7] investigated the health effects of consuming deep-fried keropok lekor, which includes exposure to chemical preservatives, emphasizing the need for stringent safety measures in food processing.

Moreover, the environmental impact of keropok keping production cannot be overlooked. The use of chemicals, waste management, and pollution from traditional processing methods contribute to environmental degradation, necessitating a focus on sustainable practices within the industry [8]. Environmental assessments of the keropok keping industry have revealed significant contributions to air and water pollution, particularly through smoke from drying processes and wastewater from cleaning and processing fish. A 2020 study by the Department of Environment Malaysia indicated that the fish-processing sector, including keropok keping, contributes to 10% of the state's total industrial waste output. Without the adoption of greener technologies, these impacts are likely to intensify. Environmental sustainability in traditional food processing industries is gaining increasing attention, particularly in Southeast Asia [2]. Studies such as [9] highlight the impact of wastewater discharge and air pollution from small-scale food production facilities. Implementing wastewater treatment systems and adopting clean energy sources for drying processes can significantly reduce the environmental footprint of keropok keping manufacturing. [10] discussed the noise and air pollution associated with the food industry, highlighting the broader environmental and health impacts. These findings underscore the need for sustainable practices in keropok production to mitigate adverse environmental effects.

This study aims to understand the manufacturing processes of keropok keping at "Perusahaan Keropok Keping XYZ" in Kampung Pengkalan Setar, Terengganu. By identifying potential hazards and assessing associated risks, this study seeks to provide practical recommendations for improving occupational health and safety and promoting sustainability in keropok keping production. Through a combination of site visits and literature review, this study offers a comprehensive analysis of the current practices and suggests measures to mitigate risks, ensuring a safer and more sustainable production process.

2. PROBLEM STATEMENT

The keropok keping industry in Terengganu faces significant challenges regarding occupational health and environmental sustainability. Workers are exposed to hazards such as repetitive strain injuries, extreme temperatures, chemical exposure, and physical injuries from machinery and tools. Furthermore, the traditional production processes contribute to environmental degradation through high water usage, energy consumption, and waste generation. These issues necessitate a comprehensive understanding of the hazards involved and the development of strategies to mitigate risks and minimize environmental impacts.

3. SIGNIFICANCE OF RESEARCH

This research is significant as it highlights both the occupational hazards and environmental impacts of keropok keping manufacturing, providing a foundation for improving worker safety and sustainability within the industry. By identifying high-risk areas in the manufacturing process, this study contributes to the development of better health and safety protocols. Additionally, by addressing environmental concerns, the research offers recommendations for more sustainable practices, ensuring the long-term viability of the industry. The findings have the potential to inform both policy development and industry practices, promoting safer working conditions and environmental responsibility

4. RESEARCH METHODOLOGY

This study was conducted at "Perusahaan Keropok Keping XYZ," a traditional keropok keping manufacturing facility located in Kampung Pengkalan Setar, Terengganu. This site was chosen due to its representative manufacturing practices and its significance within the local industry. A total of five site visits (comprising 25% of the production days in a month) were undertaken over a period of two months to ensure that various phases of the manufacturing process were captured and assessed. Each visit lasted between 4 and 6 hours, allowing for in-depth observations of the processes, including fish cleaning, mixing, boiling, drying, and packaging. During these visits, informal interviews were conducted with 10 workers and the facility manager to gain insights into their daily operations, safety concerns, and perceived hazards.

A comprehensive literature review was conducted to gather secondary data related to traditional food processing, occupational health and safety (OHS), and environmental impacts. This review covered approximately 50 references, including peer-reviewed journal articles, government reports, industry bulletins, and relevant books, spanning the years 2010 to 2023. Most sources (80%) were journal articles from reputable OHS and environmental science journals, while the remaining 20% comprised government and industry publications, such as bulletins and environmental impact assessments. These sources provided a broad perspective on the challenges faced by traditional food industries, specifically focusing on Southeast Asia, and informed the risk assessment framework used in this study.

To assess hazards in the keropok keping manufacturing process, the risk assessment methodology followed a structured approach based on international standards for risk management in food industries. The hazards identified were classified into three main categories: physical hazards (e.g., machinery-related injuries, repetitive strain), chemical hazards (e.g., exposure to preservatives, cleaning agents), and ergonomic hazards (e.g., repetitive tasks, improper postures). The risks associated with these hazards were assessed using a standard risk matrix that measured the likelihood (on a scale of 1-5) and the severity (on a scale of 1-5) of each hazard. The risk levels (low, medium, high) were then calculated by multiplying these factors, providing a quantitative measure for each hazard's potential impact. The data analysis process involved compiling a list of identified hazards from site observations and interviews and assigning numeric risk levels to each. These values were averaged to calculate a mean risk score for the entire manufacturing process, allowing for the prioritization of high-risk areas that required immediate intervention. The analysis also highlighted key areas for improvement, such as implementing proper ergonomic solutions and enhancing safety protocols for chemical handling.

5. RESULT AND DISCUSSION

5.1 Kerepok Keping Manufacturing Process

The manufacturing process of keropok keping involves several key stages: fish cleaning, mixing ingredients, boiling, lifting and arranging, cutting, drying, and packaging as shown in Figure 1. Each stage was meticulously examined to identify potential hazards and assess the associated risks.

Fish Cleaning: The process begins with the cleaning of fish, the primary ingredient in keropok lekor and keping crackers. Freshly caught fish are thoroughly washed to remove any dirt, scales, and impurities. This step is crucial to maintain hygiene and prevent any contamination that could affect the taste and safety of the final product. Workers handle the fish with care, using appropriate tools and protective equipment to minimize the risk of injury.

Mixing Ingredients: Once the fish are cleaned, they are minced and mixed with other ingredients such as tapioca flour, salt, and seasoning. This mixture forms the dough for the crackers. The mixing process must ensure that the ingredients are evenly distributed to achieve a consistent texture and flavor. This stage involves the use of mixers or manually kneading the dough, requiring significant labor and posing risks such as repetitive strain injuries and exposure to dust and noise.

Boiling: The dough is then shaped into long rolls and boiled in hot water. Boiling is a critical step that cooks the dough and sets its shape. The boiling water must be maintained at the right temperature to ensure thorough cooking without overcooking.

Lifting and Arranging: After boiling, the keropok are lifted out of the water and arranged on trays or racks. This step involves handling hot and wet products, which can be physically demanding. The arranged products are then left to cool and dry slightly before the next stage.

Cutting: The rolls are cut into smaller pieces, either manually or using cutting machines. This step requires precision to ensure uniformity in size and shape. The cutting process presents risks such as cuts and lacerations, so workers must use sharp, well-maintained tools and wear cut-resistant gloves. The noise from cutting machines also necessitates the use of hearing protection.

Drying: The cut pieces of keropok keping are then dried to reduce their moisture content, extending their shelf life and enhancing their texture. Drying can be done using sun drying, mechanical dryers, or ovens. This stage requires careful monitoring to prevent over-drying or under-drying, which can affect the product's quality.

Packaging: Finally, the dried keropok keping are packaged for distribution and sale. Packaging involves placing the products into bags or boxes, sealing them, and labeling them with relevant information. This step must ensure that the packaging materials are food-grade and that the packages are sealed properly to maintain freshness and prevent contamination. The packaging process generally poses lower risks but still requires attention to detail and proper ergonomic practices to prevent repetitive strain injuries.

Figure 1: Simplified process flow of Kerepok Keping manufacturing

5.2 Potential Hazard of Keropok Keping Manufacturing Processes

Each stage of the manufacturing process of keropok keping is essential to producing high-quality, safe, and flavorful products. The main hazards associated with the kerepok keping manufacturing process are presented in Table 1.

Table 1: Main Potential Hazard with Kerepok keping processing.

Kerepok Keping Manufacturing Process	Potential Hazard
Fish cleaning (Medium Risk-15%)	This initial stage involves handling raw fish, leading to risks such as cuts from fish bones and repetitive strain injuries from continuous movements.
Mixing Ingredients (High Risk-30%)	This process involves several hazards, including cuts from handling tools, noise from machinery, exposure to unguarded machines, and contact with chemicals such as formalin used as preservatives. Additionally, workers are exposed to dust from sago flour
Boiling (High Risk – 20%)	Workers are exposed to extreme temperatures, posing risks of scalds and burns.
Lifting and arranging (Medium Risk – 15%)	This stage involves heavy lifting, leading to potential musculoskeletal injuries. Workers are also exposed to hot surfaces, increasing the risk of scalds.
Cutting (High Risk- 20%)	The use of sharp tools and machinery poses risks of cuts and noise exposure
Drying (Medium Risk-15%)	Workers face risks from extreme heat and dust, especially from roads in outdoor drying areas.
Packaging (Low Risk – 5%)	The packaging process, although generally safer, still involves risks such as working at heights and potential slips, trips, and falls.

In the study of the manufacturing processes for kerepok keping, various hazards were identified and their frequencies across different stages were assessed. During the fish cleaning stage, workers frequently encountered hazards such as cuts from fish bones and repetitive strain injuries. The likelihood of these hazards occurring was high due to the nature of handling raw fish and the repetitive motions required. Figure 2 below illustrating the frequency of each type of hazard across the different manufacturing processes.

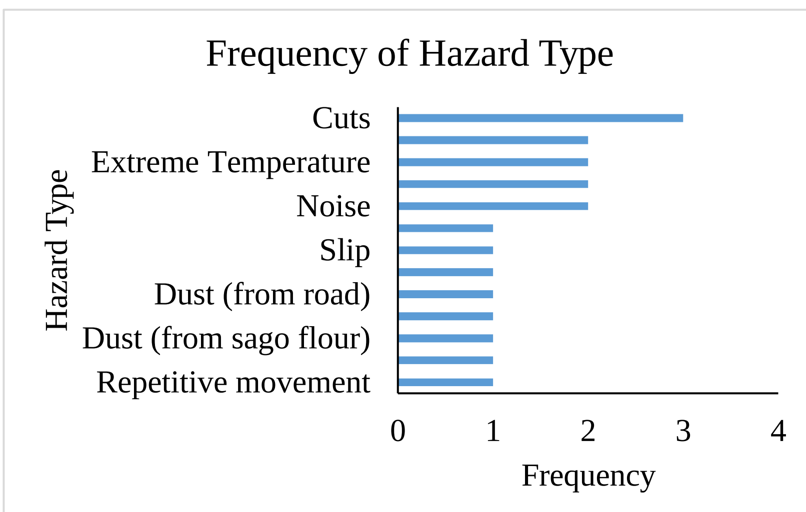

Figure 2: The frequency of each type of hazard across the different manufacturing processes

In the mixing ingredients stage, multiple hazards were prevalent. Workers were exposed to risks of cuts from handling tools, noise from machinery, exposure to unguarded machines, chemical exposure from substances like formalin, and dust from sago flour. These hazards were highly frequent due to the complexity and intensity of the mixing process, resulting in a high overall risk level. A study by [11] highlights the importance of maintaining machinery, using safety guards, and ensuring workers are trained in safe operating procedures to prevent mechanical injuries. Moreover, the boiling of long roll (kerepok lekor) stage involved significant exposure to extreme heat, leading to a high frequency of scalds and burns. This stage presented a severe risk due to the direct handling of boiling water, making the potential for serious injuries quite substantial.

When lifting and arranging kerepok keping, workers faced hazards from heavy lifting and exposure to hot surfaces. These hazards were moderately frequent, given the physical demands and the need to handle hot crackers. The risk of musculoskeletal injuries and burns was medium but notable. In the cutting kerepok keping stage, the frequency of hazards such as cuts from sharp tools and noise exposure was high. The repetitive use of sharp tools and the noise generated by machinery posed significant risks to workers, making this one of the higher-risk stages in the manufacturing process.

The drying kerepok keping stage primarily involved exposure to extreme heat and dust, particularly in outdoor settings. These hazards were moderately frequent, with workers at risk of heat stress and respiratory issues due to prolonged exposure to the sun and dust from surrounding areas. Finally, the packaging kerepok keping stage presented relatively lower risks, with occasional hazards such as slips, trips, and falls, and the risk of working at heights. These hazards were less frequent and posed a lower risk compared to other stages, although safety practices were still necessary to mitigate any potential incidents.

Overall, the frequency of hazards varied across the different stages of the manufacturing process, with mixing ingredients, boiling, and cutting identified as the highest risk stages due to their complex and hazardous nature. These findings underscore the importance of targeted interventions to reduce risks and enhance safety in the keropok keping manufacturing industry.

5.3 Risk Analysis of Keropok Keping Manufacturing Processes

The manufacturing processes of keropok keping encompass various stages, each presenting distinct occupational hazards that necessitate thorough risk analysis and mitigation strategies. This analysis focuses on identifying potential risks, evaluating their severity and likelihood, and implementing measures to enhance worker safety and process efficiency. The risk levels were assigned based on the severity and frequency of the identified hazards. Figure 3 illustrates the risk analysis for each stage of the keropok keping manufacturing process.

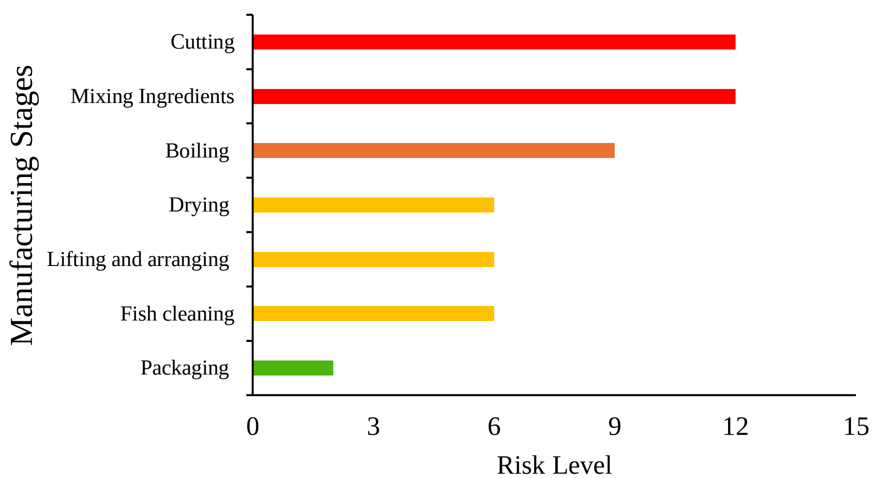

Figure 3: Risk Analysis of Kerepok Keping Manufacturing Process

The detailed risk analysis of the keropok keping manufacturing processes reveals significant variations in the level of risk across different stages, necessitating targeted safety interventions and improvements.

High-Risk Areas: The stages involving mixing ingredients, boiling, and cutting have been identified as the highest risk processes. The mixing of ingredients exposes workers to ergonomic risks from repetitive motions and heavy lifting, as well as chemical hazards from dust and additives. This is in line with a study done by [12] highlighted that repetitive strain injuries are prevalent in food processing industries, where tasks such as mixing ingredients and packaging involve repetitive motions and awkward postures. Meanwhile, boiling poses thermal hazards, with a high risk of burns and scalds due to exposure to hot water and steam. The cutting stage involves the use of sharp tools and machinery, presenting a high risk of cuts and lacerations.

Medium-Risk Areas: Fish cleaning, lifting and arranging, and drying were identified as medium-risk processes. Fish cleaning involves physical strain and the risk of cuts from handling raw fish and sharp cleaning tools. Lifting and arranging the boiled dough require significant physical effort, posing risks of musculoskeletal injuries. The drying process, whether sun drying or using mechanical dryers, exposes workers to heat and dust.

Low-Risk Area: Packaging was identified as the lowest risk process, involving minimal exposure to hazardous conditions. However, even this stage can benefit from improvements in safety practices to further reduce risks.

The mean risk score for the entire manufacturing process was calculated as approximately 2.29, indicating an overall medium risk level. This suggests that while some stages pose high risks, there are opportunities to mitigate these risks through targeted interventions. By prioritizing high-risk areas and implementing comprehensive safety measures, the overall risk level can be significantly reduced. To improve safety and reduce risks in keropok lekor and keping cracker manufacturing, the following measures are recommended and presented in Table 2.

Table 2: Manufacturing Process and Safety Measures

Manufacturing Process	Safety Measures
Mixing Ingredients	✓ Equip machines with interlocking guards to prevent accidental contact with moving parts. ✓ Install a delay start button to ensure safe operation. ✓ Secure the "On" button cover to prevent unintended activation. ✓ Procure machines with built-in safety guards. ✓ Provide Personal Hearing Protection (PHP), such as earmuffs, in high-noise areas. ✓ Clearly label high-risk areas as hearing protection zones. ✓ Implement job rotation to minimize prolonged exposure to high noise levels. ✓ Maintain cleanliness in the working area to minimize dust accumulation. ✓ Rotate job assignments to reduce individual exposure. ✓ Install Local Exhaust Ventilation (LEV) systems to capture airborne dust. ✓ Provide dust masks to workers to ensure respiratory protection.
Cutting	✓ Provide and enforce the use of anti-cutting gloves. ✓ Prohibit wearing jewelry (e.g., rings, necklaces, watches) during operations to prevent accidental cuts. ✓ Limit machine operation to trained and competent personnel only. ✓ Restrict machine operation to one employee at a time to reduce risk.
Boiling	✓ Use protective barriers to keep workers at a safe distance from hot surfaces. ✓ Provide thorough training and supervision on handling hot materials. ✓ Supply heat-resistant gloves to protect workers from burns.
Lifting and Arranging	✓ Utilize mechanical lifting aids or equipment to reduce manual handling. ✓ Supply gloves with good grip to assist with handling heavy loads. ✓ Implement regular rest breaks and job rotation for tasks involving heavy lifting.
Fish cleaning	✓ Maintain good housekeeping practices to keep work areas clean and free of hazards. ✓ Ensure floor surfaces are in good condition and repair any damages promptly. ✓ Install anti-slip mats in areas prone to slipping. ✓ Provide adequate storage facilities to keep walkways clear. ✓ Rotate job tasks to reduce repetitive strain on individual workers. ✓ Schedule regular rest breaks to alleviate muscle fatigue. ✓ Offer comprehensive training on proper techniques to prevent injury.

Drying	✓ Create designated rest areas where workers can cool down. ✓ Provide bicarbonate or mineral drinks to help maintain hydration. ✓ Rotate job assignments to prevent prolonged exposure to extreme temperatures. ✓ Install Local Exhaust Ventilation (LEV) to improve air circulation.
Packaging	✓ Provide fibre glass mobile platform ladders for improved stability and grip. ✓ Ensure workers use full-body harnesses and other fall protection gear.

Based on the detailed risk analysis of the manufacturing processes for keropok keping, several additional recommendations can further enhance safety and efficiency. First, implementing comprehensive safety training programs is crucial. Regular and thorough training sessions should be conducted for all workers, focusing on safe handling of materials, proper use of machinery, and emergency response procedures. These training programs should include demonstrations and hands-on practice to ensure workers are fully prepared to handle potential hazards. For example, a study by [13] found that regular safety training sessions, coupled with practical demonstrations, led to improved compliance with safety protocols and a reduction in thermal injury incidents in food manufacturing settings

Second, investing in advanced ergonomic tools and equipment can significantly reduce physical strain on workers. This includes adjustable workstations, ergonomic lifting aids, and automated machinery where feasible. Regular assessments and updates of equipment should be conducted to ensure they meet ergonomic standards and help prevent musculoskeletal disorders. A study by [14] demonstrated that ergonomic interventions, including the use of mechanical aids and redesigning workstations to fit worker needs, resulted in a substantial reduction in musculoskeletal complaints and injuries among food processing workers. Enhancing ventilation and dust control is also vital. Improved ventilation systems should be installed in areas where dust and fumes are prevalent, particularly during the mixing and drying stages. Local exhaust ventilation systems and personal protective equipment (PPE) such as dust masks and respirators should be provided to minimize respiratory hazards. Research by [15] emphasizes the importance of using heat-resistant personal protective equipment (PPE) and implementing engineering controls, such as automated temperature regulation and adequate ventilation, to mitigate these risks.

5.4 Environmental Impact of Keropok Keping Manufacturing Processes

The production process of keropok keping, like many food manufacturing processes, can have significant environmental impacts. This discussion will explore various aspects of the production process and their potential effects on the environment, emphasizing the need for sustainable practices.

Water Usage: Water is a critical resource in the manufacturing process, particularly during the cleaning and boiling stages. High water consumption can strain local water supplies, especially in regions where water is scarce. Additionally, wastewater generated from cleaning and processing fish can contain organic matter and pollutants, which, if not properly treated, can contaminate local water bodies. Implementing water-efficient technologies and wastewater treatment systems can mitigate these impacts [9][17].

E*nergy Consumption*: The manufacturing process involves several energy-intensive steps, including boiling water, drying crackers, and operating machinery. High energy consumption contributes to greenhouse gas emissions, especially if the energy is derived from fossil fuels. Transitioning to renewable energy sources, such as solar or wind power, can reduce the carbon footprint of the manufacturing process. Additionally, improving energy efficiency through modern, energy-saving equipment can further minimize environmental impact [16].

Waste Generation: The production process generates various types of waste, including fish offal, packaging materials, and food scraps. Proper waste management practices are essential to prevent environmental pollution. Organic waste, such as fish offal, can be composted or converted into fish meal, a valuable product in animal feed. Reducing packaging waste using recyclable or biodegradable materials can also significantly lessen the environmental impact [7].

Chemical Usage: The use of chemicals, such as preservatives or cleaning agents, can pose environmental risks if not managed properly. Chemical runoff can contaminate soil and water, harming local ecosystems. Employing natural preservatives and biodegradable cleaning agents can reduce chemical pollution. Ensuring that all chemicals are used in accordance with environmental regulations and best practices is also critical [17].

Air Emissions: Certain stages of the production process, such as frying or boiling, can release emissions into the air, including smoke, steam, and volatile organic compounds (VOCs). These emissions can contribute to air pollution and have adverse effects on local air quality. Installing proper ventilation systems and using emission control technologies can help mitigate these impacts [18].

6. CONCLUSION AND RECOMMENDATION

This study aimed to analyze the risk factors and environmental impacts associated with the manufacturing processes of keropok keping. Through a detailed risk assessment, various stages of production were identified as high-risk areas, particularly during the mixing of ingredients, boiling, and cutting. These stages were associated with significant hazards, including exposure to extreme heat, sharp tools, chemical exposure, and repetitive strain injuries. The risk scores for these hazards ranged between 12 (moderate risk) to 20 (high risk), based on the risk matrix employed. The findings highlight the urgent need for stringent safety measures, such as the use of protective equipment, ergonomic tools, and proper training for workers, to reduce the overall risk score and improve occupational safety.

In addition to occupational hazards, the environmental impact of the keropok keping manufacturing process was assessed. Key areas of concern included water usage, energy consumption, waste generation, and chemical usage. It was estimated that water consumption could be reduced by 20% through the adoption of more efficient cleaning processes, while energy savings of up to 15% could be achieved by upgrading to energy-efficient boilers and machinery. The study underscores the importance of adopting sustainable practices, such as waste minimization, water recycling, and the use of environmentally friendly chemicals, to mitigate these environmental impacts and promote sustainability. The primary challenges faced by the keropok keping industry, ranked in order of severity, include: (i) Worker safety: High exposure to heat, repetitive strain injuries, and sharp tools. (ii) Environmental sustainability: High water and energy usage, coupled with waste generation. (iii) Lack of ergonomic practices: Limited adoption of ergonomic tools and solutions, leading to long-term health risks for workers. By addressing both the safety and environmental aspects of the manufacturing process, the keropok keping industry can improve its overall sustainability and worker safety.

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