RESEARCH ARTICLE

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Quality Risk Management in Food Industry for Enhanced Hazard Identification and Improvement in Safety Management

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Abstract

In the realm of the food production industry, 'food safety' is often synonymous with the protocols governing the processing of edibles. However, it extends beyond these procedures, encompassing the cultivation of a pervasive culture of workplace safety across all divisions in collaboration with the safety department, aimed at averting accidents. Regrettably, the occupational safety and health (OSH) concerns within the food industry have historically received less attention compared to sectors like manufacturing, transportation, mining, and construction. Startling statistics from diverse countries underscore the relative neglect of OSH issues within the food industry, even though they are fundamental to the well-being of its workforce. This study delves into the methodologies employed for imparting safety awareness to personnel within various divisions of the food production industry. With expert opinions underscoring those unsafe working conditions, rather than human negligence, are responsible for a substantial portion of industrial accidents, it is essential to address this critical aspect. Divisions such as human resources, research and development, production, and safety play pivotal roles in the food production landscape. The initial and pivotal step involves the identification of occupational hazards that might contribute to accidents and injuries. This identification process enables the industry to eliminate or mitigate these risks, ultimately paving the way for a secure and safe work environment for its workforce. In this light, this work offers a comprehensive overview of occupational risks, accompanied by practical recommendations for their reduction. It introduces an array of techniques, including the identification of the highest-risk tasks for the day and the implementation of integrated workplace activities, designed to enhance risk reduction by adhering to layers of protection and other control measures.

Keywords: Food industry (FI), Hazard identification (HI), Quality Risk Management (QRM), Milk Products (MP), Industrial Accidents Risk Mitigation (IARM).

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Introduction

The food production industry, a cornerstone of modern society, serves as a vital source of sustenance for people worldwide. Beyond its role in nourishing millions, this industry bears the significant responsibility of ensuring the health and safety of its workforce. A steadfast commitment to health and safety within this sector is not merely a regulatory necessity but an ethical and operational imperative. The significance of this commitment extends beyond mere compliance with regulations; it entails the creation of a workplace culture that values safety, nurtures talent, encourages employee engagement, and ultimately fosters productivity. An effective workplace safety program goes beyond rulebooks and regulations, seeking to transform the work environment into one that prioritizes safety and reduces the risk of accidents. To achieve this, food enterprises must develop comprehensive safety plans that outline health and safety rules and procedures. These plans set the foundation for a culture where every individual within the organization not only understands the guidelines but actively participates in their implementation. The food production industry encompasses a diverse range of activities, each presenting its unique set of challenges and risks. While certain safety issues and hazards are prevalent throughout the industry, others are specific to particular segments or processes. What unifies all

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divisions of the food industry is the unassailable requirement for high standards of health and cleanliness, as the products they create have the potential to directly impact the health and well-being of consumers. Regrettably, workplace accidents are an inherent risk within the food production industry, affecting the well-being of employees and their coworkers. These incidents have far-reaching consequences, encompassing physical harm, emotional trauma, disability, stress, and even job loss or change. Moreover, the financial implications of workplace accidents can be crippling, encompassing both direct and indirect costs. Direct costs involve expenses like claim filing fees and increased insurance rates, while indirect costs include property damage, expenses associated with hiring and training temporary personnel, and production delays leading to significant financial losses. In essence, safeguarding the well-being of employees is not a mere obligation; it is an imperative that transcends legal compliance, directly impacting the viability and prosperity of food production businesses. In the pages that follow, this study delves into the realm of hazard and risk identification, the risk assessment process, and the identification of the highest risk tasks in daily practices within the food production industry. It aims to shed light on the critical importance of safety in this essential sector, emphasizing the need for comprehensive safety programs and holistic approaches to occupational health and safety. The food production industry is a sprawling landscape, comprising various subsectors such as meat processing, dairy, baking, and fresh produce, each with its distinct processes and safety challenges. The diversity in food production processes means that there is no one-size-fits-all approach to occupational health and safety. Each sector faces unique hazards, which necessitates tailored safety protocols. In this industry, ensuring the safety of both employees and consumers is paramount. Contaminated or unsafe food can lead to outbreaks of food borne illnesses, which can have severe public health consequences. Hence, it is not only the well-being of the employees at stake but also the health of the broader population that depends on the industry for safe and nutritious food products. The food production industry is subject to stringent regulations and standards designed to safeguard the quality and safety of food products. Regulatory bodies, such as the Food and Drug Administration (FDA) in the United States and the European Food Safety Authority (EFSA) in the European Union, set stringent guidelines. These regulations create a framework for safety practices, which companies must adhere to rigorously to maintain public trust and avoid legal repercussions. Cases of contamination or unsafe handling can lead to massive product recalls and even business closures. The economic implications of a safety breach extend beyond the immediate financial costs and can have long-term repercussions. A workplace with a strong focus on safety tends to attract and retain skilled workers. Employees are more likely to stay in an environment where their well-being is prioritized. A safe workplace encourages a positive atmosphere and can boost employee morale and productivity, ultimately benefiting the company's bottom line.

The recent research findings in the food industries are to provide the guidelines for problem identification in food products. Helen Onyeaka, Dassalegn Daraje Jalata, "Mitigating Physical hazards in food processing: Risk assessment and preventive strategies. This study is about the physical contaminants in food processing areas like glass pieces, plastic material, metal and so on. This study provides the hazards mitigation points to ensure the safety of food in industries. Vijay Shankul, "Everyone frequently assumes that the term "food safety, refers to the protections and procedures that must be followed while food is being processed. However, it also refers to promoting a culture of safety at work in all departments in coordination with the safety department in a business to prevent accidents. Historically, the food industry's occupational safety and health (OSH) concerns have not gotten as much attention as those of the manufacturing, transportation, mining, and construction industries. According to statistics from numerous countries, the least attention has been paid to OSH issues in the food business compared to other manufacturers. This study examines the methods used to teach personnel in the food industry's various divisions for safety. The expert claims unsafe working conditions, not human negligence, are to blame for at least 80% of industrial accidents. The human resources, research and development, production, and safety divisions are a few that come to mind. Finding occupational hazards is an important first step in figuring out what caused the accidents. By doing this, the risks will be eliminated, and a safe working environment for the staff will be established. The current work offers a summary of occupational risks together with suggestions for lowering those risks and using various techniques, such as the job with the highest risk for the day and integrated workplace activity, to identify and lower task risk by adhering to the layer of protection and other control measures. Maura Mengoni, Marco Matteucci, and Damiano Raponi, " The importance of integrating ergonomics, safety, and efficiency in the context of factory operations has been a subject of significant research attention. In this regard, the work of Maura Mengoni, Marco Matteucci, and Damiano Raponi presents a compelling approach. In their paper, "A Multipath Methodology to Link Ergonomics, Safety and Efficiency in Factories", the authors emphasize the need to harmonize these crucial factors within the factory environment. This study provides a foundation for understanding the challenges and opportunities in achieving a balanced synergy between ergonomics, safety, and efficiency, which is of paramount significance in the food production industry. Understanding human behaviour and psychology is integral to safety programs. In the food production industry, employees often perform repetitive tasks, which can lead to complacency and increased risk. Therefore, addressing human factors in safety measures is crucial in minimizing the chances of accidents and promoting

a culture of vigilance. This study will delve into the critical aspects of hazard and risk identification, the risk assessment process, and the identification of the highest risk tasks in the daily practices of the food production industry. By doing so, it seeks to highlight the necessity for a comprehensive, adaptable, and proactive approach to safety, which considers the unique challenges of the industry's various segments. In the subsequent sections of this research, we will explore the methodologies employed in hazard identification and risk assessment, the most prevalent risks in different sectors of food production, and strategies to mitigate these risks. We will also address the importance of continuous improvement and adaptability in safety practices, and how these efforts contribute not only to the well-being of employees but also to the long-term sustainability and success of companies in the food production industries.

This study is based on Quality Risk Management in milk products. Quality risk management (QRM) is a systematic and science-based approach used in the food industry to identify, assess, control, and monitor risks related to the quality and safety of food products. It is an essential tool for ensuring that food products meet regulatory requirements and consumer expectations. The principles of quality risk management provide a structured framework for this process. Here's a comprehensive explanation of the principles of quality risk management in the food industry:

METHODOLOGY

Integration into the Quality Management System

QRM is characterized by making decisions based on risk assessments. It involves identifying potential hazards, evaluating the probability and severity of those hazards, and using this information to prioritize and guide decision-making. Risks are assessed within the context of regulatory requirements and consumer safety.

Quality Risk Management Manual

Purpose

The purpose of this document is to satisfy these requirements for a Quality-based risk analysis conducted on food industries. Responsibility persons consider the results of the Quality-based risk analysis will be helpful to reduce the or eliminate the risk of the product.

Scope

This Quality Risk Management procedure defines risk assessment of the workplace in line with the quality of the product. The QRM should be carried out in compliance with this procedure / manual for Identification and evaluation of the potential quality and compliance impact of product and process deviations for all activities. This procedure provides principles for quality risk management that can be applied to different aspects of food industries quality. These aspects include Boiler, production, SCADA, Quality lab, Sampling, waste management, Tanker unloading.

Responsibilities

The EHS manager is responsible for the risk assessment method. The people involved in the risk assessment should be trained and competent to carrying out the quality risk management. The responsibilities of the personnel should consider and evaluate the EHS hazards that are present and the related impacts. The personnel should assess the related risks to Health and Safety & to reduce the impact of the risk at an accepted level. The Process and quality managers are responsible for to ensuring that the risk assessment process for reviewing and maintained documented appropriate records are retained.

Quality risk assessment

The Quality risk assessment should be done accordingly to the following steps:

Process

First should consider and listed down what are all the process should be include in the risk assessment.

Activity

Based on the listed process, to break them down into different steps and finally organize them in different tasks for each process.

R/NR

In that section, determine that the ongoing has been carried out the normal routine work or non-routine work

Type of Hazard

Understanding these hazards is essential for establishing effective risk management and safety protocols. The following are some of the primary types of hazards prevalent in the food industry:

Chemical hazards

Chemical hazards in the food industry refer to the presence of chemical substances that can compromise the safety and quality of food products. Understanding these hazards in detail is essential for identifying potential risks, ensuring regulatory compliance, and implementing effective control measures. Chemical substances such as pesticides, food additives, preservatives, or cleaning agents can contaminate food if not managed properly shown in the Figure 1.

Biological hazards

Biological hazards in the food industry refer to the presence of microorganisms, including bacteria, viruses, parasites, and fungi, that can contaminate food products, leading to health risks for consumers and challenges for the food production process. Understanding these hazards in detail is crucial for ensuring food safety and implementing effective control

measures. Bacteria (e.g., Salmonella, E. coli), viruses, and parasites pose a significant threat, potentially causing food borne illnesses. Cross-contamination and improper food handling are common causes of biological hazards. Improper storage conditions and inadequate quality control can lead to the growth of Mold and yeast on food products, rendering them unsafe for consumption shown in the Figure 2.

Physical hazards

Physical hazards in the food industry refer to the presence of foreign objects or substances in food products that can pose a risk to consumer safety and the integrity of food production processes. Understanding these hazards in detail is crucial for ensuring food safety and implementing effective control measures. These hazards include physical contaminants such as glass, metal, wood, or plastic fragments that may inadvertently enter the food during processing, packaging, or distribution. Slips, Trips, and Falls.

Types of Physical Hazards

Foreign objects

These are physical contaminants that can accidentally enter food during various stages of production, processing, or packaging. Common foreign objects include glass, metal, wood, plastic fragments, stones, and other materials that are not part of the food product.

Fire hazards

Fire hazards in the food industry can result from various sources, including faulty equipment, electrical issues, and flammable materials. These hazards can lead to fires that not only damage property but also pose a risk to worker safety and food product integrity. Preventive measures include regular equipment maintenance, fire safety training, and the use of fire-resistant materials in facility construction.

Mechanical hazards

Mechanical hazards encompass risks associated with machinery and equipment used in food processing. These hazards can include moving parts, pinch points, and potential for entanglement. Inadequate machine guarding and improper equipment handling can result in injuries to workers. Mitigation strategies involve the use of safety guards, employee training shown in the Figure 3.

Electrical hazards

Electrical hazards are a risk in food production facilities due to the extensive use of electrical equipment. Faulty wiring, malfunctioning electrical components, and inadequate grounding can lead to electrical shocks or fires. Preventing electrical hazards involves regular electrical inspections, proper wiring.

Dust explosion

Dust explosion hazards pertain to environments where fine dust particles, often from ingredients like flour or sugar, can accumulate. If the dust becomes suspended in the air and ignites, it can lead to a potentially devastating explosion. Preventive measures involve proper ventilation, dust control, and the use of explosion-proof equipment in areas prone to dust buildup.

Figure 1: Chemical hazard

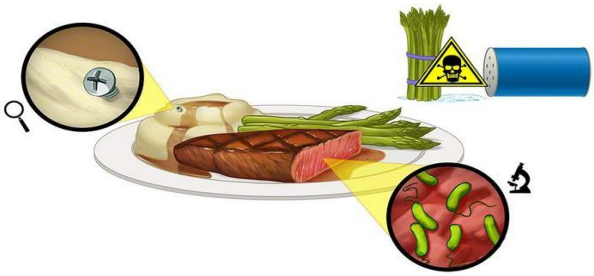

Figure 2: Biological hazard

Figure 3: Physical hazards

Allergenic hazards

Allergenic hazards in the food industry are a significant concern due to the potential for severe allergic reactions in sensitive individuals. These hazards stem from the presence of allergenic ingredients, such as nuts, soy, dairy, or gluten, in food products, and the risks are associated with inadequate labelling or cross-contact during production. Understanding allergenic hazards in detail is crucial for ensuring food safety for those with food allergies and implementing effective control measures shown in the Figure 4. The presence of allergenic ingredients in non-allergenic products due to cross-contact can trigger severe allergic reactions in sensitive individuals.

Operational hazards

Operational hazards in the food industry encompass a wide range of risks that can compromise both the safety of workers

and the efficiency of food production processes. These hazards arise during the day-to-day operations within a food facility and require detailed understanding to implement effective control measures shown in the Figure 5. Workers in food processing facilities may face operational hazards, including machinery-related accidents, burns, cuts, and ergonomic issues. Malfunctions or failures of food processing equipment can result in contamination. Or disruptions in production.

Radiological hazards

Radiological hazards in the food industry are associated with the presence of ionizing radiation, which can impact the safety and quality of food products. Understanding these hazards in detail is crucial for ensuring food safety, compliance with regulatory standards, and implementing effective control measures. Food products can be exposed to radiation from contaminated ingredients, which may have long-term health consequences shown in the Figure 6.

Environmental hazards

Environmental hazards in the food industry refer to risks stemming from various environmental factors that can affect the safety and quality of food products. These hazards encompass a broad spectrum of challenges related to natural and human-induced influences on the food supply chain. Understanding these hazards in detail is crucial for ensuring food safety, sustainability, and implementing effective control measures. Pesticides and Chemical Runoff, Agricultural practices can introduce pesticides and chemicals into the food supply chain through contaminated water and soil.

Natural hazards

Natural hazards in the food industry are risks associated with environmental events or processes that occur naturally and can impact food production, safety, and distribution. These hazards encompass a wide range of natural phenomena and understanding them in detail is essential for ensuring food safety, resilience, and effective control measures. Floods, earthquakes, and extreme weather events can disrupt food production and distribution, leading to potential shortages and food safety concerns.

Hazard

The Sources of Hazards are included.

Raw ingredients

Hazards can originate from the raw materials used in food production, such as contaminated agricultural products or allergenic ingredients.

Processing equipment

Machinery and equipment used in food processing can be sources of hazards if not properly maintained or operated.

Figure 4: Allergenic hazards

Figure 5: Operational hazard

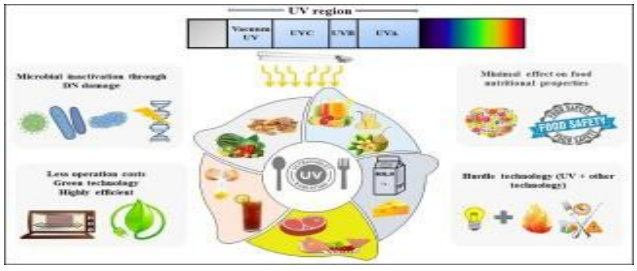

Figure 6: Radiological hazard

Human handling

Employee practices and hygiene can introduce hazards if not adhering to safety protocols and good manufacturing practices.

Environmental factors

Hazards can result from external factors like weather conditions, natural disasters, and ecological changes.

Risk

The Health and Safety Implications are,

Food borne illness

Failure to identify and mitigate hazards can lead to food borne illnesses, resulting in consumer health risks and potential outbreaks.

Injuries

Physical hazards can cause injuries, including cuts, abrasions, choking, or internal damage.

Production disruptions

Hazards, if unaddressed, can lead to production delays, financial losses, and damage to a company's reputation.

Hazard condition- N/A/E

Check the condition of the activity which is normally carried out the routine work or any abnormal has been carried out which is not in the standard operating procedure, or any emergency work has been carried out.

Existing controls

First to determine the present control measures based on the Hierarchy of control measures are:

- Elimination of the hazard
- Substitution
- Engineering Controls
- Administrative Controls
- Personal Protective Equipment

Legal Requirements

L/O

In that section, check what are all the relevant legal compliance for this activity . The legal compliance like Tamil Nadu factories rules 1950, FSSAI guidelines, Boilers act, Electricity rules, The Air (Prevention and control of pollution)rules, The water (Prevention and control of pollution) rules, The Environment protection rules, Hazardous waste management rules 2016 & applicable legislation.

Description of legal requirements

Based on the above legal requirements mention that the applicable legal rules for the specific activity.

Risk Evaluation

Probability of occurrence

The probability of occurrence has been determined based on the given rating:

- Rating-1: It hasn't happened before.
- Rating -2: It is rarely happened.
- Rating -3: It may be possible to happen.
- Rating -4: It has happened before but also may be the chance for happen again.
- Rating -5: It is very likely to happen.

Severity

The severity of the hazard has been determined based on the given rating:

Rating -1: minor

may cause a slight injury or slight pain that requires first aid.

Rating -2: medium

may cause a non-lost-time accident (NLTA), an occupational illness without lost time or an injury requiring medical treatment.

Rating -3: serious

may cause a lost-time accident (LTA) (no disability) or a lost-time occupational disease that makes it temporarily impossible to return to the usual workstation.

Rating -4: very serious

may cause permanent disability because of a serious accident or occupational illness.

Rating -5 : catastrophic

may cause death (or multiple deaths) or serious occupational illness.

Risk rating

The overall risk rating of the activity or hazard has been determined based on the given rating shown the Table 1:

Classification of risk

The classification of the risk level of the activity or hazard has been determined based on the given rating:

Is this process affects the consumers health & safety – yes/ no

In that section, evaluate that the existing process or activity carried out in the workplace has affect the consumers Health and Safety. If the activity has affected the consumers Health and Safety, need to provide the additional control measures for reducing the risk shown the Table 2.

Additional control measures

When determining the additional control measures, the Hierarchy of control measures should be considered to reducing the risks according to the following hierarchy of controls:

- Elimination of the hazard
- Classification of Risk
- Substitution
- Engineering Controls
- Administrative Controls
- Personal Protective Equipment.

Updating the assessment

The Quality based risk assessment must be updated especially in case of:

- Any modification of equipment, any change in processes and products.
- Occurrence of any incident.
- Suggestions from employees or staff for innovation to reduce risk.
- Any changes in the laws & regulations

Results & Discussion

Process Flow

The process flow of milk products are listed step-by-step.

Quality Risk Assessment

Hazard identification in the food industry is a fundamental

Table 1: Risk Assessment Guideline

	5	5	10	15	20	25
	4	4	8	12	16	20
	3	3	6	9	12	15
Severity	2	2	4	6	8	10
	1	1	2	3	4	5
		1	2	3	4	5
	Probability of occurence					

step in the process of ensuring food safety, protecting consumer health, and upholding the integrity of food products. This crucial phase involves recognizing and categorizing potential hazards that can compromise the safety and quality of food at various stages of production, processing, distribution, and consumption. Here's a comprehensive explanation of hazard identification in the food industry. Quality Risk Assessment shall be conducted by a team of persons who have a thorough knowledge of the work to be assessed shown the Table 3.

Table 3: Process flow

Preventive Measures

The Risk assessment of the workplace will help to find out the hazards, defects and risk of the process and workplace. The preventive measures should be taken to avoid the hazards happened in future. The preventive measures of different hazards are listed down shown the Table 4.

Chemical Hazards - Preventive Measures

Regulatory compliance

Adherence to food safety regulations and guidelines is essential for controlling chemical hazards. Regulatory agencies set maximum allowable levels for various chemicals in food.

Testing and analysis

Regular testing and analysis of raw materials, finished products, and processing equipment can help identify and mitigate chemical hazards.

Proper storage and handling

Safe storage and handling of chemicals, including cleaning agents and food additives, are vital to prevent contamination.

Supplier control

Ensuring that suppliers comply with safety standards and provide clean and uncontaminated ingredients is crucial.

Employee training

Educating food industry workers about proper cleaning and handling procedures is essential to reduce the risk of cross-contamination.

These hazards require meticulous monitoring, control, and prevention measures to safeguard the safety and quality of food products and protect consumer health. Stringent adherence to regulations, continuous testing and analysis, and comprehensive training are all integral components of mitigating chemical hazards in the food industry.

Biological Hazards -Preventive Measures

Good agricultural practices (GAPs) and good manufacturing practices (GMPs)

Adherence to these standards in farming and food processing is critical to reducing biological hazards.

Table 2 : Risk Rating Chart

	5	Significant Risk	Significant Risk	High Risk	High Risk	High Risk
	4	Significant Risk	Significant Risk	Significant Risk	High Risk	High Risk
	3	Moderate Risk	Moderate Risk	Moderate Risk	Moderate Risk	High Risk
Severity	2	Low Risk	Low Risk	Moderate Risk	Moderate Risk	Moderate Risk
	1	Low Risk	Low Risk	Moderate Risk	Moderate Risk	Moderate Risk
		1	2	3	4	5
	Probability of occurence					

Table 4: Quality risk assessment

Quality Risk Management													
Process	*Activity*	*R/ NR*	*Type of Hazard*	*Hazard*	*Risk*	*HC*	*Existing controls*	*Applicable legal requirements*		*Risk Evaluation*	*Classification of Risk*	*Process affects the consumers H&S*	
						N/ A/E		*L/O*	*Description of L/O*	*Risk Rating*		*Yes/ No*	*Additional controls*
Tanker Unloading	Placement of vehicle at designated location	R	Physical Hazard	Movement of vehicle	Injury	N	Wheel chock	–	–	4	Low Risk	No	Follow the existing control measure
	Hose connection	R	Chemical Hazard	Failure of hoses used for transfer of oil, milk, chemicals	Injury	N	Safety Helmet & Chemical splash goggles	–	–	4	Low Risk	No	Follow the existing control measure
Packing of Milk	Filling of Milk in pouch	R	Chemical Hazard	Milk may contact eye	Eye irritation	N	PPE	–	–	4	Low Risk	No	Follow the existing control measures
	Filling of Milk in pouch	R	Operational	Mechanical Hazard	Hand Injury	N	PPE	–	–	4	Low Risk	No	Follow the existing control measures
	product shifting	R	Operational	Strain due to Manual Handling	Ergo Nomics	N	PPE	–	–	4	Low Risk	No	Follow the existing control measures
	Handling of Milk Crates	R	Physical	Material overflow spillage	Fall Injury	N	PPE	–	–	4	Low Risk	No	Follow the existing control measures
	Receiving of empty crates	R	Physical	Fall of material	Injury	N	PPE	–	–	4	Low Risk	No	Follow the existing control measures
		R	Physical Hazard	Contact with sharp objects	Cut Injury	N	PPE	–	–	4	Low Risk	No	Follow the existing control measures
		R	Physical Hazard	Contact with sharp objects	Cut Injury	N	PPE	–	–	4	Low Risk	No	Follow the existing control measures
Milk Packing & Crate Washing	Packing of crates	R	Operational	Mechanical Hazard	Injury	N	PPE	–	–	4	Low Risk	No	Follow the existing control measures
		R	Operational	Shock & electro cution	Electrical shock	N	PPE	–	–	4	Low Risk	No	Follow the existing control measures
		R	Physical Hazard	Rushed to transfer the material	Injury	N	PPE	–	–	12	Significant Risk	No	Need to evaluate and update the skill matrix
	Storage and dispatch	R	Physical Hazard	Due to manually transfer the filled crate in designated location	Ergo Nomics	N	PPE	–	–	4	Low Risk	No	Follow the existing control measures
		R	Physical Hazard	Slip and fall of material by using trolley	Injury	N	PPE	–	–	4	Low Risk	No	Follow the existing control measures

		R	Chemical Hazard	Fire & Explosion hazard	Burn	N	PPE	–	–	4	Low Risk	No	Follow the existing control measures
	Empty Chemical Bottle	R	Chemical Hazard	May cause harm by contact with skin	skin disorders	N	PPE	–	–	4	Low Risk	No	Follow the existing control measures
		R	Chemical Hazard	May cause harm by contact with eye	Eye irritation	N	PPE	–	–	4	Low Risk	No	Follow the existing control measures
		R	Physical Hazard	Mishandling of bottle sharp objects may tear	Cut Injury	N	PPE	–	–	4	Low Risk	No	Follow the existing control measures
		R	Chemical Hazard	Fire & Explosion hazard	Burn	N	PPE	–	–	4	Low Risk	No	Follow the existing control measures
Waste Management		R	Chemical Hazard	May cause harm by contact with skin	skin disorders	N	PPE	–	–	6	Moderate Risk	No	Follow the FIFO system
	Expiry chemical or powder	R	Chemical Hazard	May cause harm by contact with eye	Eye irritation	N	PPE	–	–	6	Moderate Risk	No	Follow the FIFO system
		R	Physical Hazard	Cut injury due to contact with broken glass items.	Cut Injury	N	PPE	–	–	4	Low Risk	No	Follow the existing control measures
		R	Chemical	Without proper handling,	Respiratory problem	N	PPE	–	–	4	Low Risk	No	Follow the existing control measures
	ETP Waste	R	Environmental Hazard	Sludge may affect the environment without proper disposal	Land contamination	N	As per requirement	As per TNPCB	–	6	Moderate Risk	Yes	Acid proof tiling should be done to avoid the land and water contamination
Production			Physical Hazard	Leakage of water or anything leads to slip and fall due to poor housekeeping	Injury	N	Housekeeping	–	–	2	Low Risk	No	Follow the existing control measures
	During milking and poor filtration at milk collection	R	Allergenic Hazard	Animal hair	Illness	N	Filtration device	–	–	4	Significant Risk	Yes	Weekly twice clean the filtration device and stringent the inspection
	SMP bag stitches	R	Allergenic Hazard	Cotton thread	Illness	N	Filtration device	–	–	4	Significant Risk	Yes	Weekly twice clean the filtration device and stringent the inspection
	Uncovered milk container and poor filtration	R	Allergenic Hazard	Sand	Illness	N	Filtration device	–	–	4	Significant Risk	Yes	Weekly twice clean the filtration device &stringent the inspection

	Paint peeling in the milk collection / storage/ processing	R	Allergenic Hazard	Paint peeling	Illness	N	Filtration device	_	_	4	Significant Risk	Yes	Weekly twice clean the filtration device and stringent the inspection
	Insects fly	R	Allergenic Hazard	Allergenic hazard, affects the consumers health	Illness	N	Filtration device	_	_	4	Significant Risk	Yes	Weekly twice clean the filtration device, provide additional insect killer machine and stringent the inspection
	Human hair	R	Allergenic Hazard	Allergenic hazard, affects the consumers health	Illness	N	Filtration device	_	_	4	Significant Risk	Yes	Weekly twice clean the filtration device and stringent the inspection
		R	Biological Hazard	Chemical bottles was Not arranged properly may confused to use the right chemicals .	Wrong testing of milk may affect the health	N	_	_	_	6	Moderate Risk	Yes	Follow the FIFO system
		R	Biological Hazard	FIFO system was Not used	Chemical reaction affects the employees eye	N	PPE, MSDS	_	_	6	Moderate Risk	No	Follow the FIFO system
		R	Biological Hazard	FIFO system was Not used	Chemical reaction affects the employees' skin	N	PPE, MSDS	_	_	6	Moderate Risk	No	Follow the FIFO system
Quality Lab	Testing of milk	R	Biological Hazard	FIFO system was Not used	Respiratory problem	N	PPE, MSDS	_	_	6	Moderate Risk	No	Follow the FIFO system
		R	Physical Hazard	Manually test the milk	Ergo Nomics	N	PPE	_	_	4	Low Risk	No	Follow the FIFO system
		R	Operational Hazard	Working near in electrical system, electrical hazard	Electrical shock	N	PPE	_	_	4	Low Risk	No	Follow the FIFO system
		R	Operational Hazard	Routing of electrical wires/ cables	Electrical shock	N	PPE	_	_	4	Low Risk	No	Follow the FIFO system
		R	Operational Hazard	Routing of electrical wires/ cables	slip & fall	N	PPE	_	_	9	Low Risk	No	Follow the FIFO system
		R	Operational Hazard	Without proper circulation of air, the employees may inhale the air	Respiratory problem	N	PPE	_	_	4	Low Risk	No	Follow the FIFO system
Boiler	Filling of wood in the combustion chamber	R	Operational Hazard	May expose heat	Burn	N	PPE	_	_	4	Low Risk	No	Follow the FIFO system

Hazard analysis and critical control points (HACCP)

Implementing HACCP plans helps identify and control biological hazards at critical points in the food production process.

Proper cooking and storage

Ensuring that food is cooked to recommended temperatures and stored at safe temperatures can prevent pathogen growth.

Hand washing and hygiene

Proper training and monitoring of employee hygiene practices can minimize the risk of contamination.

Raw material testing

Regular testing of raw materials for pathogens helps identify potential sources of contamination.

Biological hazards are a significant concern in the food industry due to the potential for severe health consequences if not managed effectively. Strict adherence to food safety regulations, comprehensive training, and continuous monitoring and testing are essential components of mitigating biological hazards and ensuring the safety of food products for consumers.

Physical Hazards -Preventive Measures

Good manufacturing practices (GMPs)

Strict adherence to GMPs in food production, including equipment maintenance and employee hygiene, is crucial to minimizing physical hazards.

Metal detection and X-ray scanning

Employingmetal detectors and X-ray machines to inspect food products can identify and remove potential contaminants.

Quality control inspections

Regular inspections of raw ingredients, processingequipment, and finished products for physical hazards are essential.

Packaging quality

Ensuring the quality and integrity of packaging materials can prevent contamination from foreign objects.

Physical hazards are a significant concern in the food industry due to their potential for harm to consumers and damage to a company's reputation. Stringent adherence to food safety regulations, comprehensive training, regular inspections, and the use of detection equipment are essential components of mitigating physical hazards and ensuring the safety and integrity of food products.

Allergenic Hazards -Preventive Measures

Accurate labelling

Proper and accurate labelling of allergenic ingredients is paramount to inform consumers and enable those with allergies to make safe food choices.

Allergen control plans

Food manufacturers and processors should implement allergen control plans, which may include segregating allergenic ingredients, using dedicated equipment, and conducting regular cleaning and testing.

Employee training

Proper training of food handlers, including kitchen, is essential to reduce the risk of cross-contact and to ensure they understand the significance of allergenic hazards.

Communication with consumers

Providing clear allergen information on packaging and in restaurant menus is critical. Additionally, staff should be trained to communicate allergenic concerns with customers effectively.

Product testing

Routine product testing can help confirm that allergenic ingredients are correctly labelled and that cross-contact risks are minimized.

Addressing allergenic hazards in the food industry is not only a matter of regulatory compliance but also a moral and ethical responsibility to protect individuals with food allergies. Effective allergen control, proper labelling, and rigorous employee training are integral to reducing the risk of allergic reactions and ensuring the safety and well-being of consumers.

Operational Hazard -Preventive Measures

Workplace safety programs

Implementation of comprehensive workplace safety programs that include safety rules, procedures, and regular training for all employees.

Equipment maintenance

Regular inspection and maintenance of equipment to ensure proper functioning and safety features.

Ergonomic assessments

Conducting ergonomic assessments to identify and mitigate risks associated with repetitive tasks and manual handling.

Employee training

Providing workers with proper training on the safe operation of equipment, machinery, and tools.

Safety culture

Fostering a safety-conscious culture within the organization, where employees actively participate in safety measures and hazard reporting.

Operational hazards in the food industry can have a

significant impact on both the safety and productivity of the workforce. Ensuring proper safety protocols, equipment maintenance, and ergonomic considerations are essential for minimizing these risks. By addressing operational hazards effectively, food production facilities can create a safer work environment, reduce the risk of accidents, and maintain efficient operations.

Radiological Hazard -Preventive Measures

Supplier control

Ensuring that suppliers comply with safety standards and provide uncontaminated ingredients is crucial to prevent radiological hazards from entering the food supply chain.

Radiation equipment maintenance

Proper maintenance, calibration, and safety checks for radiation equipment are essential to prevent overexposure and ensure accurate treatment.

Regulatory compliance

Adherence to food safety regulations, including maximum allowable levels of ionizing radiation, is crucial to controlling radiological hazards.

Testing and analysis

Regular testing of both raw materials and finished products for radioactive contaminants helps identify potential sources of contamination.

Radiological hazards in the food industry are a relatively rare but critical concern. The prevention of radiological hazards is essential to protect consumer health and maintain the trust and reputation of the food industry shown the Figure 7.

Environmental Hazard -Preventive Measures

Sustainable agriculture

Implementing sustainable farming practices, such as organic farming, can reduce the use of harmful chemicals and promote soil and water health.

Pollution control

Regulations and practices to control industrial emissions and reduce pollution are essential to minimize environmental hazards.

Disaster preparedness

Developing disaster preparedness plans and infrastructure to safeguard food supplies in the event of natural disasters.

Biodiversity conservation

Conservation efforts to protect and restore natural habitats and biodiversity are vital for food production stability.

Addressing environmental hazards in the food industry is not only about ensuring food safety but also about promoting

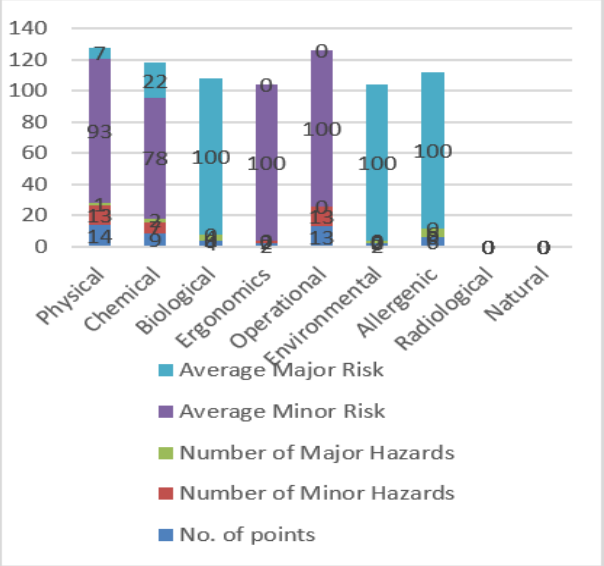

Figure 7: Overall score - graph

sustainable practices that protect the environment and secure the long-term availability of safe and nutritious food. Effective control measures involve sustainable agriculture, pollution control, disaster preparedness, and conservation efforts that contribute to a resilient and environmentally responsible food industry.

Natural Hazard -Preventive Measures

Disaster preparedness

Developing and implementing disaster preparedness plans and infrastructure to safeguard food supplies during natural disasters.

Resilient agriculture

Promoting resilient farming practices that can withstand extreme weather events and pest outbreaks, such as drought-resistant crops.

Early warning systems

Establishing early warning systems for extreme weather events, pest outbreaks, and zoonotic diseases to enable timely response.

Infrastructure resilience

Constructing food production and storage facilities that are designed to withstand natural hazards.

Addressing natural hazards in the food industry is essential for ensuring food safety, security, and the resilience of the food supply chain. Implementing effective control measures involves disaster preparedness, resilient agriculture, early warning systems, and resilient infrastructure. These measures contribute to a safer and more reliable food industry capable of withstanding the challenges posed by natural hazards.

Table 5: Overall score

SI.NO	*Type of Hazard*	*No. of points*	*Number ofMinor Hazards*	*Number of Major Hazards*	*Average Minor Risk*	*Average Major Risk*
1	Physical	14	13	1	93	7
2	Chemical	9	7	2	78	22
3	Biological	4	0	4	0	100
4	Operati onal	15	15	0	100	0
5	Environ mental	2	0	2	0	100
6	Allergenic	6	0	6	0	100
7	Radiolo gical	0	0	0	0	0
8	Natural	0	0	0	0	0
TOTAL		50	35	15	70%	30%

Quality risk assessment overall scorecard

Based on the findings in the Quality risk assessment the average minor and major risk of the activity or process are listed down shown the Table 5:

CONCLUSION

The hazard identification process in the food industry is a critical component of ensuring food safety, protecting consumers, and maintaining the integrity of food products. The process leads to several key outcomes that are vital for effective hazard control and overall safety within the industry. Here's a comprehensive explanation of the outcomes for the hazard identification process:

Identification of Potential Hazards

The primary outcome of the hazard identification process is the identification of potential hazards that could compromise the safety and quality of food products. These hazards encompass biological, chemical, physical, allergenic, operational, radiological, environmental, and natural hazards. By recognizing these hazards, the industry can take proactive steps to mitigate their risks.

Understanding Hazard Sources

The process also sheds light on the sources of hazards. These sources can include raw ingredients, processing equipment, employee practices, environmental factors, and more. Understanding the origins of hazards is crucial for implementing targeted control measures and preventing hazards from entering the food supply chain.

Risk Assessment

Once hazards are identified, the next step is to assess the level of risk associated with each hazard. Risk assessment considers factors such as the probability of occurrence, the severity of potential harm, and the number of consumers exposed. This assessment helps prioritize hazards and allocate resources efficiently.

Hazard Control Strategies

An important outcome of hazard identification is the development of hazard control strategies. For each identified hazard, specific control measures are established to prevent, reduce, or eliminate the associated risks. These strategies can include process modifications, equipment upgrades, employee training, and more.

Implementation of Preventive Measures

Thehazard identification processresultsintheimplementation of preventive measures aimed at reducing or eliminating identified hazards. This may involve the introduction of safety protocols, equipment maintenance, employee training programs, and changes in ingredient sourcing to ensure food safety.

Regulatory Compliance

The process ensures that the food industry complies with relevant food safety regulations and standards. Regulatory agencies worldwide set guidelines for hazard identification and control, and the industry's adherence to these regulations is a critical outcome.

Enhanced Food Safety Culture

A positive outcome of rigorous hazard identification is the fostering of a food safety culture within the industry. Employees become more aware of potential hazards and their role in maintaining food safety, contributing to a safer working environment.

Minimized Health Risks

Effective hazard identification directly leads to minimized health risks for consumers. By identifying and controlling hazards, the industry reduces the likelihood of food borne illnesses and other health-related issues associated with contaminated or unsafe food products.

Product Integrity and Reputation

The identification and control of hazards help maintain the integrity of food products and protect the industry's reputation. Ensuring that food is consistently safe and of high-quality builds trust with consumers.

Business Continuity

By addressing hazards, the food industry can better ensure business continuity. Hazard identification outcomes can help prevent production disruptions, financial losses, and damage to the company's reputation.

The hazard identification process in the food industry results in a series of critical outcomes that are integral to food safety and quality. These outcomes include the identification of potential hazards, understanding their sources, risk assessment, hazard control strategies, regulatory compliance,

and the enhancement of a food safety culture. Ultimately, these major outcomes work together to minimize health risks, protect product integrity, and maintain the industry's reputation.

REFERENCES

[1] Pragnesh A Patel., Vijay Shankul. (2023). A study on the hazard identification, risk assessment process and highest risk task of the daily practices in the large-scale food manufacturing industry. *SSRG International Journal of Recent Engineering Science*, 10(3), 1-9. doi.org/10.14445/23497157/IJRES-V10I3P101.

[2] Ravindra Kene., Naik, G.R. (2019). Applications of Ergonomic Analysis Tools in an Industry : A Review. *International Research Journal of Engineering and Technology*, 6(6), 1156-1161.

[3] Subas Neupaneetal, Subas Neupane, Pekka Virtanen, Tiina H Luukkaala. (2013). A Four-Year Follow-Up Study of Physical Working Conditions and Perceived Mental and Physical Strain Among Food Industry Workers. Applied Ergonomics, 45(3), 145-51. DOI: 10.1016/j.apergo.2013.08.010

[4] Marko Djapan, Ivan Macuzic, Danijela Tadic, Gabriele Baldissone. (2019). An innovative prognostic risk assessment tool for manufacturing sector based on the management of the human, organizational and technical/technological factors. *Safety Science,* Vol.119, pp. 280-291. doi.org/10.1016/j.ssci.2018.02.032, 2019

[5] Satish Kumar Nalluri, Venkata Krishna Bharadwaj Parasaram, Varun Teja Bathini. (2020). Secure Automation Frameworks for Smart Manufacturing Using Blockchain-Assisted Traceability. International Journal of Research & Technology, 8(2), 47–53. Retrieved from https://ijrt.org/j/article/view/879

[6] Sujatha, S., Sivaligam A., Prabhakaran D.,Thirumarimurugan M. (2020). A Study on the Importance of Health and Safety Environment in a Food Industry. *International Research Journal of Engineering and Technology (IRJET)*, 2(3), 2017-26.

[7] Anamai Thetkathuek, anongsak Yingratanasuk, Wallop Jaidee, Wiwat Ekburanawat. (2014). Cold Exposure and Health Effects Among Frozen Food Processing Workers in Eastern Thailand. *Safety and Health at Work,* 15(2), 1-15.

[8] Nini Xia., Xueqing Wang., Mark A Griffin., Chunlin Wu., Bingsheng Liu. (2019). Do We See How They Perceive Risk? An Integrated Analysis of Risk Perception and its Effect on Workplace Safety Behaviour. *Accident Analysis & Prevention,* 106, 234-242. doi: 10.1016/j.aap.2017.06.010.

[9] Pragnesh A. Patel, Vijay Shankul. (2023). A Study of the Hazard and Risk Identification, Risk Assessment Process and Highest Risk Task of the Daily Practices in the Food Production Industry. *International Journal of Recent Engineering Science,* vol. 10(3), pp. 1-9. doi.org/10.14445/23497157/IJRES-V10I3P101

[10] Mary A. Fox et al. (2018). Implications of Applying Cumulative Risk Assessment to the Workplace. *Environment International,* 115, 230–238.

[11] Andrea, H., Okun, Rebecca, J., Guerin, and Paul A. Schulte. (2018). Foundational Workplace Safety and Health Competencies for the Emerging Workforce. *Journal of Safety Research,* 59, 43-52.

[12] Gabriele dEttorre., and Mariarita Greco. (2015). Healthcare Work and Organizational Interventions to Prevent Work-related Stress in Brindisi, Italy. *Safety and Health at Work*, 6, 35-38.

[13] Mary A. Fox., Kristen Spicer., Casey Chosewood, L., Pam Susi., Douglas O., Johns, G. Scott Dotson. (2018). Implications of Applying Cumulative Risk Assessment to the Workplace. *Environment International,* 115 (6), 230-238. doi.org/10.1016/j.envint.2018.03.026.

[14] Robin Burgess-Limerick. (2018). Participatory Ergonomics, Evidence and Implementation Lessons. *Applied Ergonomics,* 68 (4), 289-293. doi.org/10.1016/j.apergo.2017.12.009

[15] Beriha, G.S. (2016). Assessment of Safety Performance in Indian Industries using Fuzzy Approach. *Expert Systems with Applications*, 39(3), 3311–3323.

[16] Jodi Oakman., Subas Neupane., and Clas-Hakan. (2015). Does Age Matter in Predicting Musculoskeletal Disorder Risk an Analysis of Workplace Predictors Over 4 years. *International Archives of Occupational and Environmental Health*, 89(7), 1127–1136.

[17] Patricia Foriwaa Ababio, and Pauline Lovatt. (2015). A Review on Food Safety and Food Hygiene Studies in Ghana. *Food Control,* 47, 92–97.

[18] Germán Rossetti. (2014). Study of the Management of the Development of Products in Food Production Companies. *SSRG International Journal of Industrial Engineering*, 6(2), 11-20.

[19] Matthew N. O., Sadiku Tolulope J., Ashaolu., Sarhan M. (2019). Food Technology: A Tutorial. *Published in International Journal of Trend in Scientific Research and Development (ijtsrd)*, 3(6), 435-438.

[20] Geoff Wells. (1996). Hazard Identification and Risk Assessment. Hardcover – Import, 1 March 1996 Book copy.

[21] Nicholas Chartres, Lisa A. Bero, and Susan L. Norris. (2012). A Review of Methods Used for Hazard Identification and Risk Assessment of Environmental Hazards. *Environment International*, 123, 231–239.

[22] Danielle M. Tack, DVM.; Logan Ray., Patricia M. Griffin., Paul R., Cieslak, M.D. (2020). Preliminary Incidence and Trends of Infections with Pathogens Transmitted Commonly Through Food — Foodborne Diseases Active Surveillance Network, 10 U.S. Sites, 2016–2019. 69(17), 509–514.

[23] Wendyvan, R., and Lynnj, F. (2008). Consumer perceptions of food quality and safety and their relation to traceability. *British Food Journal*, vol. 110(10), 1034–1046.

[24] ISO/IEC Guide 73:2002. Risk management - Vocabulary - Guidelines for use in standards. & ISO/IEC Guide 51:1999 - Safety aspects - Guideline for their inclusion in standards.

[25] IEC 60812 Analysis techniques for system reliability—Procedure for failure mode and effects. & ISO 14971:2000 - Application of Risk Management to Medical Devices.