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RISK ASSESSMENT AND HACCP-BASED HAZARD CONTROL IN MALT CANDY PROCESSING

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***ABSTRACT**: Malt candy is a type of hard confectionery product formulated with the addition of specific leavening agents that, during the heating (oven) process, produce a light, porous, and melt-in-the-mouth texture. The safety and quality of malt candy are strongly affected by the hygienic conditions of the production environment, process parameters, and raw material handling. Therefore, the of the HACCP system plays an essential role in identifying and controlling potential hazards at every stage of the manufacturing process. This study aims to perform a comprehensive risk assessment and apply HACCP-based hazard control measures in the malt candy production line. The research involves developing a detailed process flow diagram, identifying potential biological, chemical, and physical hazards, determining (CCPs) establishing critical limits, and formulating monitoring and corrective action procedures. Data were collected through on-site observation, environmental inspection, and evaluation of production records to assess risk levels and compliance with HACCP principles. The findings indicate that the primary Critical Control Point (CCP) is located at the inspection stage, where a metal detector is employed to ensure that the product is free from metallic contaminants and compliant with food safety requirements. Furthermore, the results suggest that metal contamination control should not only be addressed at the CCP level, but also reinforced as a Control Point within the prerequisite program (CPP), thereby enabling corrective actions to be properly traced and their effectiveness continuously evaluated. Accordingly, it is recommended that the company strengthen documentation, verification activities, and equipment maintenance at this stage as part of ongoing improvements in the implementation of the prerequisite (basic feasibility) program. This approach ensures that the application of HACCP is not merely reactive, but also preventive, measurable, and fully accountable through a clear audit trail, serving as a reference model for similar confectionery industries.*

***Keywords:** CCP, HACCP, Malt Candy, Metal Contamination, Risk Assessment*

1. INTRODUCTION

Food safety and hygiene are two fundamental aspects of food processing that directly determine product quality and consumer protection. Food safety is closely related to efforts to minimize pathogenic microbial contamination to ensure consumer health and compliance with food regulatory standards. Based on the principles of *Good Manufacturing Practices* (GMP), hygienic processing is achieved through the implementation of strict sanitation procedures, environmental control measures, and adequate personnel training. The proper implementation of GMP standards serves as the main foundation for preventing contamination and ensuring consistency in the quality and safety of food products (Hasanah, N.L., et al., 2022).

The implementation of Good Hygiene Practice (GHP), Good Manufacturing Practice (GMP), and Hazard Analysis and Critical Control Points (HACCP) systems is mandatory for all food industry enterprises during both the production and distribution processes (Morkis. G, 2010). Following Poland's accession to the European Union, a significant increase was observed within one year in the adoption of these quality management systems — GHP by 104%, GMP by 100%, and HACCP by 71%. By 2005, approximately 50% of registered food industry enterprises had implemented GHP, 45% had adopted GMP, and 21% had applied the HACCP system (Morkis. G, 2010).

In the food industry, *Standard Operating Procedures* (SOPs) are essential to minimize microbiological contamination originating from the production environment, raw materials, and equipment surfaces. The application of hygienic principles in food processing is not only intended to prevent pathogen contamination but also to ensure that each production stage complies with the standards under the HACCP system, which is incorporated in a risk-based food safety management framework (Siti, N., & Susanti, 2016).

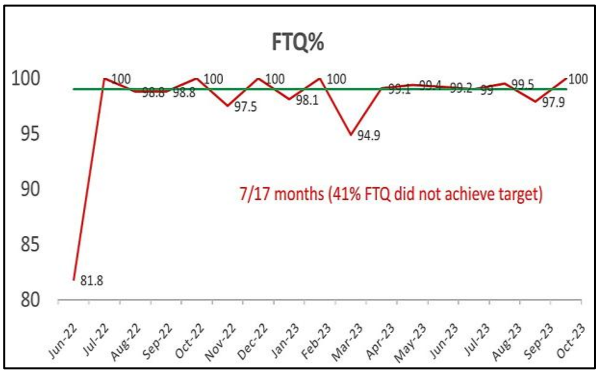
Previous studies have proven that the adoption of the HACCP system principles in various food industries such as dairy, meat, and beverage production has been effective in reducing the occurrence of pathogenic microorganisms including *Salmonella*, *E. coli*, and *Listeria monocytogenes* to levels below regulatory limits (Mahbubah, 2022). However, studies specifically addressing the implementation of HACCP in confectionery products, particularly malt candy, remain limited. Confectionery products of this type have distinct processing characteristics and pose potential physical hazards, such as metallic contamination or cross-contamination from the production environment. Furthermore, most previous studies have primarily focused on biological hazards, while chemical and physical hazards have not been comprehensively examined in an integrated manner (A., Mega. S.J.N., and Nalawati, A.N., 2024)

Given these challenges, more comprehensive research is required on HACCP-based risk assessment and hazard control in malt candy production to strengthen preventive control systems. Therefore, this study aims to identify biological, chemical, and physical hazards; define Critical Control Points; determine tolerance limits; and design frameworks for observation and corrective interventions. This approach is expected to enhance product safety assurance and quality consistency in malt candy, as well as serve as a scientific reference for implementing HACCP systems in similar confectionery industries.

Food safety refers to the conditions and measures required to prevent food from potential biological, chemical, and physical contaminants that may disrupt, harm, or endanger human health, while also ensuring compliance with religious beliefs, cultural values, and social norms so that food is safe for consumption. This definition is in accordance with The Government Regulation of the Republic of Indonesia Number 86 of 2019 concerning Food Safety.

Candy is a type of confectionery made by dissolving sugar in water. According to the Indonesian National Standard (SNI 3547.1:2008), the main ingredients used in the production of hard candy are sucrose, water, and glucose syrup (invert sugar), while other ingredients include flavoring agents, colorants, and acidulants. In addition to sugar as the basic component, flavor compounds constitute a vital element in determining the sensory characteristics of candy. The term *confectionery* originates from the Latin word *confecto* (from *conficere*), meaning “to compound,” whereas the term *candy* is derived from the arabic word *qandi*, meaning “sugar.” (Pawestri, S., et al., 2024).

First Time Quality (FTQ) is a measurement concept used to ensure that all activities are carried out correctly from the outset. When each process is performed properly on the first attempt, the resulting output will meet the expected quality in accordance with customer requirements. However, the FTQ report in this company shows an annual average value that remains below the established standard, recording



only 41%. Therefore, improvement measures are required to raise the FTQ performance to the target standard of 100%, or at least to an acceptable average level of 98%. The FTQ performance trend is presented in Figure 1 below.

Figure 1. Trend Analysis of First Time Quality (FTQ) Performance in the Candy Department, 2022–2023. Source: internal company data

Malt candy is a type of hard candy that has a solid outer texture but melts easily when consumed. This product is classified as a crystalline candy. The production of malt candy begins with the formation of hard candy pellets, which are subsequently reheated in a vacuum oven. During this vacuum heating process, the small pellets expand significantly, resulting in a porous, lightweight structure. Consequently, malt candy exhibits a hard exterior and a fragile, airy interior that melts readily in the mouth, producing a unique melt-in-the-mouth texture.

Metal contamination control should not be managed solely at the Critical Control Point (CCP) level, but should also be strengthened within the prerequisite program (CPP) to ensure the overall reliability of the food safety system. The effectiveness of CCP supervision is largely dependent on the robustness of prerequisite programs—particularly the implementation of Good Manufacturing Practices (GMP), Sanitation Standard Operating Procedures (SSOP), and routine equipment inspection and maintenance. The metal detector stage is generally recognized as a CCP due to its high hazard significance in preventing physical contamination. However, long-term system effectiveness and traceability can only be achieved when CCP control is supported by well-established prerequisite measures. The integration of CCP and CPP represents a dual-control system that enhances traceability and accountability, shifting contamination control from a reactive inspection approach to a preventive and system-based assurance model. Such reinforcement forms the basis of a traceability-enhanced prerequisite program (PRP), which is increasingly recommended for confectionery processing and similar industries to strengthen food safety management.

1.1. The HACCP Concept

The (HACCP) system represents a food safety assurance framework founded on the understanding that potential hazards can arise at multiple stages of production and must be effectively managed to mitigate risks. Its core principle emphasizes hazard anticipation and the identification of Critical Control Points (CCPs), prioritizing preventive actions over reliance on final product inspection. (Codex Alimentarius Commission, 2017).

Hazard analysis is carried out to identify potential hazards that may arise from raw materials through to the final product stage. Each identified hazard is recorded in a table known as the *HACCP Plan*, which includes the causes of the hazard, the level of risk, preventive measures, and the determination of critical control points (CCPs) (Rochman. S.F., 2020).

The application of HACCP within the food industry is tailored to specific products, processes, and production facilities, and its effective implementation necessitates prerequisite programs such as Good Manufacturing Practices (GMP) and Sanitation Standard Operating Procedures (SSOP) (FAO/WHO, 2003). The *Codex Alimentarius Commission* first adopted the HACCP system in 1993 and revised it in 1996 to develop a systematic 12-step guideline for implementation. (Koswara, S., 2009). These steps consist of five preliminary stages and seven subsequent principles of HACCP, which are outlined as follows:

1st. Assemble the HACCP team
2nd. Describe the product
3rd. Identify the intended use
4th. Construct the process flow diagram
5th. Verify the flow diagram on-site
6th. Conduct hazard analysis
7th. Determine the Critical Control Points (CCPs)
8th. Establish critical limits for each CCP
9th. Establish a monitoring system for each CCP
10th. Establish corrective actions for deviations from critical limits
11th. Establish verification procedures
12th. Establish documentation and record-keeping systems

These twelve steps represent the standard framework for the development and implementation the HACCP plan to ensure food safety and prevent hazards at every stage of food production (Sari, L., Nugroho, S.D., & Yuliati, N., 2022).

2. MATERIALS AND METHODS

In this study, all data related to the production process flow were collected comprehensively. The collected information included the adoption of GMP and SSOP guidelines within the company. The GMP implementation covered seven key aspects, namely factory building design, company management, utilities, maintenance, equipment, and sanitation practices.

2.1. Implementation HACCP concept

Subsequently, the HACCP system was designed, which included the description of the product, identification of its intended use, and the development of a process flow diagram. A hazard analysis was then conducted to recognize potential biological, chemical, and physical hazards, then proceeded with defining Critical Control Points (CCPs), setting critical thresholds, and developing monitoring protocols. (Azhary. Et al., 2022). Corrective actions were also determined to address any deviations from the critical limits. Finally, a CCP control chart was constructed to provide a concise summary and facilitate visualization of the overall HACCP implementation process as illustrated in Figure 2.

2.2. Determining the CCP (Critical Control Point)

A Critical Control Point (CCP) refers to a stage in the process where specific control measures can be implemented to prevent, eliminate, or minimize food safety hazards to an acceptable level (Codex, 2017). CCPs are directly associated with managing significant hazards that impact food safety. This determination is made after all potential hazards and their corresponding control measures have been identified, meaning that a critical control point is established to ensure food safety throughout the process (Fakhmi, et.al., 2013).

One of the most effective ways to determine and identify each CCP within a process is by utilizing a process flow diagram, which functions as a practical tool. Potential points within the production process can be identified where hazards may be prevented, removed, or minimized to an acceptable level. (Kurniawan, 2016).

To determine which stages, qualify as CCPs, a **decision tree** approach is commonly employed. Figure 3 illustrates the sequence of questions used in the CCP decision tree

(Koswara, 2023). The CCP decision tree consists of five key questions as follows:

a. Is there a control measure in place? (Q1)
b. Is control at this step necessary for food safety? (Q1a)
c. Is this step specifically designed to eliminate or reduce the likely occurrence of a hazard to an acceptable level? (Q2)
d. Could contamination with the identified hazard occur at an unacceptable level, or could it increase to an unacceptable level? (Q3)
e. Will a subsequent step eliminate the identified hazard or reduce its likely occurrence to an acceptable level? (Q4)

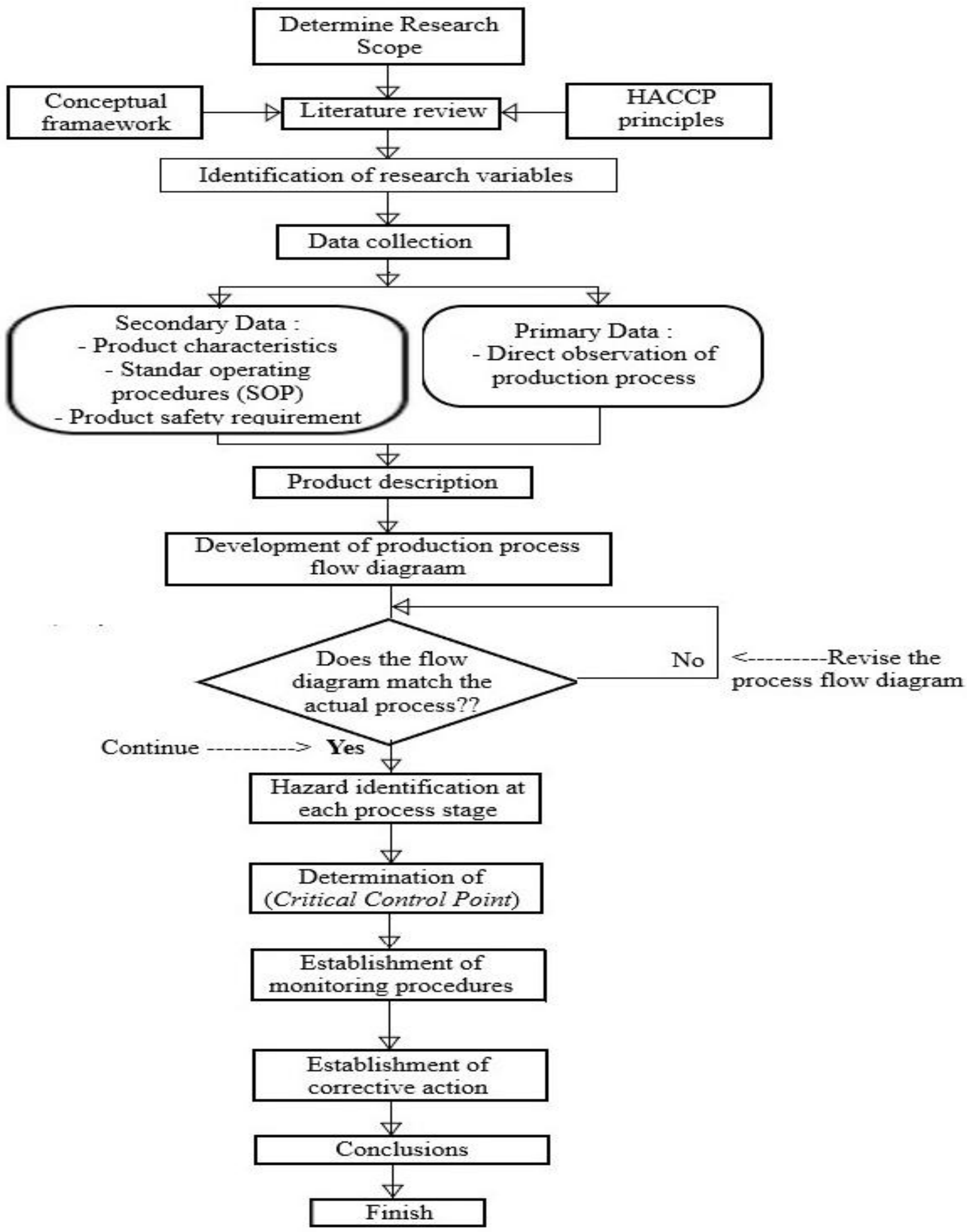


Figure 2. Research Procedure for the Implementation of HACCP in Malt Candy Products.

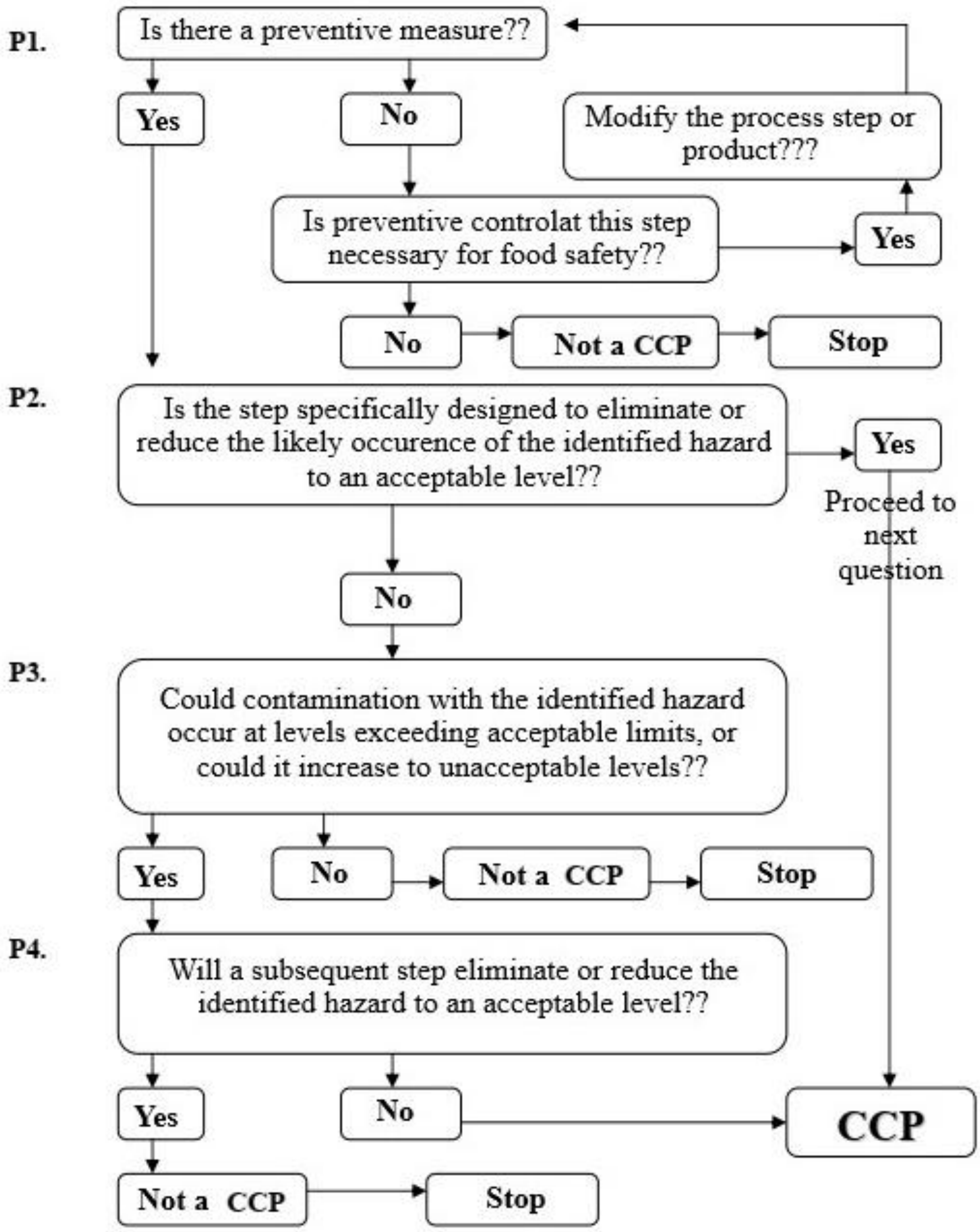


Figure 3. Decision Tree Diagram for Determining the CCP (Critical Control Point)

3. RESULTS AND DISCUSSION

3.1. Interpretation of Result

This study discusses the implementation of the HACCP system within the company's production process. The application of HACCP enables the systematic categorization of potential hazards and the establishment of a control system focused on preventing the occurrence of such hazards at critical points (Hendy Et al., 2022). Through the effective implementation of HACCP, it is expected that the resulting food products will be free from potential hazards and meet established food safety standards (Bhernama, 2017).

3.2. Product Description

The product to be analyzed using the HACCP system is malt candy**.** A detailed description of malt candy can be seen in the following Table 1.

Table 1. Product Specification of Malt Candy.

No.	Specification	Description
1	Product Name	Malt Candy
2	Product Characteristics	Intermediate product (semi-finished raw material).
3	Composition	As presented in Table 9, which lists all ingredients used in the formulation.
4	Processing Method	As illustrated in Figure 11, describing the manufacturing process of malt candy.
5	Preservation Method	Stored at a controlled room temperature between 22°C and 24°C.
6	Packaging	Primary Packaging: Polyethylene (PE) plastic bag, size 60 × 80 cm. Secondary packaging: Bucket (outer protective wrap).
7	Packaging for Distribution	Secondary packaging is arranged on pallets and tightly secured using shrink wrap.
8	Storage Conditions	Maintained at room temperature between 22°C and 24°C.
9	Distribution Method	Distributed using a forklift to designated departments.
10	Shelf Life	30 days under standard room temperature storage conditions.
11	Labeling	Includes product name, product code, quantity, expiration date, and transfer date.
12	Usage Instructions	Functions as a semi-finished raw material to be supplied to other departments for further processing.
13	Special Product Handling	Both plastic and jolang packaging must be tightly sealed, and storage temperature must comply with standard storage requirements.

3.3. Identification of Product Usage Objectives

The key ingredient used in malt candy is malt extract, which is derived from germinated cereal grains commonly barley, which has undergone the malting process (Pawestri. S, 2022) Malt extract contains enzymes such as α-amylase and β-amylase, which convert starch in the grains into simpler sugars, including monosaccharides (glucose), disaccharides (maltose), trisaccharides (maltotriose), and the polysaccharide maltodextrin. Additionally, protease enzymes hydrolyze cereal proteins and can be utilized as yeast nutrients during fermentation. Malt also contains small amounts of sucrose and fructose.

Malt candy is a type of hard candy produced through a heating process using an oven, resulting in a texture that is neither too hard nor too soft or elastic like most commercial candies. The product has a porous and hollow internal structure, giving it a light and melt-in-the-mouth texture when consumed. This unique texture is achieved through the addition of a leavening agent during processing.

Malt candy serves as a semi-finished raw material that is subsequently distributed to another department for further processing. The distribution process involves the use of pallets, and the products are transported using forklifts to the next department, where a chocolate coating process is carried out. After coating, the candies are packaged in aluminum foil and distributed to consumers.

3.4. Preparation of Process Flow Diagram

The preparation of the process flow diagram provides a detailed illustration of the entire production process of malt candy, beginning from raw materials to the formation of a semi-finished product. The flow diagram includes comprehensive information on all operational activities within the production line, such as inspection, transportation, storage, input materials used in the process, and outputs generated, including waste and reprocessed products.

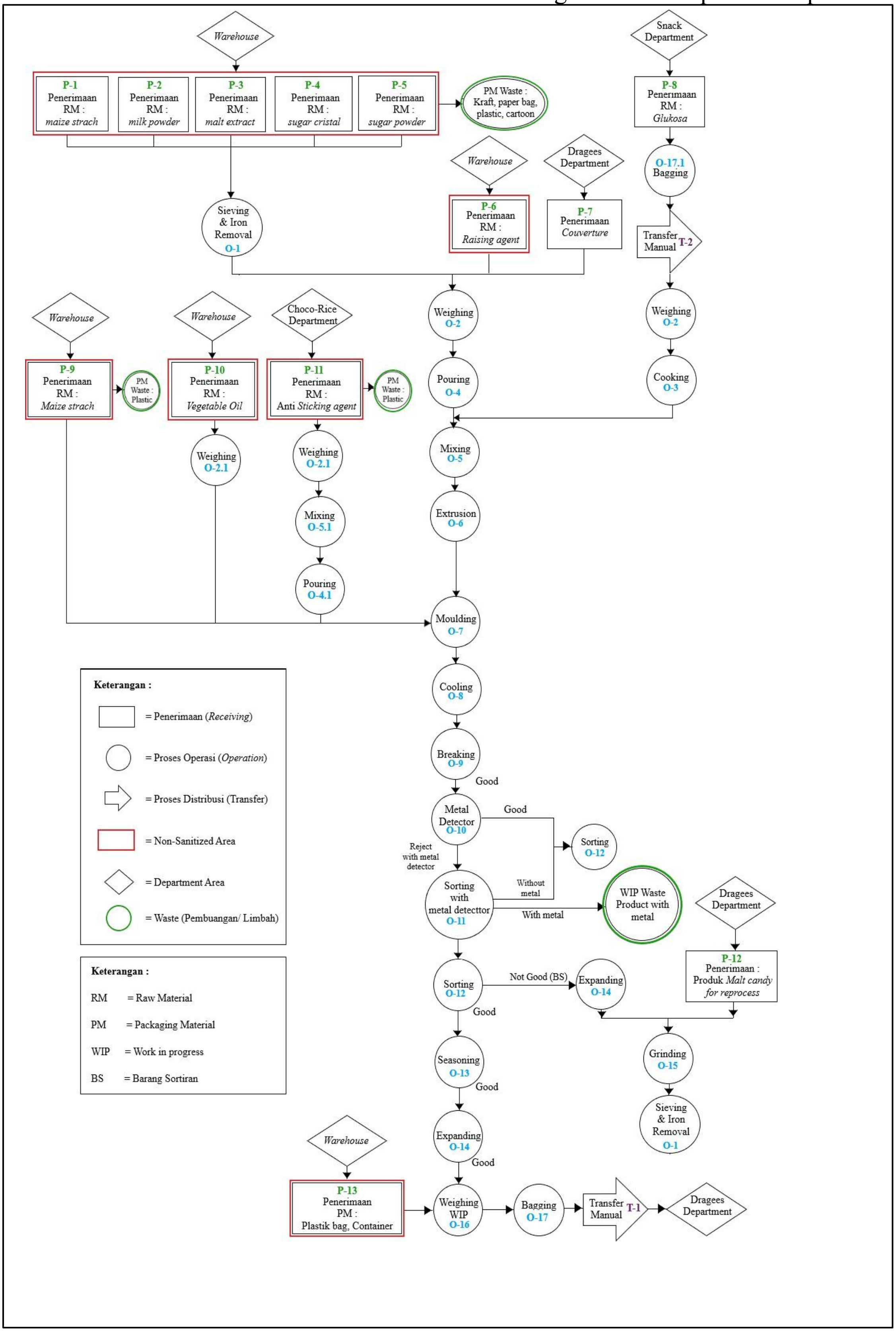


Figure 4. Process Flow Expanded Candy HACCP Plan

In the production of malt candy, most raw materials are supplied from the warehouse, while a small portion originates from other departmental areas. Raw materials sourced from the warehouse are handled within a non-sanitary area; therefore, proper and careful handling is required to control and prevent contamination between products. The distribution of the semi-finished malt candy product is also carried out through manual handling. The visual depiction of process steps malt candy production is presented in Figure 4.

3.5. Hazard Analysis

Within the HACCP framework, hazard analysis serves an essential function in maintaining food safety (Sa'diyah, K., 2024). This process encompasses key elements such as identifying potential hazards, evaluating their significance, and determining suitable preventive actions, as presented in Table 2 below.

Table 2. Hazard Analysis of Malt Candy Products and Raw Materials.

No	Material	Hazard Identification	Cause	Corrective Action
1	Malt Candy Product	Physical: Dust or hair contamination	1. Improperly cleaned bucket (secondary packaging) 2. Poor GMP implementation among workers	1. Conduct monitoring and inspection of all tools prior to use 2. Provide regular GMP briefings and training for workers
		Chemical: Metal contamination	Worn or chipped equipment and machinery	Inspect all equipment and pass products through a metal detector
		Biological: Bacterial contamination	Workers not wearing gloves	Require workers to wear gloves and replace them regularly
2	Glucose Syrup	Physical: Dust and dirt contamination	Unclean packaging material	Conduct regular inspection before use and perform filtration of raw materials
		Chemical: Metal contamination	Contamination from supplier	Perform raw material inspection prior to processing
		Biological: Mold growth	Improper storage temperature	Ensure that storage temperature is properly maintained and monitored regularly
3	Sugar Powder	Physical: Foreign material contamination	Poor handling during raw material distribution	Inspect materials upon arrival before processing
4	Malt Extract Powder	Physical: Foreign material contamination	Poor handling during raw material distribution	Inspect materials upon arrival before processing
5	Whey Powder	Physical: Foreign	Poor handling during raw material distribution	Inspect materials upon arrival before processing

		material contamination		
6	Skim Milk Powder	Physical: Foreign material contamination, clumping, rancid odor	Improper storage and exposure to light, open air, or heat	Inspect materials upon arrival; ensure packaging is tightly sealed and stored away from direct light or heat sources
7	Couverture Chocolate	Physical: White specks (*choco bloom*), rancid odor	1. Improper tempering process or incorrect storage 2. Excessive heat exposure	1. Monitor room temperature during production 2. Control temperature and humidity in production area 3. Maintain appropriate storage temperature and packaging conditions
8	Vegetable Oil	Physical: Rancid odor and discoloration	Improper storage and excessive heat exposure	Monitor temperature and packaging conditions during storage; store oil in sealed and appropriate containers
		Chemical: Oil residue	Inadequate filtering or refining process	Inspect oil upon arrival before use
9	Anti-Sticking Agent	Physical: Foreign material contamination	Improper storage method	Store materials in a dry and sealed container
10	Raising Agent	Physical: Foreign material contamination	Improper storage method	Store materials in a dry and sealed container
11	Maize Starch	Physical: Foreign material contamination and clumping	Residual corn fibers left during milling or poor storage conditions	Inspect raw materials upon arrival and ensure storage in a dry and sealed container

In the malt candy production process, several potential hazards were identified in the raw materials, including physical, chemical, and to a lesser extent, biological contamination. Physical contamination primarily originates from foreign materials such as hair, dust, and fragments of packaging materials used for raw ingredients, including plastic, paper, or cardboard. Additionally, physical contamination may also occur from the raw materials themselves, for instance, maize starch that may still contain fine corn fibers or husk residues.

Another example of physical contamination is the appearance of white specks on the surface of chocolate, known as *choco bloom*. This condition typically results from an improper chocolate tempering process caused by suboptimal room temperature specifically, temperatures lower than the required production standards. Therefore, continuous monitoring of room temperature and humidity within the production area is essential.

For raw materials with high fat content, such as vegetable oil and skim milk powder, physical contamination may be indicated by rancid odors or discoloration. These issues commonly arise due to improper storage conditions or exposure to excessive heat and light, which accelerate oxidative degradation. Consequently, vegetable oil must be stored in tightly sealed containers and kept at stable, moderate temperatures away from direct sunlight or heat sources to prevent rancidity.

Chemical hazards identified in the production process mainly include the presence of metal contaminants (Murti, 2022). These may originate from the supplier; therefore, upon arrival, all raw materials are inspected by the relevant department to assess their condition. Furthermore, vegetable oil may contain residual contaminants if subjected to inadequate refining or improper storage, especially when exposed to high temperatures during distribution. To mitigate this, all incoming materials undergo a raw material inspection immediately upon delivery.

Biological contamination generally arises from cross-contamination during manual handling of raw materials, particularly in unsanitary areas where hygiene practices are less controlled. The most common biological contaminants identified are bacteria and molds. Bacterial contamination often results from unhygienic handling during supply or improper storage conditions in the warehouse. Mold contamination, on the other hand, tends to occur under low-temperature storage conditions that favor fungal growth. To minimize these potential contaminations, all raw materials are subjected to random sampling upon arrival, followed by analytical testing in accordance with quality and safety requirements. The following Table presents the risk categories of raw materials as classified by the Indonesian National Agency of Drug and Food Control (BPOM).

Table 3. Risk categories of raw materials *Malt Candy*

Type	**Aw**	**pH**	**Categories**						**Risk**
			P1	**P2**	**P3**	**P4**	**P5**	**P6**	
Milk skim	0.6	6.6-6.8	No	No	No	No	-	Yes	Low
Glukosa syrup	0.9	4.78	No	No	No	Yes	No	No	Medium
Sugar powder	0.2	5.8-7.2	No	No	No	No	-	Yes	Low
Maize starch	0.62	6-6.8	No	No	No	No	-	Yes	Low
Malt powder	0.34	6.1	No	No	No	No	-	Yes	Low
Whey powder	0.6	5.2	No	No	No	No	-	Yes	Low
Vegetable oil	0.13	4-6.5	No	No	No	No	-	Yes	Low
Couverture	0.76	6.1-6.3	No	No	No	No	-	Yes	Low
Hard candy	0.71	3.6 – 3.7	No	No	No	No	-	Yes	Low

From the Table above, it can be concluded that 87.5% of the raw materials used fall into the low-risk category. Therefore, hard candy is classified as a type of food product with low-risk raw materials (Category III). The significance or risk level of hazards in the malt candy production process is presented in a risk category determination Table, where the risk factor is derived from the assessment of probability multiplied by the severity at each stage of the process. For non-significant categories, the values include LL, LM, LH, ML, HL, and MM, whereas the significant categories include HM*, MH*, and HH*.

The process stages categorized as non-significant in terms of hazard severity are the preparation of raw materials and equipment, mixing, moulding, cooling tunnel, breaker, sorting, expanding oven, weighing (WIP), bagging, and transferring. Conversely, the stages identified as significant hazards are the cooker, extruder, and metal detector processes. Stages that fall under significant hazards are considered for Critical Control Point (CCP) determination, indicating that these stages have higher potential risks and therefore require more frequent monitoring.
Based on the assessment results from the risk evaluation matrix, differences were observed in the significance levels. The risk

assessment matrix classifies low significance (100–1,000), medium significance (10,000–100,000), and high significance (1,000,000), which can be directly applied in CCP determination (Awangsih, 2023). Here, **s** represents *severity* and **r** represents *reasonably likely occurrence* (probability). The matrix results prioritize the stages with the highest probability values. Consequently, processes categorized as having low significance include moulding, weighing (WIP), mixing, transferring (WIP), and breaker; medium significance includes cooling tunnel, raw material preparation, and sorting; while high significance, which can be directly used in CCP determination, includes extruder, cooker, and metal detector.

Table 4. Risk Assessment Matrix for the Malt Candy Production Process.

(Reasonably) **r**	***(Severity)*** **s**		
	Low Hazard Severity **(10)**	***Medium Hazard Severity*** **(100)**	***High Hazard Severity*** **(1000)**
Low Risk **(10)**	s.r (10x10 = 100)* • Prepare raw material • Moulding • Sorting • Weighing WIP	s.r (100x10 = 1.000)* • Expanding oven • Transfering WIP • Breaker	s.r (1000x10 = 10.000)* • Sorting • Prepare raw material
Medium Risk **(100)**	s.r (10x100 = 1.000)* • Mixing • Sorting	s.r (100x100 = 10.000)* • Cooling tunnel	s.r (1000x100 = 100.00)* • Cooker
High Risk **(1000)**	s.r (10x1000 = 10.000)* • Expanding oven	s.r (100x1000 =100.000) * • Extruder	s.r (1000x1000 =1.000.000)* • Metal detector

*Low significance (100–1,000), medium significance (10,000–100,000), and high significance (1,000,000) can be directly applied in the determination of Critical Control Points (CCP).

The difference in conclusions from the two assessment methods arises because the significance assessment using the matrix approach is more specific and uses quantitative scoring, allowing a clearer classification of which stages fall into low, medium, or high significance categories.

The metal detector process can be directly categorized as a CCP, as its significance Table result is HH* and its matrix significance score is 1,000,000. The presence of metal contamination in food products poses a serious risk to consumer safety; therefore, corrective actions must be carefully defined in the event of contamination. Ensuring that products are free from metal contaminants also serves as a form of brand and quality protection for the company. Metal contamination may originate from raw materials or from the daily operation of production equipment. Contaminated products can then be removed from the production line, ensuring that contamination does not reach consumers. In most production lines, metal detection in final packaged products constitutes a Critical Control Point (CCP), as manufacturers must guarantee product safety for consumption (Yuwana, 2024). Many manufacturers choose to install metal detectors both at the beginning of the production line and at the final stage of packaging. Positioning he use of metal detection systems at several process points helps ensure product quality while minimizing waste and production downtime.

3.6. Determination of Critical Control Points (CCP).

A Critical Control Point (CCP) is defined as a specific stage, step, or procedure in which control measures can be implemented to prevent, remove, or minimize food safety hazards to an acceptable level. (Hasniani,.et al, 2024). The determination of CCPs is based on monitoring the hazard analysis conducted throughout the production process. When the level and type of hazard identified are high, certain processes require special attention and the implementation of CCP actions. The establishment of CCPs follows the Decision Tree approach, as illustrated in Figure 2. The analysis of critical control points using the decision tree is presented in the following Table 5.

CCP determination relies on the questions presented in the decision tree diagram. It contains logical questions regarding each hazard, and the answers to these questions help determine whether a process step qualifies as a Critical Control Point (CCP) or not. A process is identified as a CCP if, during malt candy production, it involves a hazard that cannot be eliminated by subsequent processes, or if it is the step where the hazard is specifically controlled or removed. The critical point in malt candy production is as follows:

1. Metal Detector

The metal detector process (O-10) is the most critical point, as any product passing through undetected and reaching consumers could have fatal consequences, directly affecting consumer safety. In this process, all produced materials are passed through the metal detector to ensure that all items proceeding to the next stage are free from metal contamination. Accumulation of metal in the human body may result in considerable risks to consumer healthmaking the metal detector the most critical control point (Febriana, Ike. 2019).

Table 5. Determination of CCP in the Malt Candy Production Process.

No	Process Step	Hazard Identification	Q1	Q1a	Q2	Q3	Q4	CCP
			Yes = Q2	Yes = Modification	Yes = CCP	Yes = Q4	Yes = Not a CCP	
			No = Q1a	No = Not a CCP	No = Q3	No = Not a CCP	No = CCP	(No / CCP)
O-1 s/d O-2	Prepare raw material and machine	Physical: contamination from plastic or paper fragments	Yes	-	No	Yes	Yes	Not a CCP
		Chemical: chemical residues from cleaning agents	Yes	-	No	Yes	Yes	Not a CCP
		Biological: cross-contamination by pathogenic bacteria	Yes	-	No	Yes	Yes	Not a CCP
O-3	*Cooker*	Physical: color, taste, and aroma not appropriate	Yes	-	No	Yes	Yes	Not a CCP
O-5	*Mixing*	Physical: contamination from fragments of plastic, thread, or paper	Yes	-	No	Yes	Yes	Not a CCP
		Biological: cross-contamination by bacteria	Yes	-	No	Yes	Yes	Not a CCP
		Physical: color and aroma not appropriate	Yes	-	No	Yes	Yes	Not a CCP
O-6	Ekstruder	Chemical: metal fragments	Yes	-	No	Yes	Yes	Not a CCP
O-7	*Moulding*	Physical: contamination	Yes	-	No	Yes	Yes	Not a

		by dust and foreign objects						CCP
O-8	*Cooling Tunnel*	Physical: inappropriate texture	Yes	-	No	Yes	Yes	Not a CCP
O-9	*Breaker*	Physical: contamination by dust and foreign objects	Yes	-	No	Yes	Yes	Not a CCP
		Chemical: contamination by metal fragments	Yes	-	No	Yes	Yes	Not a CCP
O-10	*Metal Detector*	Physical: contamination by foreign objects (metal fragments)	Yes	-	Yes	-	-	CCP
		Chemical: contamination by metal fragments	Yes	-	Yes	-	-	CCP
O-12	Sortasi	Physical: presence of foreign object contamination	Yes	-	No	Yes	Yes	Not a CCP
		Biological: cross-contamination by bacteria	Yes	-	No	Yes	Yes	Not a CCP
O-14	*Expanding Oven*	Physical: inappropriate shape and size	Yes	-	No	Yes	Yes	Not a CCP
		Chemical: presence of gas	Yes	-	No	Yes	Yes	Not a CCP
O-16	*Weighing WIP*	Physical: contamination by dust and foreign objects	Yes	-	No	Yes	Yes	Not a CCP
		Biological: cross-contamination by bacteria	Yes	-	No	Yes	Yes	Not a CCP
T-1	*Transfering*	Physical: Damage product	Yes	-	No	Yes	Yes	Not a CCP
		Biological: contamination from *unsanitized area*	Yes	-	No	Yes	Yes	Not a CCP

For processes other than the metal detector, hazard control can be managed by subsequent steps, so these processes are not considered CCPs. If metal contamination is detected in a production batch, the affected product must be immediately segregated from the main production line and clearly labeled with a pallet tag indicating the presence of contamination. This segregation step is essential to prevent the spread of contaminants and to ensure traceability of the affected batch. Following segregation, the metal detector should be recalibrated and its performance verified by the authorized quality assurance or maintenance team to confirm that it is functioning accurately and in compliance with established standards. Only after successful verification may the contaminated batch be reprocessed through the detection system. If contamination is still detected after reprocessing, the batch must be re-isolated, subjected to further investigation to identify the root cause of the contamination, and formally documented through an Extra Ordinary Report (EOR).

Each piece of equipment used in the production process must be regularly monitored and controlled to ensure hygiene and product safety. Additionally, the application of protective materials such as plastic coatings can be implemented to prevent direct contact between machine surfaces and food products. In the mixing machine, a metal detection system is also applied to identify and separate materials if any metal contamination is detected during the mixing process (Mafaza, 2022).

3.7. Determination of Critical Limits for Each CCP

Table 6. Critical Limits in Malt Candy Production.

No	Process step	No. CCP	Critical limit
O-10	*Metal Detector*	CCP-1	Metal fragments • 1.0 mm Fe • 1.2 mm Non-Fe • 1.5 mm SS (*Stainless Steel*)

The metal detector is considered a CCP because, without this process, the safety of the produced product cannot be guaranteed.

The purpose of HACCP is to prevent and reduce the risks associated with production defects and food safety hazards (Prayitno, 2018).

3.8. Monitoring of Each CCP

Monitoring procedures are the planned steps of observing or measuring critical limits to produce accurate records and ensure that these limits are capable of maintaining product safety. Monitoring procedures may include observations recorded on a checklist. The monitoring procedures for malt candy production are presented in the following Table 7

Table 7. Monitoring Procedures in Malt Candy Production

No. CCP	Process step	(*Monitoring*)				
		What?	Why?	How?	When?	Who?
CCP-1	*Metal Detector*	Device sensitivity	To prevent errors in the equipment and ensure proper operation	Routine calibration; check sensitivity by passing each test card once	Pass test card once every 2 hours, during product changeover, and after any adjustment or maintenance of sensitivity	Operator, Group Leader, and QC Technician

Based on the Table above, machine operators and group leaders are required to monitor and report any deviations to the production supervisor. Therefore, machine operators must be familiar with and study the applicable Work Instructions (WI) and participate in training, including proper operating procedures, machine operation, correct cleaning processes, Good Manufacturing Practices (GMP), and personal hygiene training. This ensures that everyone involved with CCPs, both operators and group leaders, fully understands how to manage and respond to any issues.

Corrective Action (CA) helps determine the occurrence of Critical Control Points (CCPs) through the evaluation of deviations from established critical limits. When monitoring results indicate a deviation, CA is employed to identify the root cause and assess whether the failure occurred at a point critical to food safety. Thus, CA plays an essential role in confirming that a particular stage in the process is indeed a CCP, as any deviation at that point directly impacts product safety. Moreover, data derived from the implementation of CA can be utilized to evaluate the effectiveness of the HACCP system and to revise CCP identification when necessary.

3.9. Determination of Corrective Action

The corrective actions for each CCP in malt candy production are presented in the following Table 8. The control stage represents the final phase of the analysis process, focusing on the documentation and dissemination of the actions that have been implemented (Rahayu. B.S., 2020). Corrective actions for the metal detector process are divided into two categories: for the machine and for the product. Machine-related corrective actions involve halting all operations if metal contamination is detected.

Product-related corrective actions involve separating and isolating contaminated products, dividing them into smaller packages, and passing them again through the metal detector (Siregar, 2017).

If metal contamination is found, the entire production process is inspected to identify the source of the contamination from the processing equipment. Once the source is identified, the machine causing the contamination is repaired and evaluated by the relevant team. Before resuming production, the machine must also receive approval from the QA department and be closely monitored during production. This procedure continues until no further metal contamination occurs from that machine. Subsequently, verification is conducted for each production process to ensure that the entire production line is safe and compliant with standards.

Table 8. Corrective Actions for Each CCP in Malt Candy Production

No. CCP	Process Step	Hazard	Corrective Actions Implemented by the Company	Corrective Actions By (Asriani., et al., 2023)
CCP-1	Metal Detector	Metal contamination	For the Machine: - STOP the machine - Call a technician for repair - If it cannot be repaired, the supervisor contacts the relevant supplier For the Product: - Check rejected products by passing them through the metal detector - Products that pass the metal detector are packaged if visually acceptable or reprocessed if not - If the metal detector is damaged, isolate and hold products starting from the last successfully inspected item, then pass them through a functioning metal detector - Isolate contaminated products, conduct an investigation, and issue an Extra Ordinary Report (EOR) if necessary	Corrective actions at the meta detection stage involve twc aspects: product and equipment Products containing meta fragments must be rejected anc separated to preven contamination. For equipment actions include isolating affected products, checking detector performance anc sensitivity, and repairing any malfunction before resuming production. These measures ensure effective detection, fooc safety, and compliance witl GMP and HACCP standards.

3.10. Determination of Verification Procedures

For each CCP, Quality Control (QC) personnel and the Production Supervisor (Spv) perform inspections before, during, and after machine operation to ensure that the machinery remains in proper condition and is suitable for production. This ensures that CCPs are under control and allows immediate corrective actions if any deviations or violations occur. The verification procedures are presented in the following Table 9.

Table 9. Verification Process in Malt Candy Production

No. CCP	Process Step	Verification	Inspection	Responsible Party
CCP-1	Metal Detector	Engineering	Check metal detector sensitivity using test card once per shift	QC
			Check metal detector sensitivity using test card once per shift	Production Supervisor (Spv)
			Verify metal detector settings every 6 months	Engineering Supervisor

No. CCP	Process Step	Verification	Inspection	Responsible Party
			Check metal detector sensitivity using test card every month	QA Supervisor (Spv QA)
			Inspect iron content in Finished Goods (FG) every month	QA Supervisor (Spv QA)

Verification of the production process under HACCP standards includes both internal and external audit methods. Internal audits are conducted through GMP audits. Verification of equipment involves calibration of necessary tools. Calibration is performed internally by calling the relevant technical personnel and externally by involving the equipment supplier.

3.11. HACCP Plan or Control Map

The implementation of the 5W 1H (What, Why, Where, When, Who, How) method serves as an analytical framework designed to obtain comprehensive information regarding a particular event or issue. This approach ensures a more structured identification of problems and formulation of solutions to achieve optimal outcomes. The analysis of 5W 1H implementation aims to effectively address problems and provide improvements related to the factors causing the alarm locking mold occurrence (Hermawan. D, 2022).

The control map for the malt candy production process represents a compilation of all HACCP principles that have been implemented.

Table 10. HACCP Plan (Control Map) for Malt Candy

No. CCP	Process Step	Hazard Type	CCP Parameter	Critical Limits	Monitoring	Corrective Actions	Verification	Records / Documents
CCP-1	Metal Detector	Metal contamination	Device sensitivity	Metal fragments: • 1.0 mm Fe • 1.2 mm non-Fe • 1.5 mm SS (Stainless Steel)	What: metal detector sensitivity Why: To prevent equipment errors and ensure routine calibration How: Check sensitivity by passing each test card once When: Pass test card once every 2 hours, during product	For the Machine: - STOP the machine - Call a technician for repair - If it cannot be repaired, the supervisor contacts the supplier For the Product: - Inspect rejected products by passing them through the metal detector - Products	Machine Operator, Group Leader, QC, and Supervisor	- Foreign Material training material - Attendance list of training - Training evaluation - Foreign Material form

No. CCP	Process Step	Hazard Type	CCP Parameter	Critical Limits	Monitoring	Corrective Actions	Verification	Records / Documents
					changeover, and after any adjustment or maintenance by technician Who: Operator, Group Leader, QC Where: In production process	that pass are packaged if visually acceptable or reprocessed if not - If metal detector is damaged, isolate and hold products starting from the last successfully inspected item, then pass through a functioning metal detector - Isolate contaminated products, investigate, and issue an Extra Ordinary Report (EOR) if necessary		

4. CONCLUSIONS AND RECOMMENDATIONS

The results of this study demonstrate the successful implementation of the HACCP (Hazard Analysis Critical Control Point) principles in the malt candy production process. The study produced a comprehensive HACCP control map, which includes the identification of Critical Control Points (CCPs), the associated process steps, types of hazards, hazard parameters, critical limits, and monitoring procedures specifying what, why, how, when, and who is responsible. In addition, the map outlines corrective actions and verification procedures, including detailed records and documentation. The application of HACCP ensures that potential hazards physical, chemical, and biological are systematically identified, monitored, and controlled throughout the production process, thereby enhancing product safety and compliance with food safety standards. Based on the findings, it is recommended that the production team maintains routine monitoring and verification of all CCPs, conducts periodic training for operators and supervisors on HACCP procedures, and continuously updates the HACCP plan whenever new hazards or process changes are identified. Furthermore, the use of metal detectors and other critical control measures should be strictly adhered to, and all corrective actions and documentation should be thoroughly recorded to ensure traceability and ongoing improvement in food safety management.

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REFERENCES

A, Mega. S.J.N dan Nalawati, A.N. (2024). Study of The Application of Hazard Analysis and Critical Control Point (HACCP) in Chocolate Bar Processing (Case Study at PTPN XII Kendeng ßlembu Banyuwangi). Journal of Food Industrial Technology Vol. 1, No. 2, Mei 2024, 73-86 DOI: https://doi.org/10.25047/jofit.v1i2.4921 E-ISSN. 3032-4963

Asriani, Yuniarti. T, Indratama, A. (2023). Quality, Basic Feasibility, and Implementation of Hazard Analysis Critical Control Point (HACCP) in Frozen Cooked Shrimp Processing at PT. XYZ. Buletin Jalanidhitah Sarva Jivitam, 5 (2), 2023, 149-165. DOI: http://dx.doi.org/10.15578/bjsj.v5i2.13142

Awangsih, W,. & Juwitaningtyas, T,. (2023). Determination of Critical Control Points in the Chocolate Bar Production Process at PT Aneka Coklat Kakoa Bandar Lampung. Jurnal Ilmiah Teknosains, Vol 9(1). p-ISSN 2460-9986. DOI: https://doi.org/10.26877/jitek.v9i1/Mei.12752

Azhary, Zainur.R., Sumiyanto, S., Mulyani, H., & Sipahutar, Y.H. (2022). Establishment of Critical Control Points (CCP) in the Processing of Cobia Fish (Rachycentron canadum) Panko Bites and Export Requirements to the United States. *Prosiding*. Seminar Nasional Perikanan Indonesia Ke-23. Politeknil AUP, Jakarta, 23-24 Agustus 2022. DOI: http://dx.doi.org/10.15578/psnp.12100

Bhernama, B.G,. (2017). Study of Hazard Analysis Critical Control Point (HACCP) on Unlabeled Soft Drink Products Sold by Street Traders in Banda Acah. Jurnal of Islamic Science and Technology Vol 3(2). DOI: https://doi.org/10.22373/ekw.v3i2.2097

[CAC] Codex Alimentarius Commission. The Science of food standards. [Accessed on June 2, 2025]. Available from: https://openknowledge.fao.org/items/2bb27778-26f7-4db8-9bf7-a6f1ed5ab752

Fakhmi, A., Rahman, A., & Riawati, L. (2013). Design of a Food Safety System (Hazard Analysis and Critical Control Points — HACCP) for the Sugar Production Process at PG Kebon Agung, Malang.Jurnal Rekayasa dan Manajemen Sistem Industri Vol 2(6). Teknik Industri Uniiversitas Brawijaya.

Febriana, Ike,. Dan Prayogo. (2006). Determination of The CCP (Critical Control Point) on The Production Whole Round Tiger Grouper (Ephinephelus fuscoguttatus) in PT. Alam Jaya

Surabaya, East Java. Journal of Marine and Coastal Science Vol 8(2):73. DOI:10.20473/jmcs.v8i2.21151

Hasanah, N.L, et al. (2022). Food Safety and Food Security. Publisher: PT Global Eksekutif Teknologi, ISBN: 978-623-8102-57-0.

Hasniani. Ridwan, M,.& Waliono, A.R. (2024). Determination of Critical Control Points (CCP) in the Canning Process of Lemuru Fish (*Sardinella* sp.) at PT Sarana Tani Pratama, Bali. Botani: Publikasi Ilmu Tanaman dan Agribisnis, Vol 1(3), 123-135. DOI: https://doi.org/10.62951/botani.v1i3.108

Hendy, Saputra. M., Khoiriyah. N., & Fatmawati, W. (2022). Quality Control Using the HACCP Method on 'Zahra' Madu Mongso Products (A Case Study at the Rohmah Food Home Industry in Kudus). *Jurnal Aplikasi Ilmu Teknik Industri (JAPTI)*, *2*(2), 112–124. DOI: https://doi.org/10.32585/japti.v2i2.2168

Hermawan. D., Ginantaka. A., & Syarbaini. A. (2022). Risk analysis of production machinery maintenance at pt. xyz uses fuzzy failure mode and effect analysis method: case study in amdk industry. Agroindustrial Technology Journal 08(2) 94-111. DOI: http://doi.org/10.21111/atj.v8i2.12116

Koswara, Sutrisno. (2009). HACCP dan Penerapannya Pada Produk Bakery. [Accessed on June 5, 2025]. Available from: https://tekpan.unimus.ac.id/wp-content/uploads/2013/07/HACCP-DAN-PENERAPANNYA-DALAM-INDUSTRI-BAKERY.pdf

Koswara, Sutrisno. (2023). HACCP (Hazard Analysis and Critical Control Point) Plan Model for the Chili Sauce Industry. [Accessed on September 25, 2025]. Available from: https://repository.ipb.ac.id/jspui/bitstream/123456789/122258/1/MODEL%20GENERIK%20RENCANA%20HACCP%20INDUSTRI%20%20SAUS%20CABE.pdf

Kurniawan, Wawan. (2016). Determination of Critical Control Points (CCP) and Monitoring within the Hazard Analysis and Critical Control Point (HACCP) Management System (Case Study: PT X Food Industry). *Prosiding.* Seminar Nasional Sains dan Teknologi Semnastek FTUMJ. [Accessed on October 25, 2025]. Available from: https://jurnal.umj.ac.id/index.php/semnastek/issue/view/94 p-ISSN: 2407-1848. E-ISSN: 2460-8416.

Mafaza, Anim., dan Kumalasari, I.D. (2022). Analysis of the Implementation of Hazard Analysis and Critical Control Points (HACCP) in the Oriflakes Production Process at PT. Serelia Prima Nutrisia, Yogyakarta. Agroindustrial Technology Journal 06(2) 175-187. DOI: http://dx.doi.org/10.21111/atj.v6i2.8471

Mahbubah, Febriyanti Shobaqiyatul. (2022). Implementation of Hazard Analysis and Critical Control Points (HACCP) in the Freezing Process of Vannamei Shrimp (Litopenaeus vannamei) in PND (Peel and Deveined) Form at PT Istana Cipta Sembada, Banyuwangi, East Java. Politeknik Kelautan dan Perikanan Sidoarjo. [Accessed on September 5, 2025]. Available from: https://repository.poltekkpsidoarjo.ac.id/id/eprint/299/

Morkis, Grażyna. (2010). The Level of Implementing GHP, GMP, and HACCP Systems into the Food Industry. Food Science Technology Quality. DOI: https://doi.org/10.15193/zntj/2010/73/255-270

Murti, Widyana. (2022). Critical Control Point Control in Chocolate Chip Products at PT XYZ. [Accessed on 11 September 2025]. Available from: http://repository.iti.ac.id/xmlui/handle/123456789/1201

Pawestri, Setyaning. (2022). Malt as a Flavor and Nutritional Enhancer. [Accessed on June 2, 2025]. Available from: https://linisehat.com/malt-bahan-ajaib-penambah-cita-rasa-dan-zat-gizi/

Pawestri. S, Perdhana. Et al. (2024). Physicochemical and Sensory Characteristics of Hard Candy Made of Palm Sugar and Trigona Honey. Jurnal Kolaboratif Sains, Vol (7) 9. DOI: https://doi.org/10.56338/jks.v7i9.5783

Prayitno, Sutrisno. A,.& Tjiptaningdyah, R. (2018). Implementation of the 12 Steps of Hazard Analysis and Critical Control Points (HACCP) as a Food Safety System for Fishery-Based Products. Jurnal Agrica Vol. 11(2). DOI: 10.31289/agrica.v11i2.1808.g1681

Rahayu, B.S., Maflahah, I., & Asfan. (2020). Quality Control Analysis in the Freezing Process of Vannamei Shrimp (*Litopenaeus vannamei*) Using Six Sigma. Agroindustrial Technology Journal 04(2) 108-119. DOI: http://dx.doi.org/10.21111/atj.v4i2.4932

Regulation of the Government of the Republic of Indonesia Number 89 of 2019. Food Safety. [Accessed on 5 June 2025]. Available from: https://standarpangan.pom.go.id/dokumen/peraturan/202x/2019-PP_86_th_2019_english_version.pdf

Rochman, S.N., Nurmaydha, A.,& Pratama, G.R. (2020). Implementation of the Hazard Analysis and Critical Control Point (HACCP) System in the Bakery Industry. Agroindustrial Technology Journal 04(1) 53-64. DOI: http://dx.doi.org/10.21111/atj.v4i1.4293

Sa'diyah, K., Ramadhani, L., & Harya, G. I. (2024). Hazard Analysis and Critical Control Points (HACCP) in the Product Design of Orange Fruit Juice Beverages at PT Zestful Drink Innovation. *Jurnal Pengabdian Kepada Masyarakat*, *1*(1), Hal 1–19. DOI: https://doi.org/10.3342/jkepmas.v1i1.233

Sari, L., Nugroho, S. D., & Yuliati, N. (2022). Implementation of Hazard Analysis and Critical Control Points (HACCP) in the Production Process of Cooked Peeled Tail-On Shrimp at PT X. *Technomedia Journal*, *7*(3). DOI: https://doi.org/10.33050/tmj.v7i3.1916

Siregar, Nurtama. G.P,. & Budi. (2017). Metal Detector Validation Process for Critical Control Point Control at PT XYZ. [Accessed on 10 September 2025]. Available from: https://repository.ipb.ac.id/handle/123456789/87246

Siti.N, Susanti. (2016). Control of Pathogenic Microorganisms (Foodreview Indonesia Vol. XII, No. 12, 2016, 'Trendy Bakery' edition, or pustakapangan.com). [Accessed on 10 September 2025]. Available from: https://www.foodreview.co.id/blog-5669064-pengendalian-mikroba-patogen-pada-produk-pangan.html

[SNI] Indonesian National Standard Number 3547.1:2008. Confectionery – Part 1: Hard Candy. [Accessed on 02 June 2025]. Available from: https://pesta.bsn.go.id/produk/detail/7435-sni354712008

Yuwana, N.P, dan Wahyuni, H.C. (2024). Assessing Food Safety Risks in Wafer Production. *Prosiding*. Procedia of Engineering and Life Science Vol. 7 2024. Universitas Muhammadiyah SIdoarjo.