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Designing Food Safety Management and Halal Assurance Systems in Mozzarella Cheese Production for Small-Medium Food Industry

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Abstract: *Indonesia's small and medium-sized enterprises (SMEs) are having difficulty implementing a food safety management and halal assurance system. This article aims to design a food safety and halal assurance system for Dairy Farm SMEs. This research designed a food system by identifying the application of Good Manufacturing Practices (GMP) and the HACCP to Dairy Farm SMEs based on the survey, in-depth interviews, and document standard review. The food safety system was implemented using HACCP, and six Critical Control Point (CCP) processes were identified, including milking (raw material), storage, pasteurization, curd filtering, and cheese packaging. The halal assurance system is implemented at Dairy Farm SMEs by identifying and improving the company's business processes and the mozzarella cheese production process. In addition, a Standard Operating Procedure (SOP) was developed, including a food safety system and a halal assurance system. The research results can be used wisely by Dairy Farm SMEs to assist in obtaining recommendations from the Food and Drug Supervisory Agency and halal certification.*
Keywords: *critical control point, dairy farm SMEs, food safety system, halal assurance system, mozzarella cheese*

1. Introduction

Humans consume food daily throughout their lives (Zhang et al., 2019). Food impacts a person's well-being and health directly or indirectly (Fukuda, 2015; Misselhorn et al., 2012). As a result, safe and high-quality food is critical in society (Nabi et al., 2021; Zhou et al., 2022). The current increase in food poisoning cases demonstrates that industry and society must pay more attention to food product safety (Czarniecka-Skubina et al., 2018; Ehuwa et al., 2021; Rahmat et al., 2016). The food industry is responsible for producing safe food and demonstrating how to plan and implement it by creating a food safety system (Fung et al., 2018; Zanin et al., 2017). One of the primary goals of the food industry is food and beverage hygiene, which includes hygienic design, installation and facility engineering, equipment engineering and component combinations, and maintenance (Shuvo et al., 2019).

The Hazard Analysis and Critical Control Point (HACCP) is the best method to ensure product food safety systems (Oo et al., 2019; Trafialek & Kolanowski, 2017). Over the last few years, many industries worldwide have reduced the proportion of congenital diseases caused by food and beverages (Putri et al., 2019; Trafialek & Kolanowski, 2017). HACCP is a food safety system focusing on prevention strategies for known hazards and risks at critical points in each manufacturing process (Manning et al., 2019; Susanto et al., 2022). HACCP is a systematic approach to identifying, evaluating, and controlling hazards in all stages of the food production process, which is critical for food safety (Liu et al., 2021; Shuvo et al., 2019). HACCP is a method for identifying and controlling microbiologically significant hazards in the food manufacturing process. The term hazard in the HACCP framework refers to an unacceptable food condition that may harm health (Kooh et al., 2020). A critical control point (CCP) is any point or condition in a food system where control can be exercised, or a hazard can be avoided or minimized (Aber et al., 2018). HACCP also helps to ensure

safer food production and improves and maintains the food industry's reputation. In addition, HACCP is a type of legal compliance. The HACCP principle has been adapted for use in developed countries, even in small sectors such as catering and small restaurants, to ensure the safety of the food and beverages served (Awasti et al., 2022; de Oliveira et al., 2016). Apart from HACCP, it is also necessary to implement Good Manufacturing Practices (GMP) (de Oliveira et al., 2016; Sulaiman et al., 2021). Aside from HACCP, GMP and food hygiene practices, as well as a food safety system used in conjunction with Total Quality Management (TQM), are required (van Heerden & Jooste, 2018). Obstacles to implementation include a lack of expertise, legal requirements, cost constraints, and attitudes (Karaman et al., 2012; Kotsanopoulos & Arvanitoyannis, 2017).

Besides safety, the food consumed must also be halal, especially for Muslims (Sani et al., 2020). Indonesia, with the world's largest Muslim population, is increasingly demanding that producers provide food that is not only safe but also halal. Indonesia is also a potential Muslim consumer market, and halal products are increasingly in demand (Azam & Abdullah, 2020). Religion is now a major factor in food production and consumption. Consumers seek foods that are served following their religious teachings as a form of worship and an act to uphold their faith (Iranmanesh et al., 2019; Marzuki et al., 2012). Religion is a determinant of business behavior for food producers and is sometimes used as a guide in ensuring food safety and quality (Ab Talib et al., 2015; Farouk et al., 2014).

Consuming only halal food is a fundamental aspect for a Muslim and an obligation written in the Quran and *sunnah* of the Prophet Muhammad (Ab Talib et al., 2015). Islamic teachings instruct its believers to consume only halal food and refrain from anything that is haram. As stated in the Quran, Allah commands Muslims to eat good food (Al-Baqarah verse 172), and Allah advises the types of food that are prohibited (Al-Mai'dah verse 3):

"O you who have believed, eat from the good things which We have provided for you and be grateful to Allah if it is [indeed] Him that you worship." (Al-Baqarah verse 172).

"Prohibited to you are dead animals, blood, the flesh of swine, and that which has been dedicated to other than Allah, and [those animals] killed by strangling or by a violent blow or by a head-long fall or by the goring of horns, and those from which a wild animal has eaten, except what you [are able to] slaughter [before its death], and those which are sacrificed on stone altars, and [prohibited is] that you seek decision through divining arrows. That is grave disobedience. […]" (Al-Mai'dah verse 3).

Halal means "permitted," whereas haram means "forbidden" or "illegal" (Mohamad & Khairuldin, 2018). Despite its association with ritual slaughter in Islam, the halal doctrine pervades all aspects of life, including business and management (Ab Talib et al., 2015). Currently, halal food is more than just a religious obligation for Muslims; it has also expanded into business and trade. It has become a global symbol of quality and a lifestyle choice that undoubtedly leads to a better one (Anam et al., 2018). As a result, religion significantly impacts food production and demand (Ab Talib et al., 2015; Awan et al., 2015). In addition, the growing Muslim population and non-Muslim acceptance of halal food contribute to the high demand for halal food (Purwanto et al., 2020). It demonstrates that halal food is at the forefront of the global consumer market, with food companies aggressively incorporating halal principles into their business operations (Ab Talib et al., 2015).

In today's business environment, halal should be combined with the values of virtue, purity, cleanliness, safety, and high quality, known as *Halallan-Thoyyiban*. This concept is found in the Quran:

"O mankind, eat from whatever is on earth [that is] lawful and good and do not follow the footsteps of Satan. Indeed, he is to you a clear enemy." (Al-Baqarah verse 168).

The *thoyyiban* in the preceding verse indicates that Islam teaches its followers to consume good food and the obligation to consume halal food. Quality, safety, cleanliness, and purity are all aspects of the *thoyyiban* concept. From the standpoint of the food industry, *Halallan-Thoyyiban* implies that food sources, production, and distribution must be safe and healthy (*thoyyib*) (Othman et al., 2016; Tukiran & Anuar, 2022).

This research was conducted at a Small and Medium Enterprise (SME) in the Agam District of West Sumatra. Dairy Farm SMEs (L-Dairy Farm) produces whole milk and milk derivatives. Flavored pure milk (chocolate, melon, and strawberry), mozzarella cheese, and yogurt are examples of milk derivative products. The most well-known product of this company is mozzarella cheese, also known as "L Cheese." Furthermore, this company is known as West Sumatra's sole producer of mozzarella cheese, with marketing areas encompassing West Sumatra, Riau, and Jambi. However, this SME does not yet have a Food and Drug Supervisory Agency permit or a halal certificate, which impacts product

value and marketing coverage. Furthermore, consumer interest and trust are affected because the product's safety, quality, and halalness are not yet guaranteed.

L-Dairy Farm has not implemented GMP, which is the foundation for implementing a food safety system. GMP includes 18 GMP guidelines that must be followed. The factory's location or layout is critical because it determines how much contamination occurs during manufacturing. There are still many layout errors on the L-Dairy Farm production floor, particularly in the mozzarella cheese production process. It can result in cross-contamination, resulting in products of poor quality and unsafe for consumption. Furthermore, the raw material for mozzarella cheese is derived from cow's milk, which is highly susceptible to contamination by other microorganisms that can degrade milk quality. This article aims to design a food safety system by identifying hazards in each manufacturing process using the HACCP approach and designing a halal assurance system based on HAS (Halal Assurance System) 23000.

2. Materials and Methods

The food safety system and halal assurance system were designed in stages. This SME manufactures cheese from raw materials milked directly from the cows in pen. During the field observations, interviews with employees from various departments were conducted. Workers/staff have been with the company for about two years. The interview questions were based on the 18 GMP guidelines. A survey can reveal the potential hazards of the mozzarella cheese production process and the cheese production process following the halal assurance system. Milking (raw material), receiving raw materials, storing raw materials, pasteurizing milk, coagulation process, cutting the curd, filtering curd, steaming curd, adding salt, steaming curd, storing cooked mozzarella cheese, and packaging before distribution to consumers comprise the mozzarella cheese production process. Several documents are used in the standard review, including SNI 2980:2018 for processed cheese, SNI 99001:2016 for Halal Management Systems, SNI CAC/RCP 1:2011 for General Principles of Food Hygiene, SNI ISO 22000:2018, and SNI ISO/TS 22002-1:2017 for Food Safety in the Food Processing Industry.

The food safety system was designed in stages, including identifying GMP, preparing HACCP, and drafting HACCP. Meanwhile, the halal assurance system design stages begin with identifying and improving the company's business and manufacturing processes. In addition, as a requirement for halal certification, a matrix for the relationship between production process documents and HAS documents was created (Arsyan, 2019). A Standard Operating Procedure (SOP) can be created after designing food safety and halal assurance systems. This SOP's design emphasizes the processes included in CCP, which are also aided by using a form designed as a control medium and monitors temperature and time in certain processes.

3. Results and Discussion

3.1. The 18 Guidelines for Implementing GMP

The interview questions were based on the 18 GMP implementation guidelines. The 18 GMP implementation guidelines are as follows:

1. Good Manufacturing Practices Identification

This stage identifies the application of GMP at L-Dairy Farm based on the current company layout, questionnaire results, and interviews with the Food and Drug Supervisory Agency of the Republic of Indonesia. First, the company's overall layout and the mozzarella cheese production area are considered. Then, the interviews with the owners of L-Dairy Farm and Food and Drug Supervisory Agency of the Republic of Indonesia serve as guidelines for identifying GMPs, which lead to the design of the food safety system.

2. HACCP Preparation

HACCP team formation, product description, target consumer identification, product use plan, flowchart creation, and flowchart verification are all part of the HACCP preparation stage.

3. HACCP Team Establishment

The HACCP team was formed to assist researchers and businesses in designing food safety and halal assurance systems.

4. Product Description

Product descriptions are written to identify the product name, how to use it, the type of packaging, the age of the product, where to market it, how to store it, and how to serve it. For example, Table 1 shows the product description for mozzarella cheese.

Table 1. Mozzarella Cheese Product Description

Criteria	Description
Product	Mozzarella Cheese
Cheese Name	L-Dairy Farm Cheese
Process Category	Food Processing
Composition	Pure Cow Milk, Rennet, Citric Acid, Salt, Water
Final Product Characteristics	Dry
Preservation Method	No Preservatives
Packaging - Primary	Clear *Polyethylene Plastic*
Packaging - Delivery	Cardboard
Storage Condition	Stored in the freezer, no direct sunlight exposure, and not damp
Distribution Method	Supplied directly to consumers and sent via travel agents to several regions
Storage Period	One Year
Customer Requirements	General
How to Use the Product/ Consumption Preparation	Heated
Labeling	-
SPP-IRT No.	-

5. Identification of Product Use Purposes and Target Consumers

Mozzarella cheese products should be kept in the freezer to keep them fresh. Mozzarella cheese is intended to be consumed immediately by heating cheese stored in the cooler. Meanwhile, because the product contains no harmful ingredients, the public of all ages is the target consumer of this mozzarella cheese product.

6. Flow Preparation

The flow preparation is set up in the order of the mozzarella cheese production process, from milking to packaging the mozzarella cheese product.

7. Flowchart Verification

The company, especially the mozzarella cheese production workers, verifies the flowchart to avoid mistakes.

8. HACCP preparation

Hazard analysis, CCP determination, CCP critical limit determination, monitoring procedures, corrective action, verification, HAS design, company business and production processes, document relationship matrix compilation, SOP design, and SSOP implementation evaluation are all part of the HACCP preparation process.

9. Hazard Analysis

Each mozzarella cheese production process assesses physical, chemical, and biological hazards. Table 2 analyzes the hazards of the mozzarella cheese manufacturing process.

Table 2. Hazard Analysis

Process/material/tool	Possible Physical Hazard	Possible Chemical Hazard	Possible Biological Hazard
Acceptance of Packaging Materials	Dust and plastic scraps	-	-
Receiving raw materials	Metal, glass chips, sand, gravel, plastic scraps	Antibiotics, hormones, toxic, heavy metals, cleaner, additives, hazardous chemicals,	Pathogen (e.g., *Listeria monocytogenes, Escherichia coli, Staphylococcus aureus, Salmonella, Yersinia enterocolitica, Coxiella burnetii, Staphylococcus aureus*) and virus
Milking	Metal, glass flakes, dust, sand	Antibiotics, hormones, poisons, heavy metals, detergents	Pathogen (e.g., *L. monocytogenes, E. coli, S. aureus, Salmonella, Y. enterocolitica, Coxiella burnetii, S. aureus)* and virus
Raw Material Storage (milk)	Dust and other foreign matter	Temperature, used detergents, heavy metals, direct sunlight,	*S. aureus, L. monocytogenes,* and *E. coli*
Milk Pasteurization	Dust and other foreign matter	Temperature, heavy metals, cleaning agents (detergents)	Pathogen (e.g., *L. monocytogenes, E. coli, S. aureus, Salmonella, Y. enterocolitica, C. burnetii, S. aureus*) and virus
Transferring milk to the container	Metal, glass, and dust	Metal, glass, and dust	Pathogen (e.g., *L. monocytogenes, E. coli, S. aureus, Salmonella, Y. enterocolitica, C. burnetii, S. aureus*) and virus
Coagulation	Sand, gravel, plastic scraps, glass chips, odors, dissolved solids, turbidity, taste, and color	Heavy metal Contamination, As, Fe, F, Cd, $CaCO_3$, Cl, Cr, Mn, NO_3-N, NO_2-N, PH, Zn, Cn, SO_4, Pb, Detergent as MBAS, $KMNO_4$, NH_3-N, Selenium, Cu, Al, and high temperature.	Pathogen (e.g., *L. monocytogenes, E. coli, S. aureus, Salmonella, Y. enterocolitica, C. burnetii, S. aureus*) and virus
Mixture cutting on the container	Sand/dust and metal	Temperature, detergent/container cleaning agent	Pathogen (e.g., *L. monocytogenes, E. coli, S. aureus, Salmonella, Y. enterocolitica, C. burnetii, S. aureus*) and virus
Curd Filtering	Sand/dust and metal	Temperature, detergent/filter cleaning agent	Pathogen (e.g., *L. monocytogenes, E. coli, S. aureus, Salmonella, Y. enterocolitica, C. burnetii, S. aureus*) and virus
Adding salt to curd	Sand/dust, metal, and plastic scraps	Temperature and detergent	Pathogen (e.g., *L. monocytogenes, E. coli, S. aureus, Salmonella, Y. enterocolitica, C. burnetii, S. aureus*) and virus

Process/material/tool	Possible Physical Hazard	Possible Chemical Hazard	Possible Biological Hazard
Steaming and Stretching Curd	Metal, dust, and sand	Temperature, detergents/container cleaners, and heavy metals	Pathogen (e.g., *L. monocytogenes, E. coli, S. aureus, Salmonella, Y. enterocolitica, C. burnetii, S. aureus*) and virus
Cheese Packaging	Air, metal, dust, and sand	Temperature, detergent/container cleaning agent, heavy metal contamination	Pathogen (e.g., *L. monocytogenes, E. coli, S. aureus, Salmonella, Y. enterocolitica, C. burnetii, S. aureus*) and virus

10. Critical Control Point (CCP) Determination

CCP is determined using the decision tree proposed by Codex Alimentarius. Table 3 shows that a series of questions must be answered for each identified hazard.

11. CCP Critical Limit Determination

Table 3 shows that the CCP critical limit is the maximum and/or minimum value that physical, chemical, and biological parameters must control to prevent, eliminate, or reduce to an acceptable level (Azuamah et al., 2018).

12. Monitoring Procedure

Table 4 shows that the CCP monitoring system document must explain what should be monitored, how observations should be made, where they should be made, when they should be made, and who is responsible for monitoring.

13. Corrective action

Table 4 shows that the HACCP system aims to ensure safe food production, identify potential health hazards, and implement measures to eliminate the risk of losing control.

14. Verification

The HACCP team is responsible for developing, establishing, and implementing procedures and verification activities and scheduling them. Table 4 shows that verification procedures are carried out by qualified industry personnel (or external consultants). Furthermore, the relevant government agencies are responsible for regularly validating the industry's HACCP plans and ensuring their effective implementation.

15. Halal Assurance System Design (HAS)

The L-Dairy Farm completed the HAS design in three stages: identifying, improving business processes, and mozzarella cheese production processes. Then continued with preparing a matrix of production process documents with HAS documents as a requirement for halal certification.

16. Flow Process

The process begins with cow milking and ends with receiving cow's milk as raw material. Furthermore, cow's milk is refrigerated before being heated (pasteurized). The milk is then transferred to a container while 100 grams of citric acid and 450 mL of water are mixed (mixture A), and this mixture A is mixed with the milk (mixture B). Next, mixture A was set aside for five minutes while 0.312 mL of rennet and 50 mL of water were combined (mixture C). Finally, mixtures B and C are combined (curd), the curd is formed into a dough, and the dough is allowed to stand for 20 minutes until it clumps. The dough should then be cut and rested for 20 minutes. The dough is then filtered, steamed, and 100 grams of salt are added. The dough is stretched every 30 minutes while being steamed, and it is steamed until completely dry. When the dough is dry, it is allowed to come to room temperature (cheese), then placed in the freezer for 12 hours. Finally, the cheese has been cut, packaged, and is ready for distribution.

Table 3. CCP Determination and CCP Critical Limit

Material	Process	Hazards Cause	CCP	Critical Limit
Milk	Milking	Pathogen (e.g., *L. monocytogenes, E. coli, S. aureus, Salmonella, Y. enterocolitica, C. burnetii, S. aureus*) and virus	CCP 1 - B	Following Milking SOP
Milk	Raw material storage	Temperature, used detergent, and heavy metal	CCP 2 - K	Temperature for milk storage at 0-1°C
Rennet		Storage area temperature	CCP 3 - K	Temperature for milk storage at 0-1°C
Milk	Milk Pasteurization	Temperature, heavy metal, a cleaning agent (detergent), and additives	CCP 4 - K	Temperature for pasteurization 62.5-65°C for 30 mins
Curd	Curd Filtering	Sand/dust and metal	CCP 5 - F	No sand/dust and metal
		(L. monocytogenes, E. coli, S. aureus, Salmonella, Y. enterocolitica, C. burnetii, S. aureus) and virus	CCP 5 - B	No pathogenic bacteria or virus in the curd
Curd	Curd Steaming	Temperature, detergent/cleaning agent, and heavy metal	CCP 6 - K	No contamination of heavy metal, detergent, and temperature at 75°C
		(L. monocytogenes, E. coli, S. aureus, Salmonella, Y. enterocolitica, C. burnetii, S. aureus) and virus	CCP 6 - B	No pathogenic bacteria or virus in the curd
Cheese	Cheese Packaging	Air, metal, dust, and sand	CCP 7 - F	No air, metal, dust/sand
		Temperature, detergent/cleaning agent, contamination of heavy metal	CCP 7 - K	No contamination of heavy metal, detergent, and at room temperature
		Pathogen (e.g., *L. monocytogenes, E. coli, S. aureus, Salmonella, Y. enterocolitica, C. burnetii, S. aureus*) and virus	CCP 7 - B	No pathogenic bacteria or virus in the curd

Table 4. Monitoring Procedure, Corrective Action, and Verification

HACCP Process Stages	CCP No.	Monitoring Procedure	Corrective Actions	Verification Procedure
Milking	CCP 1 - B	Regular owner monitoring of pen staff during milking	Follow the method of milking according to the SOP	Adjustment of milking practices with existing SOPs
Raw Material Storage (milk)	CCP 2 - K	Monitoring the temperature in the refrigerator	Temperature Adjustment	Calibrate the temperature control on the refrigerator
	CCP 3 - K	Monitoring the temperature in the refrigerator	Temperature Adjustment	Calibrate the temperature control on the refrigerator
Milk Pasteurization	CCP 4 - K	Temperature monitoring with a thermometer	Temperature Adjustment	Calibrate the temperature gauge
Curd Filtering	CCP 5 - F	Regular monitoring of the filter device during the filtering process	Clean the filter tool regularly	Check and clean the filter just before use
	CCP 5 - B	Regular monitoring of the filter device during the filtering process	Clean the filter tool regularly	Check and clean the filter just before use

HACCP Process Stages	CCP No.	Monitoring Procedure	Corrective Actions	Verification Procedure
Curd Steaming	CCP 6 - K	Monitoring the temperature with a thermometer and periodic cleaning of the tool	Temperature Adjustment and cleaning of the tool periodically	Calibrate the temperature gauge and clean the appliance just before use
	CCP 6 - B	Regularly monitoring equipment cleanliness	Clean the steamer regularly	Clean the steamer just before use
Cheese Packaging	CCP 7 - F	Regularly monitoring equipment cleanliness	Clean packaging equipment regularly	Clean packaging tools just before use
	CCP 7 - K	Regularly monitoring equipment cleanliness	Clean packaging equipment regularly	Clean packaging tools just before use
	CCP 7 - B	Regularly monitoring equipment cleanliness	Clean packaging equipment regularly	Clean packaging tools just before use

17. Business Process at L-Dairy Farm

This stage identifies business processes by modifying the organizational structure, as shown in Figures 1 and 2, and by developing a business process model that refers to Porter's value chain model, as shown in Figure 3.

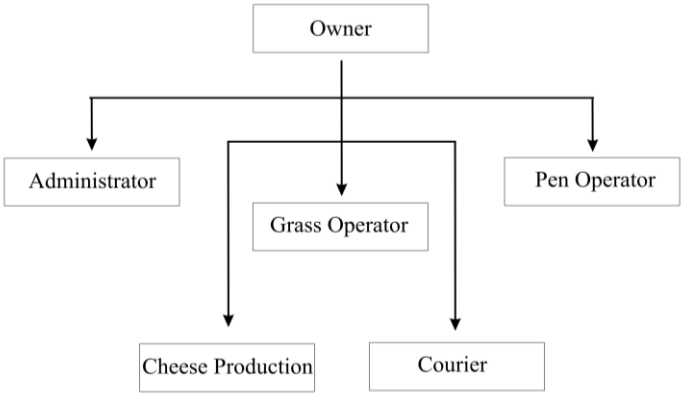

Figure 1. L-Dairy Farm Organizational Structure – Present

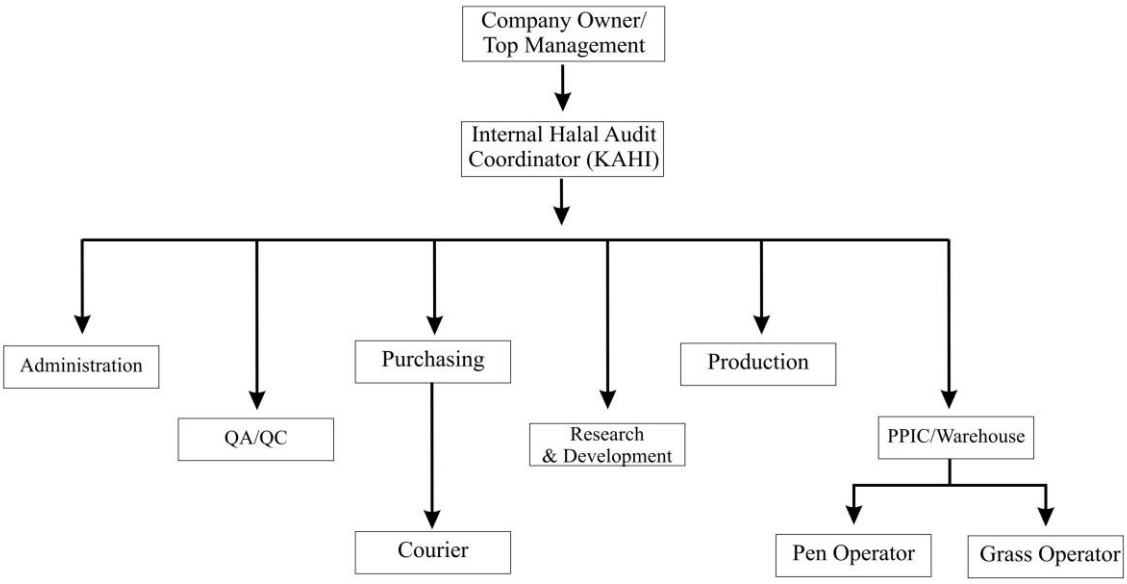

Figure 2. L-Dairy Farm Organizational Structure – Corrected

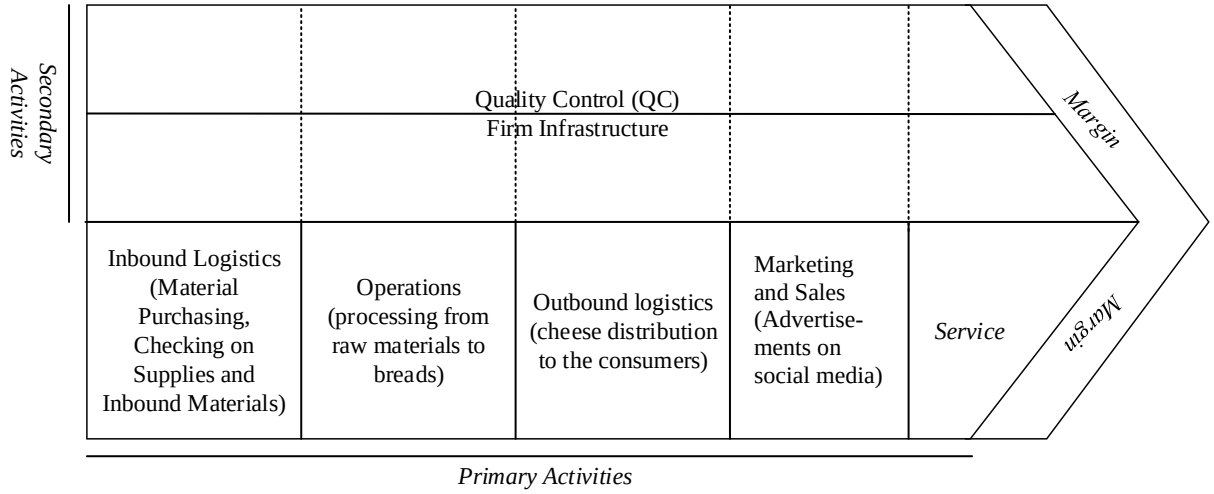

Figure 3. Porter's Value Chain Business Model on L-Dairy Farm – Present

Porter's value chain business process model distinguishes between primary and secondary/support activities in the operation of a company. The primary activities are inbound logistics, operations, outbound logistics, marketing and sales, and service. Quality control (QC) and firm infrastructure are secondary activities (company finance).

18. Mozzarella Cheese Production Process at L-Dairy Farm

This stage is completed to determine the activities of each process in L-Dairy Farm's divisions. Figures 4 to 9 show the production process (OPC) for mozzarella cheese production.

1. Materials Purchasing and Inbound Logistics OPC

Figure 4 shows the OPC for purchasing raw materials and repairing them. Purchasing raw materials includes checking the quantity of stock in the warehouse, arrival of orders, purchasing raw materials, quality, and quantity of materials, checking whether raw materials have expired, and storing raw materials in the warehouse. Figures 4–9 show the current OPC and the corrected OPC. Several improvements have been made to OPC inbound logistics, including improving the raw material warehouse inspection process. First, there is an inspection of the condition of the raw material warehouse, whether it is sterile from animal waste or haram/unclean. Examining expired materials, expired ingredients of halal labels, halal labels, producers, distributors, quality and quantity of materials previously only expired, and quality and quantity of ingredients are all part of improving the incoming material inspection process. The final process improvement is to keep track of material purchases and inbound logistics. Notes are taken to perform traceability, which is the basis for internal audits.

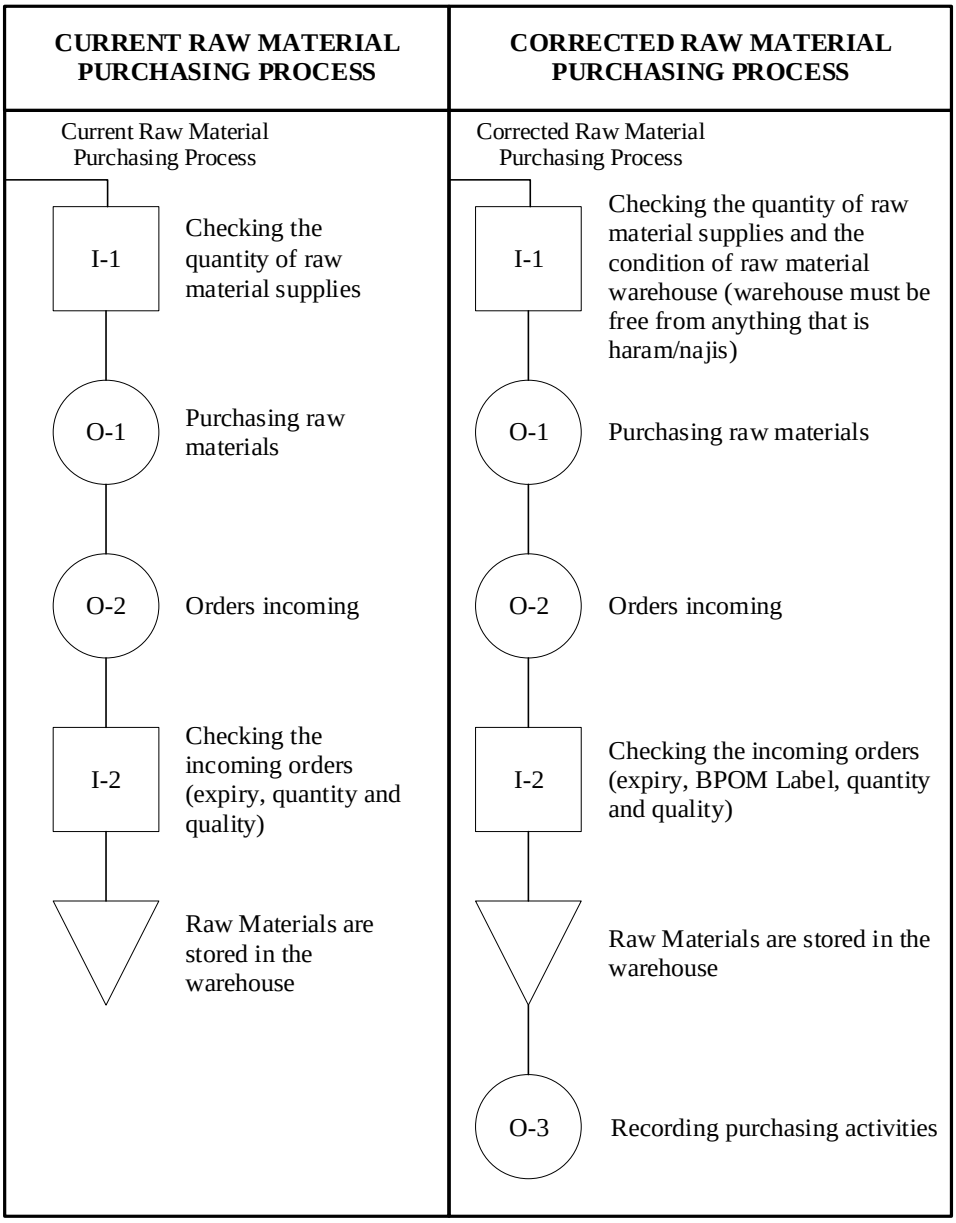

Figure 4. Inbound Logistics

2. Operations OPC (Production Process)

Figures 5 to 7 show two OPCs for the manufacturing process (operations): current OPC and corrected OPC. There are improvements in corrected OPC, which are as follows: making a worksheet that refers to the formula and material matrix recognized by the Assessment Institute for Foods, Drugs, and Cosmetics Indonesian Ulema Council (LPPOM MUI). At this point, it is important to determine whether the ingredients used are consistent with the L-Dairy Farm version of the mozzarella cheese raw material formula. A critical point is established for the new material if new materials are added. This stage is useful for determining the new material's critical point. Special stickers must be placed on equipment and machines to distinguish between products certified as halal and those not. Documenting the manufacturing process (operations).

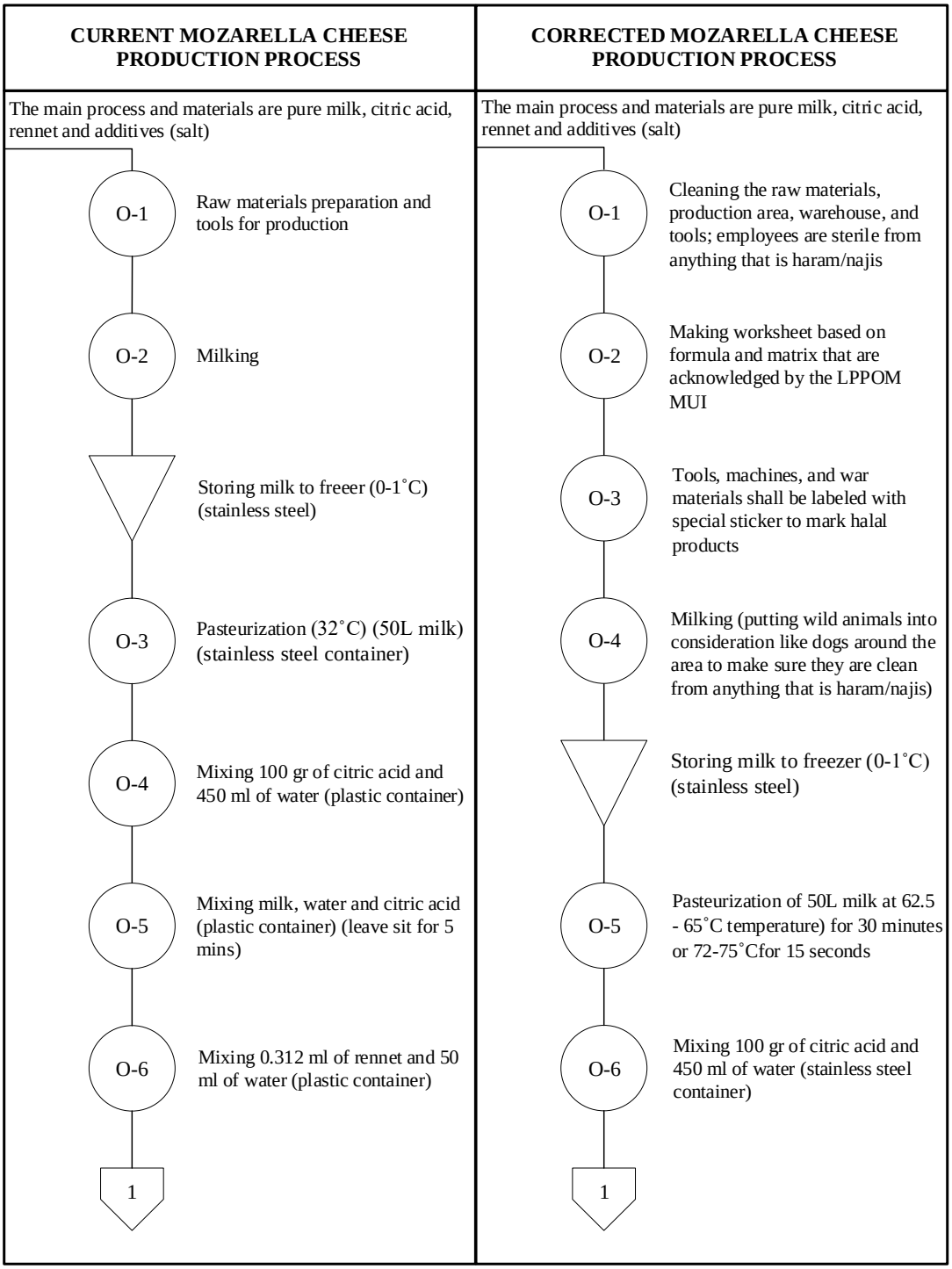

Figure 5. Production Process OPC

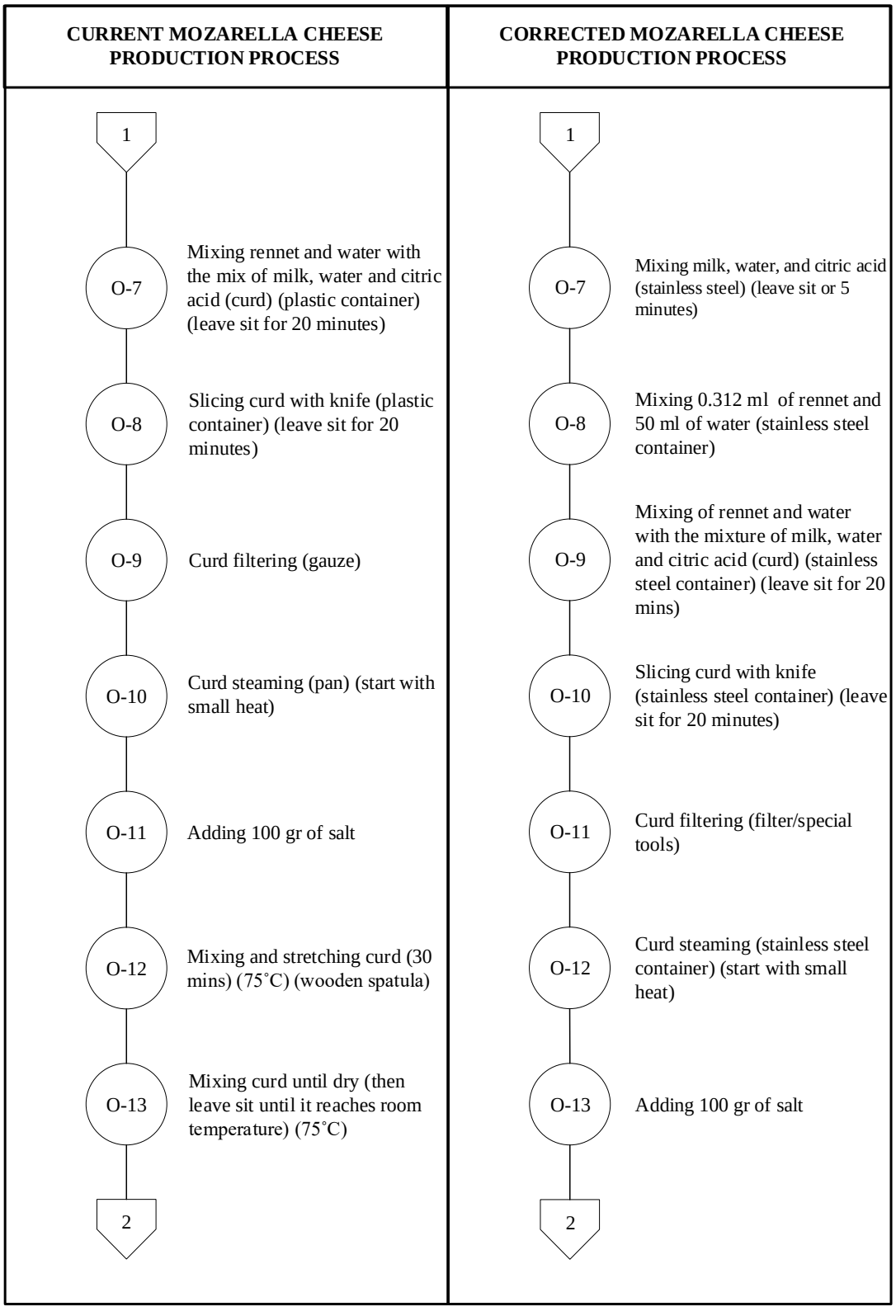

Figure 6. Production Process OPC (Continuation)

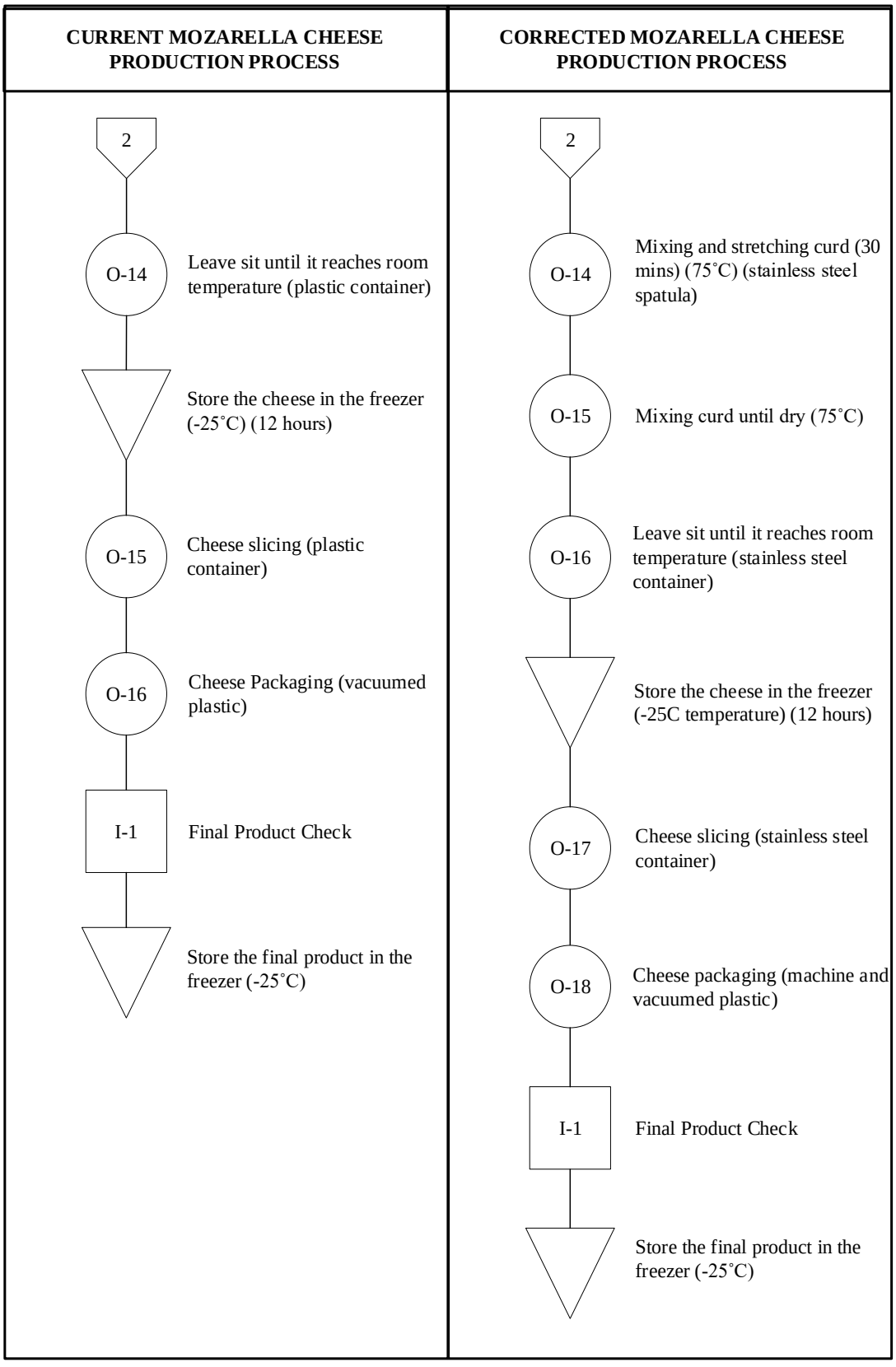

Figure 7. Production Process OPC (Continuation)

3. Outbound Logistics and Marketing Sales OPC

The flow of product and sales logistics processes at L-Dairy Farm is divided into out-of-region and direct sales, represented by OPC outbound logistics and marketing sales. Figure 8 shows the current OPC on the left and the corrected OPC on the right. Vehicle inspection before distribution is added to the corrected OPC; the vehicle must be free of all haram/*najis* (unclean). Additionally, sales records outside the order area were created for audit purposes. Figure 9 shows OPCs for direct sales

(current and corrected). This direct sale is for customers who come to L-Dairy Farm directly. The goal of documenting outgoing and direct sales logistics processes is to carry out outbound and sales logistics, which then become materials for internal audit.

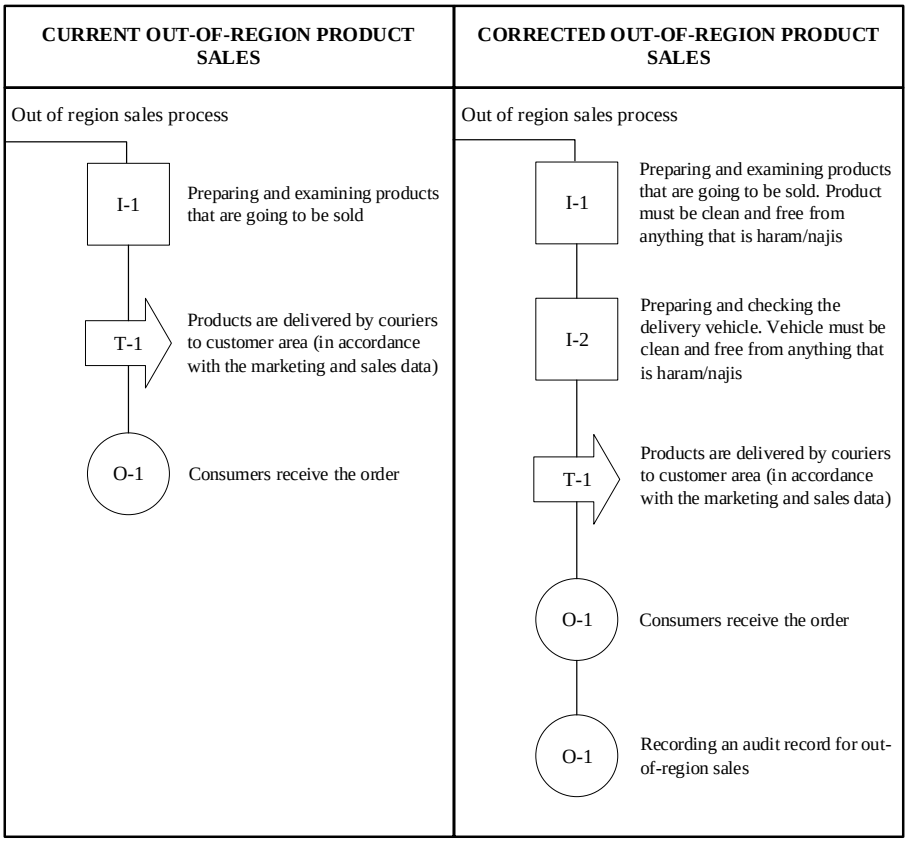

Figure 8. Out-of-Region Product Sales OPC

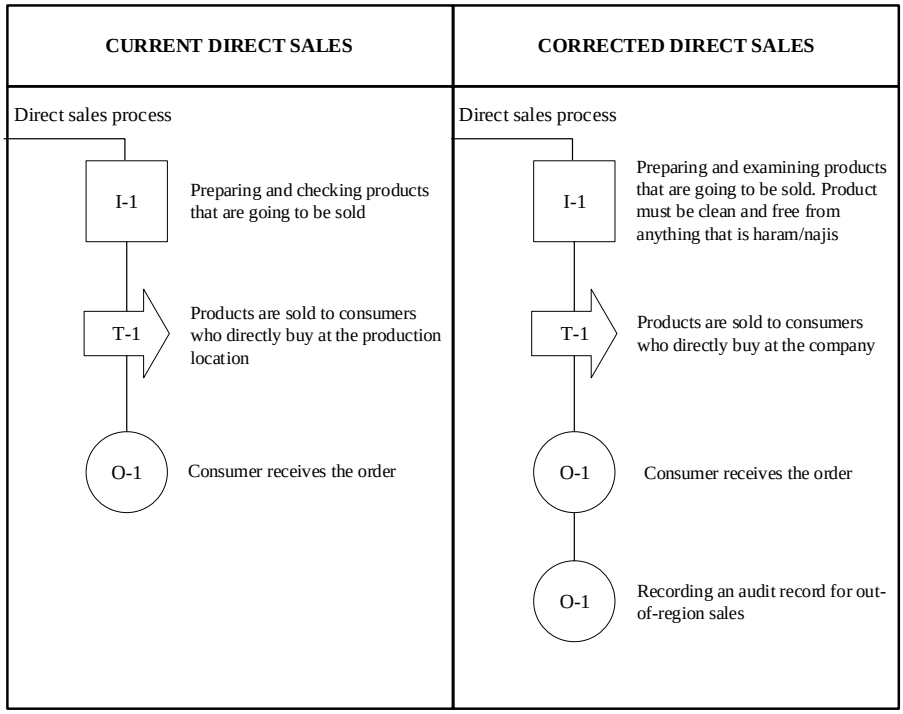

Figure 9. Product Direct Sales OPC

3.2. Preparation of Document Relationship Matrix

Some unfinished documents (not marked with a checklist) will be planned during the documentation requirements preparation. Halal policy documents, halal management team documents, training documents, and halal education and management review documents are all examples of these

documents. Figure 10 of Porter's value chain model will classify these documents as secondary activities.

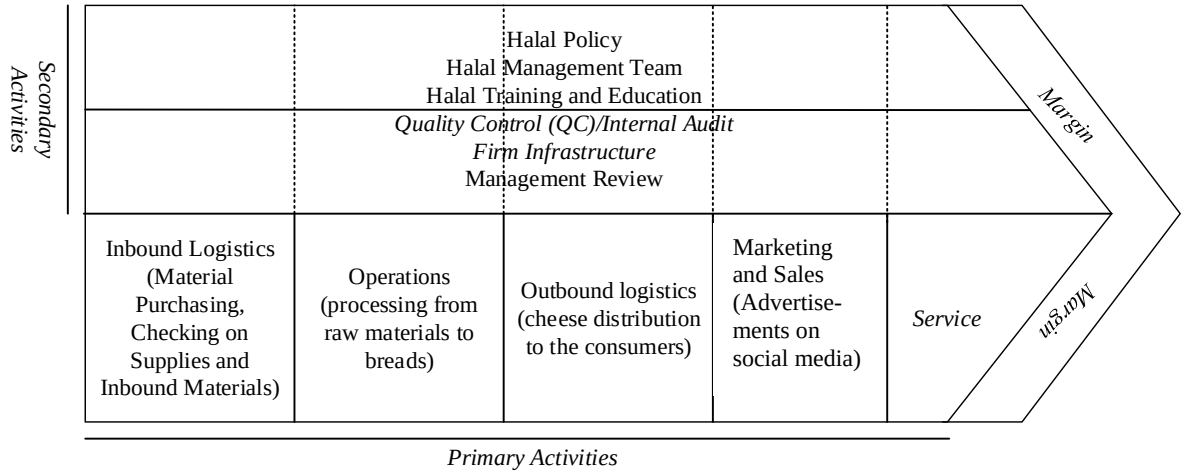

Figure 10. Porter's Value Chain Business Model at L-Dairy Farm Adjustment to Matrix

Table 10. Matrix of Relationship and Document of Halal Production Process with HAS Documents Requirements for MUI Halal Certification

No	Halal Production Process	MUI Halal Registration Documents					
		Material	Product	Written Procedure for Critical Activities	Search Ability	Procedure for handling products that do not meet the criteria	Internal Audit
1	Raw Material Recap Form	√					
2	PPIC Form	√					
3	Distributor Selection Form	√					√
4	Request documents for raw materials from the warehouse	√			√		
5	Sales request document		√				
6	Formula Documents	√	√	√	√		√
7	Production order letter documents		√				
8	Sales Documents		√			√	
9	Production Division QA/QC Documents	√					√
10	Purchasing Division QA/QC Documents	√	√	√			√
11	Distribution and Sales Division QA/QC Documents		√			√	√

3.3. SOP Designing

The SOP is intended to cover the entire process of the mozzarella cheese production process according to the flow chart, GMP guidelines, and hazard analysis. Each process has a procedure and a supervisor. The designed procedure improves the actions in the lamb jerky manufacturing process.

The actions in the CCP process are based on critical limits, monitoring procedures, and corrective actions. This SOP's design focuses on the processes included in CCP. As a result, a form in the CCP processes will act as a medium for controlling and monitoring temperature and time in certain processes. Other procedures are based on a variety of effective actions that are specific to each process. The SOPs listed below have been formed:

1. *Milking*. Person in Charge (PIC): Special Staff for Milking

First, prepare materials and equipment free of all haram/unclean substances. Next, create a milking environment free of haram/unclean substances and comfortable for the milking process. Milking is done twice daily, at 5 a.m. and 5 p.m. Calm the cow, so the milking process goes smoothly. To ensure that the milk from the milking is halal, healthy, clean, and not contaminated with dirt/unclean and foreign objects from the milker's hand, the officer who will do the steaming must first wash his hands clean, wear gloves, an apron, a mask, and a hairnet. Before milking, the udder is cleaned with a disinfectant and dried with soft tissue paper or a soft cloth. After the nipples have dried, strip one or two at a time. Cow nipples must be lubricated for a smoother and easier milking process that does not harm the cows. The udder is cleaned again and disinfected after the milking is completed. Then, clean and store the milking utensils. The cows have been thoroughly milked (the water content is depleted after being milked).

2. *Milk Reception.* PIC: Special Staff for Milk Reception

Prepare reception tools and materials (stationery, scales, containers) that are free of anything haram/unclean. To avoid contaminating the product, the officer who will conduct the reception must first wash their hands and wear gloves, an apron, a mask, and a hairnet. Weigh the milk production. Keep track of milk production statistics and transfer milk production to the production and marketing division. Then, recap data on milk production.

3. *Milk Storage.* PIC: Special Staff for Storage/Warehouse

Prepare a refrigerator free of all haram/ unclean. Officers storing milk must thoroughly wash their hands and wear gloves, aprons, masks, and a hairnet to avoid contaminating the product. Use a stainless steel milk container free of all haram/unclean substances. Milk is kept at temperatures below zero degrees Celsius. The temperature control every six hours.

4. *Milk Pasteurizing.* PIC: Special Staff for Production

Prepare haram/unclean tools and materials (thermometer, stainless steel container). Officers who intend to pasteurize must thoroughly wash their hands and wear gloves, aprons, masks, and a hairnet to avoid contaminating the product. Pour 50 L of milk into a stainless steel container. For 30 minutes, heat the milk to 63°C. Temperature and time must be continuously monitored during pasteurization to prevent errors. Finish by turning off the stove and cleaning and storing used utensils. Finally, place the pasteurized milk in a stainless-steel container with a capacity of 50 L.

5. *Coagulation.* PIC: Special Staff for Production

Prepare tools (stainless steel containers) and materials free of haram/unclean substances; in this case, the citric acid and rennet must be certified halal. To avoid contaminating the product, officers performing the coagulation must thoroughly wash their hands and wear gloves, aprons, masks, and a hairnet. In a stainless steel cup, combine 100 grams of citric acid and 450 mL of water while stirring (mixture A). Next, combine the pasteurized milk with mixture A (mixture B). Allow the mixture to sit for 5 minutes. Next, in a stainless steel cup, stir together 0.312 mL of rennet and 50 mL of water (mixture C). While stirring, combine mixtures B and C (curd). Allow the curd to coagulate for 20 minutes. After that, clean, wash, and store used equipment.

6. *Filtering.* PIC: Special Staff for Production

Prepare tools (stainless steel container, filter cloth, and knife) and materials free of haram/ unclean. To avoid contaminating the product, the officer conducting the screening must thoroughly wash their hands and wear gloves, an apron, a mask, and a hairnet. Before moving the curd, which is still in the container, the clotted curd is cut into pieces so the water in the curd can escape. Next, transfer the curd with a stainless steel container onto a filter cloth; at this point, the water contained in the curd will flow out into the bucket that has been prepared; this discarded water is known as whey water. Filtering is done in stages based on the capacity of the filter cloth. First, officers monitor the whey water collection bucket, and if it becomes full, it is replaced with an empty bucket so that the whey water. Does not spill on the floor, contaminating and disrupting the production process. After

filtering, the curd is placed in a stainless steel container and steamed. Finally, clean, wash, and store used equipment.

7. *Steaming.* PIC: Special Staff for Production

Prepare clean tools (stainless steel pans, spatulas, knives) and materials. Officers who will do the steaming must first wash their hands and wear gloves, aprons, masks, and a hairnet to avoid contaminating the product. Next, place the filtered curd in a clean pan. At this point, the skillet is double-layered by adding water between the two layers of the pan. The heat from the stove can spread evenly, and the steaming results can be maximized. The curd should be steamed over low heat first. Then the fire can be adjusted. The temperature at these steamings reaches 75°C. Cheese milk is made by steaming until the liquid that is still contained in the curd comes out and then discarding it. Continue to steam the cheese while stretching it until it is completely stretched. Turn off the heat when the cheese milk has run out, and the mozzarella cheese has been completely stretched out. After that, remove the mozzarella cheese from the pan and place it in a stainless steel container. Allow the cheese to reach room temperature on the table. Finally, clean, wash, and store used equipment.

8. *Mozzarella Cheese Packaging.* PIC: Special Staff for Packaging

Prepare tools (vacuum machines) and materials (clear polyethylene) that are free of all haram/unclean substances. Officers who will perform the packaging must thoroughly wash their hands and wear gloves, aprons, masks, and a hairnet to avoid contaminating the product. Packaging is carried out after the cheese has been stored for more than 12 hours after steaming. Put 250 grams of cheese into the appropriate size plastic. After that, vacuum until the air in the package is completely sucked up. Store the cheese back in the refrigerator at -25°C. Finally, clean, wash, and store used equipment.

9. *Final Product.* PIC: Special Staff for Quality Control (QC)

Prepare tools (vacuum machines) and materials (clear polyethylene) that are clean from all haram/unclean. Officers carrying out the packaging must thoroughly wash their hands and wear gloves, aprons, masks, and a hairnet to avoid contaminating the product. Next, inspect the product to ensure its quality, safety, and halal status (organoleptic). Next, perform chemical, biological, and physical tests on a regular and as-needed basis. After that, clean, wash, and store used equipment.

10. *Sales and Distribution.* PIC: Special Staff for Marketing/Purchasing

Prepare tools (vacuum machines) and materials (clear polyethylene) that are free of all haram/unclean substances. Officers who will perform the packaging must thoroughly wash their hands and wear gloves, aprons, masks, and a hairnet to avoid contaminating the product. Mozzarella cheese is kept in the fridge at -25°C. The FIFO (First in, First Out) system is used for product retrieval, meaning that products arriving will be sold first. In the salesroom, the mozzarella cheese is neatly arranged. A waiter or employee accompanies every customer who comes in; employees must provide excellent service and offer additional products to customers. After purchasing the item, the customer brings the basket to the cashier's desk, where the cashier computes the total amount of groceries using a cash register or calculator. Then, place it in the bag size corresponding to the number of products purchased by customers. Products for distribution must be placed in a closed box. Before distributing the product, ensure that the vehicle used is haram/unclean. Finally, clean, wash, and store used equipment.

11. *Employee.* PIC: Head of Production

Employees involved in food production must be: 1) in good physical and mental health; 2) free of wounds, skin diseases, or other infectious diseases that could contaminate production products; 3) Hand washing before beginning food processing, after-sneezing, coughing, using the toilet, handling raw materials, handling dirty utensils, and managing trash; and 4) Wearing work clothes and equipment such as aprons, gloves, hairnets, footwear, and masks. In addition, employees' health should be checked regularly.

12. *Tools.* PIC: Head of Production

The container should be simple to clean and include sanitary features (disinfectant). The food-contact surface must be smooth, not chipped, not absorb water, and not rust. Used equipment must be cleaned/washed and dried right away. The washed and dried equipment is placed on a closed shelf according to the equipment's name.

13. *Storage.* PIC: Head of PPIC/Warehouse

Wet and dry raw materials, as well as mozzarella cheese products, must be kept separate. Refrigerated or frozen milk and rennet are stored at temperatures below zero degrees Celsius. The mozzarella cheese is stored in the refrigerator at -25°C. Citric acid is stored in a box at a temperature of 25°C.

14. *Reception of Additional Materials and Packaging.* PIC: Production Staff

The staff verifies that the order quantity matches the amount entered on the form for receiving additional materials and packaging. The received salt, citric acid, and packaging materials are placed on the shelf/dry material storage container. Rennet is kept in the freezer at temperatures below zero degrees Celsius.

15. *SSOP Implementation Evaluation*

Indonesian Food Law Number 7 of 1996 aims to prevent the reproduction of rotting microorganisms and pathogenic bacteria in food, drinks, equipment, and buildings that can harm food. However, most observations on the implementation of Sanitation Standard Operating Procedure (SSOP) at L-Dairy Farm, particularly in the production process of mozzarella cheese, are deemed to have failed to meet the requirements. It is based on the application of eight key sanitary requirements: water safety; cleanliness of surfaces in contact with foodstuffs; cross-contamination prevention; maintaining hand washing, sanitation, and toilet facilities; protection from contaminants; correct labeling, storage, and use of toxic materials; monitoring employee/worker health condition; and pest removal from the processing unit.

4. Conclusion

GMP has largely not been implemented at L-Dairy Farm, particularly in terms of criteria for location, buildings, sanitation facilities, production equipment, processing, employees, labeling, storage, maintenance, and implementation of guidelines. Most SSOPs have not been implemented at L-Dairy Farm, particularly those concerning the cleanliness of surfaces in contact with foodstuffs, the prevention of cross-contamination, the maintenance of sanitary facilities and toilets, the correct labeling, storage, and use of toxic materials, the protection from contaminants, the monitoring of employee health conditions, and the elimination of pests from processing units. The current research on food safety system design is only up to the sixth principle, which is the preparation of verification procedures. Therefore, it is suggested that the following study investigate up to seven principles: preparing documentation and recording systems to ensure effective and efficient supervision of HACCP and halal assurance system implementation.

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