Review on hazard analysis and critical control point (HACCP) in the dairy product: Cheese

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Abstract. Hazard Analysis Critical Control Point (HACCP) is a control system in the effort to prevent problems that are based on the identification of critical points in the handling and production stages. HACCP is a form of risk management that was created to guarantee food safety with a preventive methodology which is considered to provide guarantees in producing food that is safe for consumers. The purpose of this study was to determine the application and effectiveness of HACCP from fresh milk and its derivative products in the form of cheese at PT. G, so that a system that is truly capable of guaranteeing the product is produced. In the milk production process there are many aspects that need to be considered, starting from the initial stage of quality control of raw materials to the final product of the production process which is then stored in a warehouse. The method used is the elaboration of the Codex Alimentarius Commission in the European Committee for Standardization 2004 Hazard Analysis Critical Control Point (HACCP) system. Based on the analysis of the flow diagram shows that there are critical control points both for microbiological, chemical and physical quality in the process of receiving raw materials (fresh milk) and at the production of critical points.

1. Introduction

Milk is an important food for the health and metabolism of the body because it contains complete and balanced nutrition, namely protein, carbohydrates, fats, vitamins and minerals. Milk and milk products are interrelated products that have an important part in the food supply chain [3]. Milk can be consumed in the form of fresh milk and also in processed form. One of the factors that determine the quality of milk and the direction of its development is the chemical content. The chemical content of milk is strongly influenced by the process of handling dairy cows by breeders. Milk and milk products have a complex composition that makes milk a good medium for spoilage growth and the production of pathogenic microorganisms so that in a short time the milk becomes unfit for consumption [16]. The process of making milk in each industry varies greatly depends on the type of product produced. Broadly speaking, the milk processing production process consists of receiving and storing raw materials, preparing raw materials, producing, packaging, and storing. To guarantee product quality from the influence of impurities, milk processing is carried out by a closed system that is controlled or operated from a special room.

Quality in the manufacturing industry, in addition to emphasizing the products produced, also needs to be considered in the quality of the production process. In the dairy industry, milk that is damaged becomes unhealthy milk. Damage can occur at an early stage in the dairy farming unit, at milk
receiving centers, pathways that are unknown and not associated with potential health risks to consumers due to the presence of pathogens in milk and due to environmental contamination [11]. Food hygiene is a primary for the food industry, and it includes the hygienic design and engineering of installations and facilities [2]. Artisanal and industrial cheeses are an essential component of the Canary diet and economy but are potentially hazardous products if processed under non-compliant conditions [14].

The main determinant that affecting the quality and safety of dairy products is the quality of raw milk, typically milk derived from good sterile cow's milk. Proper handling is needed to extend the shelf life of milk. Pasteurization and homogenization is one way that can be done to prevent damage to milk. Pasteurization is the process of heating milk at a fairly high temperature for a certain period of time with a relatively high temperature, the aim is to destroy microorganisms, increase safety and to extend the shelf life of milk. But the pasteurization process cannot eliminate one hundred percent of microorganisms in milk, some species such as thermodynamic microorganisms and gram negative bacteria may survive the pasteurization process so that later they multiply in the final product which disturbs the safety and quality of milk products [16]. The industry produces conventional and organic milk in the form of milk derived from cows, sheep, and goats to become more stable dairy products such as butter, cheese, and yogurt [20].

One of the dairy companies in Indonesia is PT. G, which is one of the products derived from dairy: cheese. Increasingly the level of consumption of cheese, especially in Indonesia is increasing because cheese is one of the dairy products that contain high levels of protein, calcium, vitamins, etc. that are consumed and preferred by various groups. Cheese can be made from cow's milk, goat's milk, sheep's milk, milk camel's, and so on. In Indonesia, cheese is made from cow's milk which is processed in several stages such as acidification, thickening, curd processing until maturation. Acidification or ripening stage (ripening) serves to prevent the growth of undesirable microorganisms so that the taste of the product does not change. Cheese production is growing rapidly from year to year this can be caused by the consumption of the community increasing.

In the HACCP framework, the term hazard refers to agents or foodstuff conditions that do not apply to consumer health. Physical, chemical, or biological hazards originating from raw, semi-finished, or raw materials finished product. Evaluation of the severity of the hazard and its possible impact is called a hazard analysis. The growth of microorganisms and conditions which lead to the presence of microorganisms in the food should be evaluated [20]. The application of HACCP can provide benefits for companies. HACCP is a quality control system since raw materials are prepared before mass production and delivery of the final product. The implementation of the HACCP system would therefore eliminate the possibility of complaints because of the risk of a food product. Furthermore, HACCP can also function as a trade promotion in the age of global markets with high competition. HACCP has long been recognized and accepted internationally as a trade promotion to effectively the food safety management system. This method is a systematic preventive approach to food safety, to identify potential contamination and then evaluate the points or steps that must be taken to maintain food quality. However, performance and effectiveness in preventing contamination depend on proper implementation and application [21]. Medium and small-sized dairy companies are no exception; they also exhibit these important deficiencies together with those of training workers and technical staff, insufficient physical conditions, and the cost of the HACCP implementation [15].

The implementation of the HACCP plan in the global food market strengthens companies’ positions and improves their competitiveness [8]. European regulations on foodstuffs indicate that safety must be ensured by a preventive approach, such as implementation of prerequisites and application of
procedures based on HACCP principles [1]; [6]; [7]. The lack of knowledge, motivation, and trust in food safety legislation together with the lack of financial resources and human resource limitations are the main barriers to the fulfillment of the requirements demanded by official control [12]; [1]; [24].

The HACCP plan also needs to be reviewed if there are changes to the production process. This will have an impact on increasing or decreasing production processes in the flow chart, causing higher or lower scores on the probability (probability level); and lead to changes in the Critical Control Point. Therefore the purpose of this study is to determine the application and effectiveness of HACCP from fresh milk and its derivative products in the form of cheese at PT. G, so that a system that is truly capable of guaranteeing the product is produced.

2. Materials and Methods

This research was a qualitative descriptive study in the form of a literature review from PT G, in May 2020. The literature study method uses various written sources in the form of books, journals, scientific article, etc.

2.1 Procedure

HACCP (Hazard Analysis Critical Control Points) is a system that identifies, evaluates and controls real hazards for food safety. Through HACCP, quality assurance of food safety can be guaranteed, and each stage of the processing process is controlled by risks and dangers that arise [10]. The Codex Alimentarius Commission in the 2004 European Committee for Standardization describes the Hazard Analysis Critical Control Point (HACCP) system:

The HACCP system is based on the following 7 principles:

Principle 1: Conduct an analysis of potential hazards.
Principle 2: Determine critical control points.
Principle 3: Establish critical boundaries.
Principle 4: Establish a system to oversee CCP control.
Principle 5: Establish corrective actions that must be taken when a critical control point (CCP) is out of bounds.
Principle 6: Establish a re-checking procedure to ensure that the HACCP system is working effectively.
Principle 7: Prepare documentation relating to all procedures and records that are appropriate for these principles and their application.

All components that cover the seven principles of the HACCP system are presented in the form of a matrix / table, namely:
1. Table of hazard analysis of raw materials and process stages, and determining the level of risk
2. Critical Control Point (CCP) determination table
3. Critical Control Point (CCP) matrix, which contains the process that includes the CCP along with the critical points and procedures that must be taken to control it.
4. Matrix Control Point (CP), contains the process including CP along with critical points and procedures that must be taken to control it.

3. Results and Discussion

Put together the HACCP Team
This team consists of various members with different disciplines. For companies that do not have the required employee specifications, external involvement is needed. The scope of the HACCP program needs to be established in advance to assist the process of identifying the need for the number and expertise of head figure personnel in the HACCP. Duties and responsibilities of the HACCP Team Composition The people involved in the ideal team include:
1. Staff Quality Assurance or Staff Quality Control.
2. Production Personnel (understand raw materials and production processes)
3. Personnel from the Technical / Engineering division.
4. Microbiologist In a small company, one person can fill the above positions and can even wait for the entire HACCP Team. In this case consultants need help or advice from outside parties.

| Table 1. Duties of the HACCP team leader and HACCP team members |
|---------------------------------------------------------------|
| Duties of the HACCP team leader                              | Duties of the HACCP team member                                  |
|----------------------------------------------------------------|------------------------------------------------------------------|
| Determine and control the scope of HACCP to be used          | Organize and document HACCP studies in the factory concerned     |
| Directing the design and implementation of the HACCP system in the factory | Carry out a review (assessment) of all deviations from the critical limit |
| Coordinate and chair team meetings                           | Conduct an HACCP internal audit (HACCP Plan or Quality Assurance Work Plan) |
| Determine whether the HACCP system that is formed has met the Codex provisions, pay attention to the compliance of the system with the regulations or standards that apply and the effectiveness of the HACCP system to be made | Communicating HACCP operations                                  |
| Maintain HACCP documentation or records                      |                                                                  |
| Maintain and implement the results of the internal audit of the HACCP system |                                                                  |
| Because the Team Leader is an HACCP expert in the company / factory, it must have communication and leadership skills, and have high attention to the type of business being run |                                                                  |

Requirements of the HACCP team are that the decisions of the HACCP Team can be a management decision. For this reason, the HACCP Team should consist of divisions from business units (Quality Assurance, Production, Marketing, etc.) and multidisciplinary by taking into account product types, technology processing, handling and distribution techniques, marketing methods and ways of consuming products, and potential hazards. The HACCP team can also consist of several levels of personnel (General Manager, QA manager, Inspector, Overseer, etc.).

4. **Describe and Identify Product Use**

4.1 **Main raw materials: Fresh Milk**

Fresh milk needs to be processed to increase shelf life so that it can be consumed more easily. But milk cannot only be consumed as liquid milk, the industry dairy produces a variety of milk-derived products such as cheese. Fresh milk according to the National Standardization Board (2008) is a liquid derived from udder healthy cows obtained by proper milking, without adding or reduction of any component and does not warm up, milk from all types of mammals contains the same component, but the amount of each component varies depending on the species of mammal, milking time, age of cattle, animal health, animal feed and environmental conditions such as climate and time lactation [4].

4.2 **Reception (fresh milk)**

*Dairy Farm* (DF) produces approximately 120 tons of fresh cow's milk per day which is stored in a *balance tank*. Fresh milk which has a natural temperature of 30-37°C is a medium that supports bacterial growth. Therefore, before being sent to the processing unit, fresh milk is lowered in temperature
from 30-37°C to 6-8°C. The cooling process is carried out using a plate heat exchanger ice-water-cooled (PHE). Cold milk is then pumped to the balance tank. After that, the milk is lowered again to 4 °C and pumped to the reception tank. To ensure fresh milk quality is guaranteed, the department Quality Control (QC) will conduct temperature checks, pH checks, tests alcohol, and organoleptic tests regularly. Milk storage at the reception tank is also limited to only 24 hours. The following is the standard of fresh milk according to SNI 01-3141-1992 found in Table 2.

| Table 2. Fresh Milk (according to SNI 01-3141-1992) |
|--------------------------------------------------|
| Milk Characteristics                        | Value                        |
| Specific Gravity                          | 1,026 – 1,028 g/cm³          |
| Minimum fat content of                      | Minimum 3.0%                 |
| Levels of dry matter without fat            | Minimum 8.0%                 |
| Protein levels                             | Minimum 2.7%                 |
| Color, odor, taste and consistency          | Normal                       |
| Acidity Level                              | 4.5-7°SH                     |
| Alcohol test (70%)                         | Negative                     |
| E.coli                                     | Maximum 10 APM/ml            |
| Salmonella                                 | Negative                     |
| Freezing point                             | -0.520°C to -0.560°C        |
| Forgeries                                  | Negative                     |
| TPC (CFU/ml max)                           | 1x10⁶                        |

The specifications of fresh milk produced by this DF unit can be seen in Table 3.

| Table 3. Quality Requirements for Fresh Milk (SNI 3141.1: 2011) |
|---------------------------------------------------------------|
| No.    | Characterization                          | Unit               | Determinate |
| 1      | Specific gravity (at temperature 27.5 °C) | g/mL               | 1.0270      |
| 2      | Minimum fat content                       | %                  | 3.0         |
| 3      | Minimum dry matter content without fat    | %                  | 7.8         |
| 4      | Minimum protein content                   | %                  | 2.8         |
| 5      | Color, taste, odor, thickness             | -                  | No change   |
| 6      | Acid degree                               | SH                 | 6.0 - 7.5   |
| 7      | pH                                        | -                  | 6.3 - 6.8   |
| 8      | Alcohol test (70%) v/v                    | -                  | Negative    |
| 9      | Maximum microbial contamination:          | CFU/mL             | 1 x 10⁵     |
| 1.     | Total Plate Count                         | CFU/mL             | 1 x 10²     |
| 2.     | Staphylococcus aureus                     | CFU/mL             | 1 x 10³     |
| 3.     | Enterobacteriaceae                        | CFU/mL             |             |
| 10     | maximum somatic cell count cells          | Sel/mL             | 4 x 10⁵     |
| 11     | Antibiotic residues (penicillins,         | -                  | Negative    |
|        | tetracyclines, aminoglycosides,           |                    |             |
|        | macrolides)                               |                    |             |
| 12     | False test                                | -                  | Negative    |
| 13     | Freezing point                            | °C                 | -0.520-0.560|
| 14     | Peroxidase test                           | -                  |             |
| 15     | Maximum heavy metal:                      | µ g/mL             |             |
| 1.     | Lead (Pb)                                 | µ g/mL             |             |
| 2.     | Mercury (Hg)                              | µ g/mL             |             |
3. Arsenic (As)

Fresh milk used as raw material in the unit of PT. G has a very high quality. Good quality raw materials will also play a role in producing high quality products.

5. Production Environment

Sanitation process in PT. G with Cleaning In Place (CIP) and Cleaning Out Place (COP). The fundamental difference between these two types of methods is that in CIP, the processing unit is cleaned in place without removing the device circuit while in the COP the circuit is removed first then cleaned one by one. Currently, the automatic washing method (CIP) is more widely used in factories/industries, this is because this method is considered simpler than COP. In addition, CIP has been equipped with a disinfection system so that contamination is very minimal, the machine is easily installed and dismantled [23].

The chemicals used for CIP are 68% nitric acid and caustic. There are two types of CIP that are generally carried out, namely intermediate CIP and CIP final. In CIP intermediates, the chemicals used are only caustic. Usually done every time the production cycle in the process line and every problem in the process filling. Whereas in the CIP final, caustic, and acid are nitric used interchangeably in the process pf cleaning. For the processing unit, the CIP is final done week once a while for filling, the CIP is final done everyone production cycle. The CIP process is carried out by flushing water, then caustic, then rinsed again with water, then sprayed with nitric acid and then rinsed again with water.

COP is conducted in all units of the cheese production process except the pasteurization unit and line cheese production Ricotta. The chemicals used in COP are detergents special used to shed fat, disinfectants, and oxonium for sanitation.

6. Dairy Products: Cheese

Making cheese is a process of removing water, lactose, and some other minerals from milk to obtain concentrated fat, and milk protein. Milk, rennet, starter culture, and salt are main ingredients for cheese. The key procedures for producing cheese, according to some sources, are as follows [9].

Cheese is one of the foods derived from milk and has a soft, half-texture soft, hard and very hard. Mozzarella cheese has a hard and supple texture. This cheese is commonly used as an additional ingredient in making pizza and other dishes and is very good to be cooked by melting immediately after being removed from the refrigerator. Mozzarella cheese that is able to form fibers when heated cannot be replaced by other cheeses and has good nutritional value and taste.

| Cheese variants | Parameter | Characteristics |
|----------------|-----------|-----------------|
| Mozzarella Block (200 and 1000 g) | Composition | fresh milk, culture, rennet (microbial), salt, CaCl2, citric acid |
| | Serving size | 30 g |
| | Total fat | 7 g 11% |
| | Protein | 7 g 11% |
| | Total carbohydrate | 1 g 0% |
| | Sodium | 410 mg 18% |
| | Potassium | 25 mg 1% |
| | Calcium | 15% |
| | Age and conditions storage | 1000 g 12 months at -18°C or 40 days at -2 to 4°C |
| | | 200 g 6 months at -2 to 4°C |
6.1 Flow Chart Production Process Mozzarella Cheese

[Diagram showing the production process of Mozzarella cheese, including steps like fresh milk cooling, reception, pasteurization, cooling, cultures and rennet addition, cutting, stringing, and scalding, curd and whey draining, curd stretching and molding, cooling, salt, dry off, and packaging.]
Figure 1. Diagram of making Mozzarella cheese in Yogurt House

The sequence of production as follows:
1. Processed of mozzarella cheese

Mozzarella cheese is made by adding the culture and rennet to milk cows. Mozzarella cheese products have shaped beams. The block diagram of mozzarella cheese making process can be seen in Figure 1

2. Pasteurization and Cooling

Pasteurization was done by heating milk, using PHE at a temperature of 72°C for 15 seconds. The heated milk flow rate of 2000 L/h. The output temperature of the pasteurization engine is 35-37°C.

3. Addition of Culture and Rennet

The addition of culture and rennet into milk is carried out in a fermentation tank called Cheese Vat. In this fermentation tank, there is a jacket whose function is to regulate the temperature of the milk being processed. Increases and decreases in temperature by increasing and decreasing the amount of water vapor introduced into the jacket. Every 2000 L milk is added 40 grams of rennet, CaCl₂, and bacterial culture of St. Thermophilus. The initial temperature of the milk in the fermentation tank is 35°C. After rennet and culture are mixed, the temperature will be increased to 37 °C. Furthermore, the culture and rennet milk mixture is allowed to stand for about 40-60 minutes while stirring occasionally.

4. Cutting, Stirring, and Scalding

The process of cutting and stirring the mixing process. For the cutting process, the shape of the stirrer is used as a fork to form small clumps to be made into cheese (curd). Then, stirring is done with a shorter time of cutting. In this stirring process forms the stirrer is used as a shovel. After the scalding process is carried out by adding the heat coming from the steam into the mixture until the mixture reaches a temperature of 42 ° C. Scalding is carried out for 15 minutes until the curd settles at a pH of 6.2 to 6.3. The curd of this scalding process has a harder but still stretchable texture.

5. Stretching and Molding

Stretching was done to stretch the texture of the cheese before printing. A total of 20-25 kilograms of curd is processed in stretching machines, then water is added at a temperature of 80°C. The stretching process is carried out for 10-15 minutes. Molding is carried out using the same tools. Streams of the water from the product, brought into the cheese when molding to reduce the temperature of the cheese. The amount of mass that enters the cylinder mold is 1 kilogram. The molds are then inserted into a box-shaped mold and allowed to form a square cheese.

6. Cooling and Salting

The block-shaped cheese will then be immersed with water at a maximum temperature of 4°C for 1 hour. During immersed in water, the cheese must be reversed so that both sides of cheese undergo the same treatment. Cooling is done so that the texture of the cheese becomes harder. For 200 grams of mozzarella cheese, 1 kilogram of cheese blocks will be divided into 5 parts and then cooled. After cooling, the cheese will be immersed in a 4°C temperature salt solution with a salt concentration of 23-24%. This immersion is done for 2 hours for 1 kilogram of cheese and for 15 minutes for 200-gram of cheese. Salting is done with the aim of giving a savory taste and preserving high salt content cheese is an extreme condition that can inhibit the growth of microbes.

7. Dry off

Drying the cheese is done to remove the remaining water content as a result of the cooling process and salting. This drying is done by attaching cheese to cool storage and exhaled dry air with a temperature
of -2 °C. To block mozzarella cheese which will in shredded, drying is carried out for 48 hours. As for a block of cheese to be directly packaged, drying is carried out for 1 hour.

8. Grinding
In shredded mozzarella cheese, the blocks of cheese will be shredded by using an automatic machine then the addition of anti-caking is done so that the elasticity of the cheese is maintained. The anti-caking used is potassium sorbate with a concentration of 1% per 200 grams of cheese. This shredded mozzarella cheese is packaged in PET packaging.

9. Packing and Storage
The cheese put in the refrigerator for 1 hour for 200 grams of cheese size and 2 days for 1-kilogram cheese. Block-shaped cheese will be packaged using a vacuum machine. The vacuum method was chosen to prevent air in the package so the oxidation process can be avoided to maintain product quality.

Packaged cheese stored in the refrigerator. This storage temperature will greatly affect the shelf life of cheese. If stored at -18°C, cheese has a shelf life of 1 year whereas if stored at a temperature of 1-4°C the shelf life becomes 40 days.

6.2 Flow chart verification

| Table 5. Standard / SNI 01-2980-1992 to processed cheese |
|----------------------------------------------------------|
| Description                                              | Requirements         |
| Water                                                    | Max 45%              |
| Protein                                                  | Min 19.5%            |
| Fat                                                      | Min 25%              |
| Microbiological Examination                              |                        |
| • The number of bacteria                                 | Max 300 colony/grams |
| • E. coli bacteria                                       | Max – 3 APM          |
| • Yeast and mold                                         | -                    |
| Ash                                                      | Max 5.5%             |
| Additive                                                 | As permitted          |

Verification procedures are carried out by recording HACCP, reviewing product deviations and arrangements, confirming CCPs under control, checking the methods used, testing. The verification procedure is then continued with random sampling and analyzing it. The verification procedure ends with system validation so that it can meet all Codex requirements and update the system if there are changes at the process stage or materials used in the production process.

7. Identification and Analysis of Hazard of Fresh Milk in the admission process

| Table 6. Identification and analysis of hazard of raw material (fresh milk) |
|---------------------------------------------------------------|
| Process Step | Potential hazard | Hazards | Risk analysis | Preventive measures            |
|---------------|------------------|---------|---------------|--------------------------------|
|               |                  |         | Severe | Opportunity | Risk Factor |                          |                          |
| Raw material  | Microbiology     | Raw materials | High   | Medium      | High        | • Comply with SOP. |                          |                          |
|               | (Eschericia coli | are contaminated with other materials |        |             |             | • Equipment sterilization must be done at all times |                          |                          |
|               | Salmonella, Staphylococcus aureus) |                  |        |             |             |                          |                          |                          |
| Quality       | Chemical         | Antibiotic residue from | Low   | Low         | Low         | • Sterilization       |                          |                          |

9
Microbiology

Unsterile equipment
Cross-contamination from workers

Low Medium Low

- Operators must implement SOP that have been determined

Milk weighing with Milk Reception Scale

Microbiology

Unsterile equipment

Low Low Low

- (before and after) Equipment used must be sterilized

Milk storage Reception tank

Microbiology

Unsterile equipment

Low Low Low

- Equipment used must be sterilized

Storage tank 4°C

Microbiology

Unsterile equipment

Low Low Low

- Sterilization is done before putting the milk into a storage tank

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8. Hazard Product Identification and Analysis: Cheese

Table 7. Hazard Identification of Cheese Raw Materials

| Raw Materials  | Hazard                                      | Corrective action                  |
|----------------|---------------------------------------------|-----------------------------------|
| Fresh Milk     | Microbiology, chemical and physical         | Storage temperature <4 °C          |
|                |                                              | Transfer the right equipment       |
|                |                                              | Sanitary equipment                 |
| Starter Culture| Microbiology                                 | Storage temperature < -40 °C       |
| Rennet         | Microbiology                                 | Storage temperature < 4 °C         |
| Salt           | Microbiology, chemical and physical         | Room temperature: Store at 15°-25°C|
|                |                                              | proper personal handling           |
| Water          | Microbiology, chemical and physical         | Water Quality and supply           |

(Canadian Food Inspection Agency, 2001)

Table 8. Hazard Identification and Analysis of Product: Cheese

| Input / Process Stage                  | Level of Potential Hazard |
|---------------------------------------|---------------------------|
| Pasteurization 72-73 °C for 15 seconds| Low                       |
| Cooling up to 40 °C with the addition of 5% starter | Medium                      |
| Incubating the rennet enzyme for 43 °C for 1-2 hours | High                         |
| Coagulation                           | Low                       |
| Separation of whey with curd at       | Medium                     |
9. Determination of Critical Control Points (CCP)

This HACCP can be done by analysis using the CCP decision tree for both raw materials and each stage of the process. The CCP determination in the process of receiving raw materials was presented in Table 9.

Table 9. Determination of CCP Raw Materials (Milk)

| Process Stage                      | Hazard                        | Preventive Measure | Q1 | Q2 | Q3 | Q4 | CCP |
|------------------------------------|-------------------------------|--------------------|----|----|----|----|-----|
| Receiving Raw Materials            | Microorganism contamination  | Appropriate SOP determination & equipment sterilization must be done at all times | Y  | Y  | -  | -  | CCP |
| Quality Inspection                 | Microorganism contamination  | Operators must implement the SOPs that have been determined | Y  | Y  | -  | -  | CCP |
| Weighing milk with Milk Reception Scale | Microorganism contamination | Sterilization of equipment before and after use | N  | -  | -  | -  | -   |
| Shelter inside Milk Reception tank | Microorganism contamination  | Use of sterilized equipment | N  | -  | -  | -  | -   |
| Storage Tank (4°C)                 | Temperature fluctuation      | Check the temperature regularly | Y  | N  | N  | -  | -   |

Note: Q1 : Question 1 ; Q2 : Question 2 ; Q3 : Question 3 ; Q4 : Question 3 ; Q4 : Question 4

This HACCP can be done by analysed using the CCP decision tree in the cheese making process. The raw material in identification is determined as CCP.

The determination of CCP in the process of making cheese is presented in Table 10.

Table 10. determines CCP in the process of making cheese

| Input / Process Stage | Danger | Q1 | Q2 | Q3 | Q4 | CCP / Non CCP |
|-----------------------|--------|----|----|----|----|---------------|
| Pasteurize 72-73°C for 15 seconds | Contamination from tools used | Y  | Y  |    |    | CCP           |
Cooling up to 4°C with the addition of 5% starter
Incubating 43°C for 1-2 hours with rennet enzyme
Separation of whey with curd at 40°C
Soaking for 2 hours with salt
Packing

Mismatch of cooling time can cause other bacteria to enter Microbiology, chemistry and physical CCP
When separation occurs contamination of the equipment used Adding too much salt can cause the cheese to harden and the ripening process will slow CCP

Table 11. Determination of CP in the process of making cheese

| CCP Process Stage                   | Critical Limits                                                                 |
|-------------------------------------|---------------------------------------------------------------------------------|
| Pasteurize 72-73°C for 15 seconds   | Clean equipment must be ensured before use (no dirt in the tool)               |
| Cooling up to 4°C with the addition of 5% starter | It must be ensured that the cooling must be at the desired temperature (in set time) |
| Incubating 43°C for 1-2 hours with rennet enzyme | The enzymes used must be known for their origin and composition |
| Separation of whey with curd at 40°C | Clean equipment must be ensured before use (no dirt in the tool)               |
| Soaking for 2 hours with salt       | Salt composition must be adjusted before adding Packing according to SOP and no contamination from outside and must be done sterile |
| Packing                             |                                                                                  |

11. Determination of Corrective Actions in the Production Process

Table 12. Monitoring

| CCP Stage          | Process Stage              | What                        | Where                      | How                        | When          | Who                         |
|--------------------|---------------------------|-----------------------------|----------------------------|----------------------------|---------------|-----------------------------|
| Pasteurize         | 72-73°C for 15 seconds    | Tool surface                | Place of pasteurization    | Perform a visual inspection | Every production | Pasteurization Section     |
|                    |                           | External condition of the appliance |                           |                            |               |                             |
| Cooling up to      |                           | Cooling time temperature    | In the cooling area        | Observed the temperature of the cooling conditions | Every production | Cooling section             |
| 4°C with the       |                           |                             |                            |                            |               |                             |
| addition of 5%     |                           |                             |                            |                            |               |                             |
| starter            |                           |                             |                            |                            |               |                             |
| Incubating         | 43°C for 1-2 hours with   | Enzymes used                | At the incubation site     | observing from the list of items that enter | Every production | Incubation section         |
|                    | rennet enzyme             |                             |                            |                            |               |                             |
| Separation of      |                           |                             |                            |                            |               |                             |
|                    |                           |                             |                            |                            |               |                             |
Table 13. Corrective Actions

| CCP Process Stage | Corrective Actions |
|-------------------|--------------------|
| Pasteurize 72-73 °C for 15 seconds | Perform cleaning tools every time it used |
| Cooling up to 4°C with the addition of 5% starter | Re-cooking |
| Incubating 43°C for 1-2 hours with rannet enzyme | - Complaints to suppliers, |
| Separation of whey with curd at 40°C | - Contact the QC Head and determine whether to agree or not. |
| Soaking for 2 hours with salt | Perform cleaning tools every time it used |
| Packing | Re-cooking or down grade |
| | The product is destroyed or used as animal feed |

Table 14. Verification

| CCP Process Stage | Verification |
|-------------------|--------------|
| Pasteurize 72-73°C for 15 seconds | Review form the condition of each pasteurizer used |
| Cooling up to 4°C with the addition of 5% starter | Review the cooling tool condition form every time it used and do maintenance every month |
| Incubating 43°C for 1-2 hours with rannet enzyme | Review form |
| Separation of whey with curd at 40°C | Receipt every month |
| Soaking for 2 hours with salt | Review form |
| Packing | Review form |
| | Packaging testing and checking |

Table 15. Documentation

| CCP Process Stage | Documentation |
|-------------------|---------------|
| Pasteurize 72-73°C for 15 seconds | Pasteurization records |
| Cooling up to 4°C with the addition of 5% starter | Cooling tape |
| Incubating 43°C for 1-2 hours with rannet enzyme | Records of incubation and enzyme reception |
| Clumping | Clump Clumps |
| Separation of whey with curd at 40°C | Separation Records |
| Soaking for 2 hours with salt | Added salt recordings |
| Packing | Packing Records |
Conclusion
Cheese is one of the dairy products that are widely favored by the community, especially in Indonesia. One company that processes milk into cheese is PT.G which produces cheese mozzarella. In the process of processing, PT. G has implemented various procedures in accordance with established standards. One of them is implementing a Hazard Analysis and Critical Control Point (HACCP) from the quality control stage of raw materials until the products are ready to be distributed. The process of making cheese consists of the acidification stage, the thickening stage, the curd processing stage until the ripening stage. From these stages there are several potential hazards in terms of physical, chemical and biological. The stages that need to be watched out are in the cooling and packaging stages because both stages are considered to have high contamination potential. Cheese mozzarella PT. G passed various tests with strict supervision so that its products have met the standards established.

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