

GMP Evaluation and HACCP Plan in Black Tea Industry, Central Java, Indonesia

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Abstract—It is necessary to monitor the black tea production process in an industry. The food control method in the black tea production process is carried out using GMP analysis and HACCP planning. This study aimed to evaluate the implementation of GMP in industry and prepare a HACCP implementation plan. The observation results show that several minor and major deviations still occur in the GMP aspect of the black tea production process. If there are deviations, corrective procedures must be carried out so that the black tea production process can run well and the company is ready to implement HACCP. Based on the observation activities, implementing GMP in industry can be categorized as a good score. The HACCP implementation plan prepared can be implemented in the black tea production process.

Keywords— Black tea, food safety, GMP, HACCP.

I. INTRODUCTION

Black tea is a processed product from tea leaves made through oxidation [1, 2]. The result of brewing black tea has a deeper color and stronger aroma due to the enzymatic oxidation process in the tea [3, 4]. The quality of the tea leaf picking determines the product's final grade. This is one of the reasons that most tea production units owned by a factory are located near tea plantations. This is done to minimize damage to tea leaves during the distribution process. Usually, tea leaves will undergo the picking process twice, in the morning and afternoon [5]. During the black tea production process, a food safety system is still involved to ensure that the tea produced is safe for public consumption.

A food safety system is needed in the food production process because there have been many cases of food poisoning [6, 7]. Food contamination can be caused by several things, including cross-contamination and the presence of allergen compounds and toxin compounds found in food. Food quality guarantees that are recognized throughout the world include suitable food production methods (Good Manufacturing Process), good hygiene practices (Good Hygiene Practice), SSOP (Standard Sanitation Operating Procedure), and HACCP (Hazard Analysis Critical Control Point). Implementing a food quality assurance system can provide a sense of security for consumers regarding food safety. The fundamental level in the food safety system is GMP.

GMP shows that the food production process has been carried out by predetermined standards. This is also supported by the quality of the buildings, employee machines, and facilities owned by the production unit. This calculation and analysis regarding quality are carried out because to support a good food production process; it is also necessary to support facilities and good quality workers. These factors also influence the determination of critical points regulated in HACCP.

HACCP shows that processed food has been categorized as safe from various physical, chemical, and biological contaminants [8]. This is closely related to ensuring food safety. Food safety guarantees must be provided by producers

to consumers to create a sense of security for consumers in consuming the food. A producer who has guaranteed that the food produced is categorized as safe food can reduce the incidence of food contaminants [9]. The main critical point in black tea production is the enzymatic oxidation event. Enzymatic oxidation is the stage in the oxidation process of epigallocatechin and gallate to become orthoquin; then, it will undergo condensation to become bisflavonol and yellow theaflavin. Next, theaflavin will undergo condensation and turn into brown thearubigin. This thearubigin will undergo a polymerization and precipitation reaction with protein to produce an insoluble substance [10, 11]. When this enzymatic oxidation process does not work well, it will make poor-quality black tea.

The success of the black tea production process depends not only on the success of the enzymatic reaction. The implementation of GMP and HACCP in industry is one of the benchmarks for a product to be declared genuinely safe for consumption by the public. GMP and HACCP are one of the controls for food quality assurance so that food produced in an industry that has implemented GMP and HACCP is safe from contamination. Therefore, the research carried out aims to analyze the implementation of GMP and HACCP planning in the X black tea industry in Central Java.

II. METHOD

This research is a case study conducted at a black tea production unit located in Batang Regency, Central Java, which was carried out from January to February 2022. The research was carried out through several stages, namely observation, data collection, and continued with data analysis. The observation process was carried out by surveying production locations and interviewing all employees and leaders in the production unit. Observations were carried out to obtain initial information regarding the stages of the tea production process carried out in the production unit. Data collection is carried out by taking notes on all facilities, building layout, and a series of production processes following the requirements set out as GMP and HACCP standards. All data obtained is then analyzed descriptively for the HACCP

implementation plan, and a scoring analysis is carried out regarding the implementation of GMP in the production unit. The study of GMP implementation was carried out by the scope of GMP, which is regulated by the Minister of Industry of the Republic of Indonesia Number 75/M-IND/PER/7/2010. The area of GMP controls 18 GMP aspects, including the following [12].

1. Location
2. Building
3. Sanitary facilities
4. Machinery and equipment
5. Material
6. Process monitoring
7. The final product
8. Laboratory
9. Employee
10. Packer
11. Product labels and descriptions
12. Storage
13. Maintenance and sanitation programs
14. Transportation
15. Documentation and recording
16. Training
17. Product Withdrawal
18. Implementation of guidelines

Preparing an HACCP implementation plan is carried out based on the HACCP implementation guidelines, which have been regulated in SNI-01-4852-1998 [13] regarding hazard analysis systems, critical point control, and implementation guidelines. The requirements that must exist in a HACCP system are as follows.

1. Establishment of a HACCP Team
2. Creation of product descriptions
3. Identify the planned use of the product
4. Making production process flow diagrams
5. Verify flow diagrams in the field.

The main principles of HACCP regulated by the National Advisory Committee on Microbiological Criteria for Food, 1992 (NAMCP) and the Codex Alimentarium Commission (CAC) are as follows [14].

1. Hazard analysis
2. Determination of critical control points
3. Determination of critical limits
4. Determination of monitoring procedures
5. Determination of corrective actions
6. Implementation of verification procedures
7. Determination of documentation procedures

All data regarding the implementation of GMP in the tea production unit is then subjected to scoring analysis. The results of the scoring analysis are used as a basis for the level of success of production units in implementing GMP. Deviations found in the implementation of GMP need to be analyzed to become the basis for improving the performance of GMP in the future.

III. RESULT AND DISCUSSION

GMP Evaluation

The evaluation results of GMP implementation in tea production units show that GMP implementation in production units is included in category C or less, with 3 cases of severe deviations and 15 cases of significant deviations. The details of the GMP assessment of the tea production unit are as follows.

1. Location

Major deviation 1

The location of the tea production unit is strategic because it is close to tea plantations and main roads. This can facilitate transporting raw materials in and out of the production unit. The production unit is also far from the place of business, which can cause pollution to processed food. The deviation at the location of the production unit is a section of the main road that has holes in it, causing puddles of water. Stagnant water at the production unit location can cause pollution and endanger the transportation process.

2. Building

Major deviation 3

The building layout in the tea production unit is separated between the production location and the office. This aims to avoid cross-contamination during the production process. Several parts of the building experience deviations, including the following.

Floor. The type of floor used for the wet sorting room and oxidization room uses white ceramic, which cannot absorb water. The floor in the production unit forms dead corners, so it is pretty tricky to clean.

Wall. It was found that walls with ceramics were used, making it easier to carry out the cleaning process. The walls still form dead angles, so cleaning is more complex.

Roof. The tea production unit does not use a ceiling but is only covered with galvalume. Several parts of the top have holes.

Door. The door does not have an automatic opening and closing feature, allowing cross-contamination.

Ventilation. Some rooms are equipped with ventilation, but the amount of ventilation in the drying and dry sorting rooms is limited.

3. Sanitary facilities

Major deviation 4

Serious deviation 1

Several significant irregularities were found in sanitation facilities, including inadequate toilets; no signs warning to wash hands with soap after using the bathroom; hand washing facilities are not equipped with soap, hand dryers, and closed trash cans; and no partial rinsing facilities. A serious deviation found in sanitation facilities was dirty toilets. Sanitary facilities in a production unit must be maintained so as not to cause contamination of the food products being processed.

4. Machinery and equipment

Major deviation 1

The major irregularities found in machines and equipment were machines with holes and rust. Devices that have holes and rust can be a source of contamination in the production process. Rusty machines are no longer suitable for use because they can cause the transfer of dangerous chemical compounds from engines to products to humans

5. Material

The materials used are in accordance with specified standards and meet the material quality criteria. The criteria for the materials used are that they are not damaged, do not contain dangerous ingredients, and do not endanger health.

6. Process monitoring

Major deviation 1

Process supervision had major irregularities because microbiological testing was not carried out on the materials. Microbial testing is essential to detect contamination from microorganisms, especially thermophilic pathogenic microorganisms, so they do not become a source of contaminants in processed products.

7. The final product

Major deviation 1

The major deviation in the final product was that biological and microbiological testing needed to be carried out. Physical testing aims to evaluate the presence of organisms or organism carcasses that may still be present during the production process. Microbiological testing aims to detect pathogenic microorganisms that may still be present in the final product.

8. Laboratory

Major deviation 1

The major deviation found in the laboratory was that the measuring instrument needed to be calibrated in stages. This calibration process aims to ensure that the measuring instruments used remain accurate.

9. Employee

Major deviation 1

Serious deviation 2

The major deviation found among employees was that employees did not use personal protective equipment. This can cause cross-contamination with products and harm employees' health. Serious deviations found were employees not washing their hands and employees wearing jewelry in the production room. Employees' habits of not washing their hands and wearing jewelry can cause contamination of the products produced.

10. Packaging

No Deviation

The packaging process for tea products does not experience irregularities. Primary packaging is packaging that is directly attached to the product. The primary packaging used is a paper sack. Secondary packaging is packaging that is outside the primary packaging and functions to protect the product from the outside. The secondary packaging used is a cardboard box or plastic sack.

11. Product labels and descriptions

No deviation

Labels and descriptions of products used for tea already have informative and clear labels. On the packaging label used, the product's net weight, expiration date, and best before are listed.

12. Storage

No deviation

No deviations were found in the aspects of packaging, labels, product descriptions, and storage. This aspect has been well taken care of to maintain product quality.

13. Maintenance and sanitation programs

Major deviation 1

The major deviation in the maintenance and sanitation program aspect was that several production facilities were damaged. Production facilities that are starting to become damaged can hamper the production process and can also cause contamination of dangerous chemical compounds during the production process.

14. Transportation

Major deviation 1

The major deviation found in the transportation process was that temperature and humidity checks were not carried out during the product transportation process. Temperature and humidity greatly affect the quality of the final product, so it is necessary to check in stages so that temperature and humidity do not become factors that cause product damage during the transportation process.

15. Documentation and Recording

A production unit requires documentation and recording. This is used as a recording medium. Documentation and recording can be used as a basis for corrective action and evaluation decision-making.

16. Training

Training activities aim to ensure that all employees in the production unit have the capability to carry out their duties.

HACCP Implementation Plan

HACCP planning in the production process can determine critical conditions so that appropriate handling analysis can be carried out according to requirements in the field.

1. Establishment of a HACCP Team

The HACCP team is tasked with organizing and controlling the entire production chain to meet the requirements for HACCP certification. The primary need in the team is the availability of human resources. Some job descriptions of the HACCP team are as follows.

TABLE 1. Job Description on the HACCP Team

No	Position	Job Description on the HACCP Team
1.	Team Leader	<ul style="list-style-type: none"> - Prepare, compile, and validate HACCP manual documents - Fully responsible for the implementation of HACCP in the company environment - Providing food safety system training programs for all employees
2.	Vice Chairman	<ul style="list-style-type: none"> - Assist the team leader in carrying out the task of implementing HACCP in the company - Carry out the duties of the chairman if the chairman is absent - Participate in being responsible for the implementation of HACCP in the company environment - Provide input, suggestions, and improvements in a system to improve company quality
3.	Secretary	<ul style="list-style-type: none"> - Responsible for preparing and creating manual documents regarding HACCP - Ensure that all employees receive documents regarding HACCP that the company has prepared - Carry out archiving activities for all documents related to HACCP
3.	Member team	<ul style="list-style-type: none"> - Responsible for implementing HACCP in the production department - Monitoring and evaluating potential hazards in each production process

		<ul style="list-style-type: none"> - Participate in preparing manual documents regarding HACCP - Provide input and improvements to HACCP
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2. Making Product Descriptions and Product Usage Plans
Product descriptions are details of the products produced, including the name of the product and the regulations relating to the product. The product description provides a general overview of the product delivered. The product description is as follows.

TABLE 2. Product Description

No.	Information	Description
1.	Product name	Black tea
2.	Composition	Dry black tea
3.	Biological, chemical and physical characteristics	Dry product, maximum water content 8%
4.	Production Method	Picking, withering, fermentation, drying
5.	Packaging	Bag
7.	Shelf Life	12 months, stored at room temperature
8.	Storage method	Stored in a dry place with a maximum humidity of 70%
9.	Product use	It can be brewed with hot water and consumed; it is not suitable for babies

3. Creation and Verification of Production Process Flow Diagrams

The flow diagram that has been created is then carried out in a verification process to adapt it to existing conditions in the field. If a process is found that is not in accordance with the flow diagram, improvements can be made to the production process. The black tea production process uses the Orthodox Rotorvane system, which produces tea leaves with smaller particle sizes. The stages of the production process consist of receiving shoots, withering, rolling, milling, wet sorting, enzymatic oxidation, drying, dry sorting, packaging, and storage. The flow diagram for the production process is as follows.

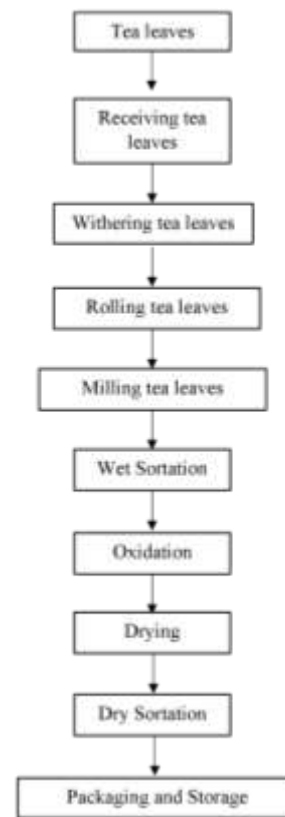


Fig 1. Flow Chart Tea Processing

4. Hazard Analysis and Determination of Critical Control Points

The analysis results of determining critical points in a series of production processes aim to determine the existence of critical points and become the basis for further handling processes. Four critical points were found during the production process based on observation activities. An explanation of the critical points in the black tea production process is as follows.

TABLE 3. Hazard Analysis and Determination of Critical Control Point

Process Stages	Danger	Cause of danger	Preventive measure	CCP Category
Reception of shoots	Physical: gravel Biological: caterpillars	There is cross contamination from tea plantations	Carry out the sorting process before further processing is carried out	Non-CCP
Withering	Physical: temperature, time	The temperature entering the system is unsuitable, and the withering time is incomplete	Ensure that the temperature in the tool is appropriate, and determine the length of time for the withering process.	CCP
Rolling	Chemistry: cross-contamination	The rolling machine is not running well, so the rolling process is not perfect.	Check the winding machine regularly	Non-CCP
Milling	Physical: size is not uniform	The grinding machine was not working correctly, so the tea leaves were not ground perfectly.	Check the grinding machine regularly	Non-CCP
Wet sorting	Chemistry: temperature and humidity	The presence of friction from a machine can cause an increase in temperature. Increasing temperature can damage the quality of the tea produced	Equip the room with a humidifier so it doesn't damage the products being made.	Non CCP
Oxidation	Chemistry: temperature, humidity	Inappropriate temperature and humidity can cause the oxidation process to fail.	Ensure temperature and humidity comply with predetermined standards	CCP
Drying	Chemistry: drying temperature	The drying process could improve, making the product not completely dry.	Ensure drying temperature meets standards	CCP
Dry sorting	Chemistry: temperature and humidity	Temperature and humidity are not suitable, which can damage the characteristics of the final product.	Ensure temperature and humidity during the dry sorting process	CCP
Packaging and storage	Physical: gravel	The presence of physical contamination can cause a decrease in product quality	Ensure cleanliness in packaging and storage areas	Non CCP

5. Dermination of Critical Limits and Monitoring Procedures
Determining critical points and critical limits in a series of production processes aims to determine the upper and lower limits allowed in the production process. The purpose of deciding these limits is as an indicator in the production chain control process. The determination of critical limits and monitoring efforts carried out during the production process are as follows.

TABLE 4. Determination of Critical Limits and Monitoring Procedures

Critical Control Points	Critical Limit	Monitoring
Oxidation	The minimum temperature is 19C, and the maximum temperature is 21C Minimum humidity 90% and maximum humidity 97%	Check at the beginning, middle and end of the oxidation process so that the temperature and humidity comply with predetermined standards
Drying	Inlet temperature 100C Drying time 24 minutes	Check the inlet temperature during the production process and control the drying time
Dry Sorting	The minimum temperature is 25C and the maximum temperature is 26C	Check the temperature used during the dry sorting process

6. Determination of Corrective Actions, Verification and Documentation
Determination of corrective actions is carried out based on deviations that arise during the production process. If the variations that occur cause minor losses, modifications to the production process are made; if the deviations occur in a major form, causing significant losses, then the production process is stopped, and improvements are made to the production process chain. Verification is carried out based on the conformity of the SOP for the quality of raw materials to the final product. Verification procedures are also related to the results of tests carried out in the laboratory. The entire series of processes must be carried out with excellent and structured documentation procedures to facilitate the traceability process throughout the production process and become an asset for the company.

IV. CONCLUSION

Based on the observation activities that have been carried out, it can be concluded that there are several deviations in implementing GMP in the black tea processing industry. This

deviation needs to be corrected first before preparing to implement HACCP during the production process. The results of the CCP analysis found 4 CCPs that need to be considered during the production process to create a safe tea product for consumption by the public.

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