

Implementation of Hazard Analysis and Critical Control Point (HACCP) on Bread Bakery Production Process in Bunga Mawar Puti Bakery

Ika Nawang Puspitawati^{1*}, AR Yelvia Sunarti², Erwan Adi Saputro³, Suprihatin⁴, Luluk Edahwati⁵, Vika Dwi Wulandari⁶ and Bayu Aji Bibarog⁷

^{1,2,3,4,6,7}Department of Chemical Engineering, Pembangunan Nasional University “Veteran” Jawa Timur Indonesia

⁵Department of Mechanical Engineering, Pembangunan Nasional University “Veteran” Jawa Timur Indonesia

Abstract. This study aims to identify the hazards and potential that may arise at every stage of the bread production process in the Bakery by the HACCP system, analyzing the implementation of quality control and determining the CCP in the production process of bread at the bakery in Bunga Mawar Puti Bakery, Jatirejo, Mojokerto. The research was conducted using a survey method, by following the whole process of making bread bakery from the receiving raw materials to the packaging of the final product. The method of data analysis used was the descriptive analysis method. This research identifies results in the process of making sausage pizza bread, from raw materials to products that have the same dangers reviewed, including the physical, chemical, and biological. The results showed that CCP was found in 3 processes in the stage of the production process of sausage pizza bread. First, in the process of mixing bread dough, there is a chemical hazard caused by metal-contaminated materials. Second, the process of receiving cheese, sausage has biological hazards in the form of *Escherichia coli* bacteria. Third, the cooling process before packaging has physical hazards in the form of dust and dirt. The implementation of HACCP in Bunga Mawar Puti Bakery can help in fulfilling the quality requirements, increase consumer confidence and give the vigilance of occurrence of contamination.

Keywords. HACCP, CCP, Food Safety, MSME, Bread Bakery

1 Introduction

Based on data from the Ministry of Small Cooperatives and Medium Enterprises (SMEs) Indonesia shows that business Micro, Small, and Medium Enterprises (MSMEs) have approximately 99.99% (62.9 million) of the total of business actors in Indonesia in 2017, large business only 0.01% or about 5400 units [1].

Based on statistical on Indonesian food consumption, in 2020 shows that in the last 5 years, the average consumption per capita of the Industry bakery growing 8-10%/year[2]. Bread is flour-based food product flour that is processed using the oven or steamed. Bread attracts a lot of consumer from children until the elderly, but do not have food safety assurance. Efforts to control, prevent and control the safety of a food ingredient are not easy. It takes some effort and conditions that must be met. Food safety in a product is the most important thing in maintaining the quality of a food product. This is because food safety concerns the safety of human health. The most basic of food safety, as much as possible no contaminants stay in the food or products produced.

National Agency of Drug and Food Control (BPOM) Indonesia, in 2019 recorded that the most common causes of food poisoning occurred because household processed food was around 265 cases and processed food from the home industry was around 97 cases [3]. These data show the need there is a system that can guarantee and support food safety and quality assurance in the food industry especially in MSMEs, with implement the Hazard Analysis and System Critical Control Points (HACCP). Body National Standard (BSN) provides food safety standards that are safe for consumption. For that it is necessary quality control in the production process, starting from raw materials, processes to finished products.

HACCP is a systematic approach to the identification, assessment, and control of hazards during production, processing, manufacturing, and preparation of food [4][5][6]. The goal of the HACCP system is to identify potential threats and identify them as Control Critical Points (CCP). By analyzing and controlling process documentation for possible emerging threats, the system develops principles that will lead to safe food guarantees. Employees are appointed in the organization who are responsible for managing the HACCP plan.

* Corresponding author : ikanawangpuspita@gmail.com

Designated employees must have appropriate qualifications and in-depth knowledge of the principles of the HACCP Code [7][8].

Bread is food made from wheat flour, water, and yeast which is made through the kneading, fermentation (dough development) stages using yeast, and the baking process in the oven. It can be seen from the increasing number of bread brands circulating in the market with a variety of unique products. One of the famous bakery products in the Mojokerto area that is currently being liked by many people is sausage pizza bread produced by Bunga Mawar Puti Bakery. Pizza Bread is a round oven cake made with fresh yeast dough, topped with tomato sauce, cheese, and a variety of other ingredients. Now, it can be topped off with a variety of ingredients that may include sauces, sausages, and cheese. The sausage pizza bread which is one of the products from Bunga Mawar Puti Bakery, as shown in Figure 1.



Fig. 1. Sausage pizza bread by Bunga Mawar Puti Bakery.

If HACCP is applied in the food industry, including bakery, the benefits obtained include: Prevent or detecting unsafe raw materials or ingredients before they enter the production system, Keeping the problem from becoming big and being handled by implementing early detection, Be aware of contamination in facilities that are shared for various products, Reduce internal product containment and product destruction, Prevent testing dependence on the final product which could lead to the release of unsafe products. So the purpose of our project is to know the production process of sausage

pizza bread and implementation of HACCP on Bunga Mawar Puti Bakery to ensure that the product is safe, clean, and hygienic for consumption.

In the previous study related to the implementation of HACCP in the banana bread industry, the results of the identification in this application obtained hazards from a physical point of view in the form of hair, dirt, insects, dust, and sand. From chemical hazards in the form of metal contamination to rust and biological hazards in the form of microbes and CCP determination is determined using a decision tree [9]. In other studies, Implementation of HACCP and prerequisite programs in the food business in Turkey, the results indicated that proper food safety practices and prerequisite food safety programs for HACCP were often not being followed in many food businesses. Time and temperature errors and inadequate handwashing practices were wide in most food businesses. Emphasis on implementing prerequisite programs in preparation for HACCP is needed in food businesses [10]. A study conducted by [11] stated that from the overview of the HACCP system implemented in the bakery, there was no reduction in quality of the final product during the manufacturing process, with particularly strong implementation of prerequisites and total commitment and sense of responsibility of all employees. Rather, there was a guarantee of product quality, as shown by several studies, demonstrating that the HACCP system has a positive effect on the quality of end products.

This study aims to identify the hazards and potential that may arise at every stage of the bread production process in the Bakery by the HACCP system, analyzing the implementation of quality control and determining the CCP in the production process of bread at the bakery in Bunga Mawar Puti Bakery, Jatirejo, Mojokerto.

2 Research and Method

2.1 Time and Place

This study was conducted at the bakery in Bunga Mawar Puti Bakery, Jatirejo, Mojokerto in March-May 2021.

2.2 Research Design

This study using a survey method, by following the whole process of making bread bakery from the receiving raw materials to the packaging of the final product. The method of data analysis used was the descriptive analysis method. This study direct interviews with employees and making direct visits to the Bunga Mawar Puti Bakery and compare the results of observations and interviews to find out the application of HACCP to Mawar Puti Bakery.

2.3 Method

This research uses the HACCP method which is divided into 2 stages, including the Preliminary Step to Hazard Analysis and the HACCP implementation. Preliminary Step to Hazard Analysis

1. Training on HACCP. Researchers must have an understanding of food safety theory, understand the principles of HACCP, know the role and use of HACCP in the production process;
2. Description of products that have specific properties. Hazards that may occur from receiving raw materials to products must be identified by food safety requirements;
3. Identify the use of the product to classify consumers based on the risks that can be caused when consuming the product, and provide information that the product can be distributed to all populations or only sensitive (sensitive) populations. The sensitive population group consists of the elderly, infants, pregnant women, the sick, and people with limited immunity (immunocompromised);
4. Preparation of flow charts, by recording the entire process from receiving raw materials to becoming products;
5. Verify the flow chart, by reviewing the production process directly, coordinating with production operators, and testing product samples to prove the accuracy of the flow chart that has been prepared with the actual production process. If in the field application the flow chart is not appropriate, then modifications or improvements are made to the flow chart. On the other hand, if the flow chart is appropriate in the field, it will be documented against the flow chart by filling out the flow chart verification form [12].

2.4 Hazard Analysis

1. Analyzing hazards, referring to process flow diagrams, viewing HACCP, and listing all potential hazards that may occur at each stage of the process. These hazards include biological, chemical, and physical hazards. The risk assessment (significance) of the hazard is based on the probability that the hazard will occur and the level of seriousness of the hazard. By combining the probability with the severity of the hazard, the level of risk/significance of the hazard of a product can be determined [10] (Maulana et al., 2012);
2. Establish a Critical Control Point (CCP), obtained from the process when analyzing a hazard has a significant hazard analysis;
3. Establish critical limits, by setting standards for processes that have significant hazards;
4. Establish a CCP monitoring system, taking into account what needs to be monitored, how to monitor it, the time and frequency of monitoring, who should monitor it, and where it should be monitored;
5. Establish corrective action, if the result of a CCP exceeds the critical limit;
6. Establish verification actions periodically and directly documented. Verification procedures in the production process by checking regularly by identifying all HACCP implementations, to control and ensure that all procedures as a whole are running effectively;

7. Prepare documents, including all records regarding product safety. Effective and efficient documentation is evidence that critical limits have been met and correct corrective action has been taken so that the results of activities can be recorded properly.

3 Result and Discussion

Bunga Mawar Puti Bakery has a variety of bakery products, but there is one mainstay product they have, it is sausage pizza bread. This sausage pizza bread is sold among other products. So we choose this sausage pizza bread. The product description in Bunga Mawar Puti Bakery as shown in Table 1.

Table 1. The product description in Bunga Mawar Puti Bakery.

Parameter description	Explanation
Product name	Sausage Pizza Bread
Composition	Wheat flour, sugar, salt, olive oil, cold water, and yeast
Product characteristics	Sausage pizza bread is round, diameter 20 cm and weight 30 grams with tomato sauce on it and cheese mixed with sausage.
Processing method	Toaster Oven
Primary packers	PP Plastic (Polypropylene Plastic)
Storage conditions	Room temperature and avoid direct sun
Storage time	1 week

Making of sausage pizza bread at Bunga Mawar Puti Bakery begins with processing the ingredients into pizza bread dough. The ingredients used to make the dough are 2 kg of Cakra flour, 25 grams of granulated sugar, 40 grams of salt, 30 grams of olive oil, 1250 ml of cold water, and 10 grams of yeast. For making the dough, all dry ingredients and olive oil are put into the bowl (specifically for salt and yeast are separated by the placers). This measure of ingredients can make 13 dough pizza bread. Then the ingredients are mixed using a large capacity mixer. Then 1250 ml of cold water is put into the mixture while mixing it until smooth. The finished dough is weighed every 250 grams and formed round. Then the dough is rolled into a flat circle like pizza bread. During the formation of pizza bread, the formed dough is coated with flour to facilitate the forming process. After forming into pizza, the dough is baked into the oven for 30 seconds. Then you can add toppings with tomato sauce, cheese, and sausage. The next step is the pizza bread that has been given the topping is put in the oven to bake for 10-15 minutes. After the pizza bread is cooked, the packaging process is carried out in plastic. sausage pizza bread that has been made, served directly to customers at the Bunga Mawar Puti Bakery.

3.1 Hazard Analysis

The hazard analysis for consumers due to allergies to ingredients used for consumers in production process of

sausage pizza in the Bunga Mawar Puty Bakery at ingredients, such us wheat flour, sugar, salt, olive oil,

water, sausage, cheese, tomato sauce and PP Plastic. Some hazard analysis as shown in Table 2 - Table 4.

Table 2. Hazard Analysis, Risk Assessment, and Control Mechanisms for Sausage.

Storage Conditions	Potential Hazard	Risk Assesment		Outcome	Significant Risk (Y/N)	Explanation/Reason/ Evidence/ Cause	Control Mechanism
		Severity (S)	Probability of Occurance (PO)				
A or R	Physical (P)	3	2	6	NO	Inappropriate conditions for storage and distribution	Approved supplier and metal detector
	Chemical (C)	3	3	9	NO	Deteriorated raw material	Approved supplier and COA
	Biological (VP)	5	3	15	YES	Increase temperature : more than 10 C growth and multiplication of pathogen micro-organisms	Pasteurization Lab test and COA
	Biological (SP)	5	3	15	YES	Increase temperature : more than 10 C growth and multiplication of pathogen micro-organisms	Pasteurization Lab test and COA
	Allergen (A)	1	1	1	NO	Not an Allergen Ingredient	NA
	Radiation (R)	2	1	2	NO	Very rare to occur	NA
	Halal (H(KG/MO))	5	3	15	YES	Must have evidence or from HALAL animals as cows or chickens	Valid HALAL Certificate

Table 3. Hazard Analysis, Risk Assessment, and Control Mechanisms for Cheese.

Storage Conditions	Potential Hazard	Risk Assesment		Outcome	Significant Risk (Y/N)	Explanation/Reason/Evidence/ Cause	Control Mechanism
		Severity (S)	Probability of Occurance (PO)				
A or R	Physical (P)	3	2	6	NO	Inappropriate conditions for storage and distribution	Approved supplier and sieves
	Chemical (C)	3	3	9	NO	Deteriorated raw material	Approved supplier and sieves and COA
	Biological (VP)	5	3	15	YES	Increase temperature : more than 1,5 C growth and multiplication of pathogen micro-organisms	Pasteurization and COA
	Biological (SP)	5	3	15	YES	Increase temperature : more than 1,5 C growth and multiplication of pathogen micro-organisms	Pasteurization and COA
	Allergen (A)	4	3	12	YES	Cheese are Allergen ingredient due to presence of lactose	Allergen control program and Labelling
	Radiation (R)	2	1	2	NO	Very rare to occur	NA
	Halal (H(KG/MO))	3	4	12	YES	Must have evidence come from HALAL animals milk as cows	Valid HALAL Certificate

Table 4. Hazard Analysis, Risk Assessment, and Control Mechanisms for Tomato Sauce.

Storage Conditions	Potential Hazard	Risk Assesment		Outcome	Significant Risk (Y/N)	Explanation/Reason/Evidence/ Cause	Control Mechanism
		Severity (S)	Probability of Occurance (PO)				
A or R	Physical (P)	3	2	6	NO	Inappropriate conditions for storage and distribution	Approved supplier and sieves
	Chemical (C)	3	3	9	NO	Deteriorated raw material	Check the quality of the tomato sause when the raw materials arrive
	Biological (VP)	4	3	12	YES	Inappropriate conditions for storage and Increase temperature : more than 28 oC	Check tomato sause before processing
	Biological (SP)	4	3	12	YES	Inappropriate conditions for storage and Increase temperature : more than 28 oC	Check tomato sause before processing
	Allergen (A)	1	1	1	NO	Not an Allergen Ingredient	NA
	Radiation (R)	2	1	2	NO	Very rare to occur	NA
	Halal (H(KG/MO))	1	1	1	NO	-	NA

Table 2 to Table 4 shows that the dangers for consumers due to allergies to ingredients used for consumers. The table also contains the microbiology used and the potential for halal or not material. And

there is information on whether the materials used cause radiation. And also a Control Mechanism to keep materials safe and keep production running smoothly.

3.2 Prerequisite Programs

Prerequisite programs are programs and practices that are put in place to maintain a sanitary environment and minimize the risk of introducing a food safety hazard, or it can be defined Prerequisite programs are pro-grams and practices put in place to address the role the production environment plays in producing safe food products [10]. The prerequisite programs in the Bunga Mawar Puti Bakery as shown in Table 5.

Table 5. Prerequisite Programs At Bunga Mawar Puti Bakery.

Prerequisite Programs	YES/NO
Personal Hygiene	YES
Past Control	NO
Foreign Materials Control Program	YES
Facility Location	YES
Recall & Withdrawal	YES
Rework Management	NO
Waste Management	YES
Equipment Design	YES
Supplier Approval	YES
Transportation & Distribution Control	YES
Cleaning & Sanitation	YES
Allergen Control Program	NO
Traceability	NO
Storage & Receiving of RM	YES
Calibration	NO
Utilities	YES
Training	YES
Maintanance	YES
Biological Hazard Control Program	YES
Customer Communication	YES
Layout	NO
Chemical Control Program	NO
Food Defense	NO

Table 5 shows that prerequisite programs in the Bunga Mawar Puti Bakery, it can be seen that the Personal Hy-giene is yes because the employees at the Bunga Mawar Puti Bakery already use headgear, chef uniforms, aprons, trousers, and safety shoes. At the

Table 6. Critical Control Point of Production Sausage Pizza in Bunga Mawar Puti Bakery.

Materials	Potential Hazard	Risk Assesment		Total	Significant Risk (Y/N)	Explanation/Reason/ Evidence/ Cause	Control Mechanism	Q1	Q2	Q3	Q4	PRP/OPRP (SPPs) or CCP
		Severity (S)	Probability of Occurance (PO)									
Sausage	Physical (P)	3	2	5	N	Inappropriate conditions for storage and distribution	Approved supplier and metal detector	Y	-	-	-	PRP
	Chemical (C)	3	3	6	N	Deteriorated raw material	Approved supplier and COA	Y	-	-	-	PRP
	Biological (VP) (SP)	5	3	8	Y	Increase temperature: more than 10 C growth and multiplication of pathogen micro-organisms	Pasteurization Lab test and COA	Y	Y	N	N	CCP
Cheese	Physical (P)	3	2	5	N	Inappropriate conditions for storage and distribution	Approved supplier and sieves	Y	-	-	-	PRP
	Chemical (C)	3	3	6	N	Deteriorated raw material	Approved supplier and sieves and COA	Y	-	-	-	PRP
	Biological (VP) (SP)	5	3	8	Y	Increase temperature : more than 1,5 C growth and multiplication of pathogen micro-organisms	Pasteurization and COA	Y	Y	N	N	CCP
Tomato Sauce	Physical (P)	3	2	5	N	Inappropriate conditions for storage and distribution	Approved supplier and sieves	Y	-	-	-	PRP
	Chemical (C)	3	3	6	N	Deteriorated raw material	Check the quality of the tomato sause when the raw materials arrive	Y	-	-	-	PRP
	Biological (VP) (SP)	4	3	7	Y	Inappropriate conditions for storage and Increase temperature : more than 28 oC	Check tomato sauce before processing	Y	N	N	-	OPRP

Bunga Mawar Puti Bakery, a Foreign Substance Control Program was carried out, because all ingredients must be clear and clean from any material that makes the material a hazard and consumers can feel safe, and in there use transportation and distribution control, because the delivery of materials must be kept clean and can be more orga-nized for shipping materials or products, and there is no allergen control in Bunga Mawar Puti Bakery because consumers already know what foods they should avoid avoiding having allergies. In addition, at the Bunga Mawar Puti Bakery, a Biological Hazard Control Program is carried out, because of the high possibility of biological hazards during the production process.

3.3 Critical Control Point (CCP)

Critical Control Points (CCP) can be determined after the hazards at each stage of the process are identified in the hazard analysis stage. Each identified and significant hazard is classified as a CCP or not a CCP using the CCP determination chart. Hazards that are not significant from the hazard analysis do not need to be continued on the Critical Control Point (CCP) determination diagram [13].

CCPs may located at any point in the food production plant where hazards need to be prevented, eliminated, or reduced to acceptable levels. The identification of CCPs should ensure appropriate control measures that are effectively designed and implemented. In particular, if a hazard has been identified at a step where control is necessary for product safety and no control measure exists at that step, then the product or process should be modified at that step or at an earlier or later stage, to include a control measure. Moreover, a monitoring system per critical point should be established and implemented [14]. The critical control point (CCP) in the Bunga Mawar Puti Bakery as shown in Table 6.

Table 12 shows determining the CCP at the stages of the production process which have potential hazards that may arise during the process, including physical, chemical, and biological hazards. The ingredients included in the CCP are water, sausage, cheese, and PP Plastic. Table 12 explained the dangers contained in the material in full and there is an explanation of when the production process takes place. With this table, it is very helpful to consumers regarding the materials and processes carried out.

4 Conclusions

Based on the research have conducted can conclude that, the Identify the process of making sausage pizza bread by observing the flow of the bread-making process from raw materials to products. In this application, there are dangers in terms of physical in the form of dirt, dust, and gravel. From chemical hazards in the form of metal contamination and dyes as well as biological hazards in the form of destructive microbes, molds, or fungi such as *Aspergillus flavus*, *Salmonella* spp, *Staphylococcus aureus*, *E.coli* dan *Shigella* spp. In addition, the application of HACCP at Bunga Mawar Puti Bakery can assist in meeting quality requirements, increase consumer confidence and provide awareness of contamination, so an internal audit must be carried out and documented to meet the requirements in the implementation of HACCP by the relevant management and It is necessary to increase awareness of the hygiene of the production room, the hygiene of workers, the hygiene of the production process and the hygiene of machines and equipment to avoid physical, chemical and biological hazards.

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