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Quality Control Management in Processed Beef Production in MSMEs (PT XYZ)

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ABSTRACT

This study focuses on the design and implementation of a quality control management system for the production of rendang at PT XYZ, a local SME. The objective of this research is to analyze and design an integrated quality control system using Statistical Process Control (SPC) tools, including P-control charts and Fishbone diagrams. Data collection was carried out through direct observation, interviews with the owner, and documentation of production records from February 2025. The study found that although the production process was within statistical control limits, there were still variations in product quality, especially in taste and aroma, as well as packaging issues. This research emphasizes the importance of a structured quality management system to enhance product consistency and reduce defects. Recommendations for improvement include formalizing standard operating procedures (SOPs), conducting regular worker training, and adopting modern equipment to ensure more uniform production conditions. The findings of this study provide practical insights for SMEs in the food processing industry to improve product quality and operational efficiency, while also contributing to the development of quality management systems in the local food production industry.

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1. INTRODUCTION

According to the Central Statistics Agency (BPS), the food and beverage business made for 38.05% of the GDP of the non-oil and gas processing industry in 2023, which is 6.61% of the national GDP[2]. Micro, small, and medium enterprises (MSMEs) play a significant role in the processed food industry, especially in processing traditional Indonesian products such as rendang. Rendang is no longer just a favorite dish in Indonesia. For the Minangkabau ethnic group, rendang is a sign of cultural identity and one of Indonesia's most recognizable traditional foods. Additionally, it has been extensively promoted abroad through expatriate communities and other culinary diplomacy initiatives [10].

However, food processing MSMEs face major problems in terms of product quality control. Research conducted by [4] shows that many culinary small and medium enterprises (MSMEs) have implemented integrated quality management principles, but they still do not understand the basic concepts of product and service quality, which impacts business sustainability. In the case of processed meat products, this issue is increasingly complicated and it is important to consider the food safety aspect. There is evidence that food MSMEs that implement a quality management system can improve product quality and operational efficiency. Studies conducted by [5] show that the use of SPC can help monitor and control the production process in real-time, prevent breakdowns, and ensure that products meet desired quality standards.

Quality control can be divided into two categories, namely tools that use numerical or quantitative data, and tools that use verbal or qualitative data. For numerical data processing, there are several tools such as check sheets, Pareto Charts, Histograms, scatter charts, Control Charts, and run charts. These align with the classifications emphasized in a systematic review of both the conventional Seven Basic Quality Tools and the New Seven Tools framework in Indonesia [7].

PT XYZ, an MSME, is engaged in rendang production with innovations to increase product durability. They face the challenge of maintaining quality consistency while extending the shelf life of products. Flavor variations, inconsistent textures, and possible microbiological contamination that can harm food are common problems. To ensure that the product is not only safe for consumption but also of consistent quality, this condition requires systematic quality control [9].

Based on this background, the purpose of this research is to analyze and design a quality control management system for the production of processed beef (rendang) at PT XYZ. To achieve this goal, this study will use an approach that uses fishbone diagrams and p control maps. It is hoped that this research will provide practical assistance for similar MSMEs in improving product quality and provide academic references for the development of quality management systems in the processed food MSME industry.

2. METHOD

This study uses quantitative and descriptive approaches. The goal is to provide an overview of how quality control is used in the production process of processed beef. The main focus of this study is to assess the effectiveness of product quality control and trace the factors causing damage to products made by PT XYZ. The research location was purposively chosen at PT XYZ's production site in Sukabumi City, West Java. The determination of this location is based on the fact that PT XYZ is a local product development company that is building a production quality system. Therefore, it is important to conduct research on the quality control system used. The object of this research is the quality control process in the production of processed beef at PT XYZ. The research population includes all of PT XYZ's production until February 2025. Data collection was carried out by means of direct observation, interviews with the owner of PT XYZ, and documentation of production and quality data.

In this study, statistical quality control—also known as statistical process control—was used. The goal is to evaluate the quality of processed beef products produced by PT XYZ and find the components responsible for product damage or non-conformity. The p-control chart and the fishbone diagram are the three main approaches used to support this analysis.

The P control map is used to monitor the proportion of defective products in the production process. The steps in making a p control map are.

Calculates the damage percentage (P). Damage is calculated with equation 1.

$$p = \frac{np}{n}$$

Determining the Central Line (CL) The center line describes the average of the damage percentage of the entire subgroup. The calculation uses the formula[3].

$$\bar{C} = \frac{\sum c}{g}$$

Calculating the Upper Control Limit (UCL) UCL is calculated to determine the upper limit of the variation that is still acceptable [3].

$$UCL = \bar{C} + 3\sqrt{\bar{C}}$$

Calculating the LCL Lower Control Limit (LCL) shows the lower limit of the variation that is still reasonable [3].

$$LCL = \bar{C} + 3\sqrt{\bar{C}}$$

2. 1 Fishbone Diagram/Ishikawa

Causation diagrams are used as a tool to identify and describe the relationship between causes and defects in processed beef products. Through a visual approach in the form of fish bones, companies can map the factors that affect product quality in more detail and systematically. Each branch on the diagram presents a category of major causes such as human, machine methods, materials, environment, and management. Once the dominant problem is identified, the next step is to trace the root cause of the product defect through the branches available on the diagram. Thus, PT XYZ MSMEs can develop appropriate improvement steps to improve the quality and consistency of the products produced.

3. RESULTS AND DISCUSSION

3.1. Input Analysis

Input is an important factor that determines the final quality of processed beef products at MSME PT XYZ. Based on the results of observations and interviews, it is known that the main raw material used is fresh beef obtained from local suppliers in the nearest market area in Sukabumi City. The meat chosen must meet quality criteria such as bright red, chewy texture, and free of excess fat. In addition to beef, other supporting raw materials are spices such as chili, lemongrass, galangal, onion, and garlic, most of which are also sourced from local farmers.

The human resources involved in the production process consist of business owners who also act as quality supervisors, as well as 5 daily workers. Most of the workers are experienced in traditional food processing, but do not fully understand the principles of quality control formally. Regular training and briefings on hygiene standards, material measurements, and packaging techniques have been carried out periodically, although they have not been supported by a fully written SOP document.

The production facilities include a semi-modern production kitchen with basic equipment such as industrial stoves, rendang stirring machines, and autoclaves for sterilization. However, the capacity of the tool is still limited so that at a time when production volumes are high, the risk of production delays and potential quality errors tends to increase. The sanitation of the production room is quite good with a daily cleaning schedule, but from the observation results there are several areas that need improvement, especially in the sewer and raw material storage space that are still open.

3.2 Process Analysis

In making beef rendang at MSME PT XYZ, the process is a crucial stage, in which there are production activities that are divided into four main stages, namely cutting, processing, sterilization and packaging. Each of these stages is carried out with strict supervision to minimize the risk of contamination and maintain the final quality of rendang products as expected. At the process stage, there is a chart that is depicted as in the diagram below as follows.

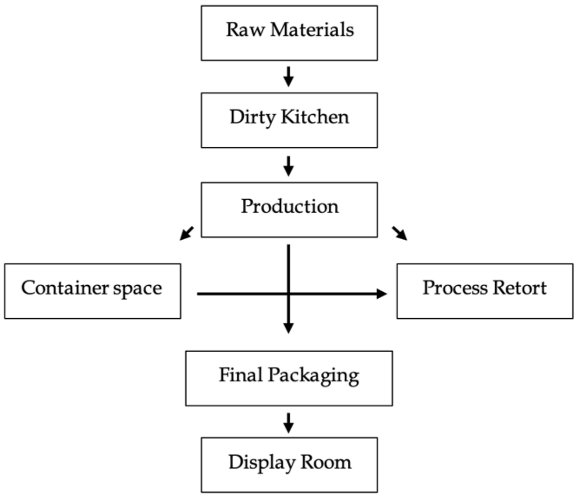

Figure 1. Production Diagram

Source: Data Processing (2025)

1. Raw Materials
   In making beef rendang at MSME PT XYZ, the procurement of raw materials is the first stage and is the stage that most determines the final result. The raw materials used are ingredients that are still very fresh. The available raw materials will be re-selected before then entering the dirty kitchen for further handling.
2. Dirty Kitchen
   At this stage, the raw materials will go through an initial washing process to remove coarse impurities. In addition to the washing process, other processes are also carried out such as cutting, grinding, seasoning and other processes. Each stage is carried out by a workforce that is equipped with personal protective equipment (PPE) such as gloves and masks, as well as hygienic equipment.
3. Production Room
   After going through processing in the dirty kitchen, it then enters the production room to carry out the processing process. This processing is the core process of making rendang.
4. Sterilization
   Sterilization is a key stage in ensuring that products are free from pathogenic microorganisms. The methods used include heat sterilization (thermal processing) using a retort machine with a predetermined temperature and time. This process is monitored manually and in real-time using temperature monitoring tools to guarantee each batch of products reaches safe sterilization parameters.

5. Packaging
   Sterilized products are cooled first before entering the packaging area. Packaging is carried out in a clean room to prevent re-contamination. The packaging used is tailored to the type of product and considers the durability of the product during distribution. Each product is labeled with production information, expiration dates, and production codes for easy tracking in case of problems in the future.

3.3 Output Anaylsis

The output produced from the above process is beef rendang products in ready-to-eat packaging. This beef rendang product is packaged in several special plastic packaging laminated with aluminum foil to add product protection. The product is packaged in attractive and practical packaging. With good processing and packaging, PT XYZ beef rendang can last up to two years. Even so, the taste and physical shape of this packaged rendang product still feels good and the quality is guaranteed.

3.4 Production and Percentage of Damage to MSME Products of PT XYZ

Processed beef into rendang in ready-to-eat packaging is a product produced by PT XYZ. However, out of those production volumes, some products are not worth selling due to their poor quality, which can disappoint customers, as the products have to be sorted before being marketed.

The quality control system aims to improve the household products produced by improving the knowledge and skills of PT XYZ's product processors, reducing errors during production, and improving storage resistance. If there are defects in the product during the production process, funds will be wasted and the company will become less productive and efficient.

Product performance is one of the indicators that can be used to determine product quality, such as unchanging taste and good and attractive packaging. Table 1 shows the percentage of damage based on the results of research and observations of production at PT XYZ.

Tabel 1. Performa Variabel

Day	Production Quantity (pcs)	Type of Damage (Pcs)			Total Damage	Proportion of Damage
		Burnt	Damaged Packaging	Taste and Aroma	for example	p
1	25	1	1	1	3	0,12
2	30	1	1	2	4	0,13333
3	28	0	0	2	2	0,07142
4	22	0	0	1	1	0,04545
5	35	2	2	2	6	0,17142
6	30	0	1	2	3	0,1
7	25	2	1	2	5	0,1
8	28	0	0	0	0	0
9	32	1	1	1	3	0,09375
10	26	1	0	1	2	0,07692
11	22	1	0	1	2	0,09090
12	30	1	1	1	3	0,1
13	28	0	0	1	1	0,03571
14	25	0	0	0	0	0
15	32	1	1	2	4	0,125
16	27	1	1	1	3	0,11111
17	30	1	0	1	2	0,66667
18	25	0	0	1	1	0,04
19	28	2	2	1	5	0,17857

Day	Production Quantity (pcs)	Type of Damage (Pcs)			Total Damage	Proportion of Damage
		Burnt	Damaged Packaging	Taste and Aroma	for example	p
20	32	1	1	1	3	0,09375
21	30	0	0	0	0	0
22	26	0	1	1	2	0,07692
23	28	0	0	1	1	0,03571
24	32	0	0	0	0	0
25	30	1	1	1	4	0,13333
26	22	0	0	1	1	0,04545
27	25	0	0	1	2	0,08
28	30	0	0	0	0	0
SUM	**783**	**19**	**15**	**29**	**63**	

Sourced: Processed Data (2025)

On average, around 28 pcs of PT XYZ rendang are made every day. This low production volume is due to limited capital, a partially manual production process by hand, and less effective marketing. During the production process, various factors can cause damage, such as dirt, damaged packaging, and changes in taste and aroma.

3.5 Frequency of Production Failures

During the production process, rendang products often suffer damage. Of the 783 items produced in February 2025, 29 items have undergone changes in taste and aroma. Burns and damaged packaging are other damages that often occur. Rendang often fails to be made due to negligence or heat irregularities. Often, processors lose focus because they are working on something else. Table 2 shows the amount of product damage.

Tabel 2. Frequency of Breakdowns and Production Failure Percentages at PT XYZ

No	Category Reject	Number of Rejections	Percent Reject (%)	Cumulative Percent (%)
1	Taste and Aroma	29	46.03174603174603	46.03174603174603
2	Burnt	19	30,158730158730158	76.19047619047619
3	Damaged Packaging	15	23,809523809523807	100.0
Sum		63	100,0	

Sourced: Processed Data (2025)

The results of the failure control map analysis showed that the change in taste and aroma of 29 items out of 783 items produced in February 2025 led to the type of product damage that is likely to occur, as shown in the pareto chart in Figure 2.

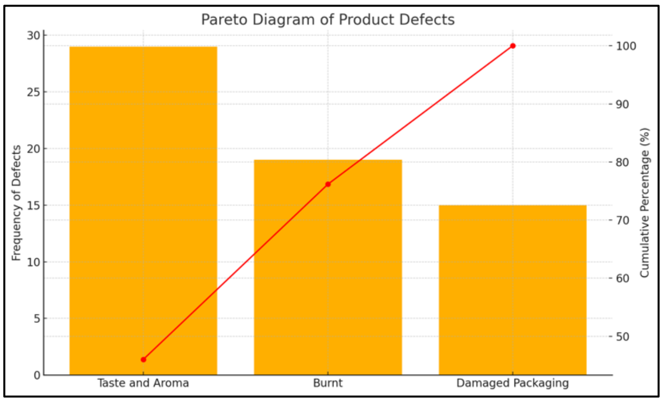

Figure 2. Pareto Chart of Production Failure at PT XYZ

Source: Data Processing (2025)

3.6 P-control chart Analysis Calculates Damage Percentage

Important factors in quality control carried out in PT XYZ's rendang production are efforts to reduce the number of errors and product damage, maintain quality in accordance with standards, and reduce consumer complaints. Continuous supervision is required at every stage of the production process, from raw materials to final products, to ensure that the quality of the resulting products has been in accordance with the plan. One of the Statistical Quality Control (SQC) methods, the p-control chart method, can be used to evaluate the process. This ensures that management decisions are made based on data and are unbiased. During the production process, the quality standards that have been set must be kept in mind as part of PT XYZ's quality control. Quality control aims to ensure that goods or services are produced in accordance with pre-defined standards, as in the food industry with HACCP systems to maintain consistent, safe output [1].

Tabel 3. Production Quantity, Damage Per Unit, CL, ULC, LCL at PT XYZ

Day	Production Quantity	Number of Defects	Proposing Non-Conforming (p/CL)	Persen Non Conforming	LCL	UCL
1	25	3	1,491428571	12	0	0,243662
2	30	4	1,657142857	13,33333333	0	0,229442
3	28	2	0,887755102	7,142857143	0	0,234671
4	22	1	0,564935065	4,545454545	0	0,254434
5	35	6	2,130612245	17,14285714	0	0,218391
6	30	3	1,242857143	10	0	0,229442
7	25	5	2,485714286	20	0	0,243662
8	28	0	0	0	0	0,234671
9	32	3	1,165178571	9,375	0	0,224711
10	26	2	0,956043956	7,692307692	0	0,240493
11	22	2	1,12987013	9,090909091	0	0,254434
12	30	3	1,242857143	10	0	0,229442

Day	Production Quantity	Number of Defects	Proposing Non-Conforming (p/CL)	Persen Non Conforming	LCL	UCL
13	28	1	0,443877551	3,571428571	0	0,234671
14	25	0	0	0	0	0,243662
15	32	4	1,553571429	12,5	0	0,224711
16	27	3	1,380952381	11,11111111	0	0,237501
17	30	2	0,828571429	6,666666667	0	0,229442
18	25	1	0,497142857	4	0	0,243662
19	28	5	2,219387755	17,85714286	0	0,234671
20	32	3	1,165178571	9,375	0	0,224711
21	30	0	0	0	0	0,229442
22	26	2	0,956043956	7,692307692	0	0,240493
23	28	1	0,443877551	3,571428571	0	0,234671
24	32	0	0	0	0	0,224711
25	30	4	1,657142857	13,33333333	0	0,229442
26	22	1	0,564935065	4,545454545	0	0,254434
27	25	2	0,994285714	8	0	0,243662
28	30	0	0	0	0	0,229442
	783	**63**	**27,65936219**	**222,5465923**	**0**	**6,596788**

Sourced: Processed Data (2025)

During the February 2025 production period, PT XYZ experienced 63 units of total damage out of 783 product units, with a damage rate of 8.05%. Although this level of damage does not indicate a significant level of damage, the still limited scale of production leads to a decrease in average daily output. The upper and lower control limits during one month of observation can be calculated using the p-control map. The results of the analysis showed that the average proportion of damage (CL) was 0.0805, with the highest upper control limit (UCL) of 0.254 and the smallest lower control limit (LCL) of 0. Since the entire value of the daily proportion of damage was between the UCL and LCL limits during this period, the products produced by PT XYZ were still within the control limits statistically, indicating that the production process did not change due to certain factors. The results of [13] research on eggroll snack production show that using a p control map can help MSME management make daily decisions with data and control the proportion of defective products below the specified UCL. The p control map also shows whether the condition of the production process is stable or requires immediate improvement. According to research conducted by [15] on the tofu production process in Central Java MSMEs, p-control maps can find product faults caused by temperature differences and non-uniform manual work standards. As a result, the product defect rate dropped by 23% after 30 days of control map-based evaluation, indicating that this technique is effective for small businesses.

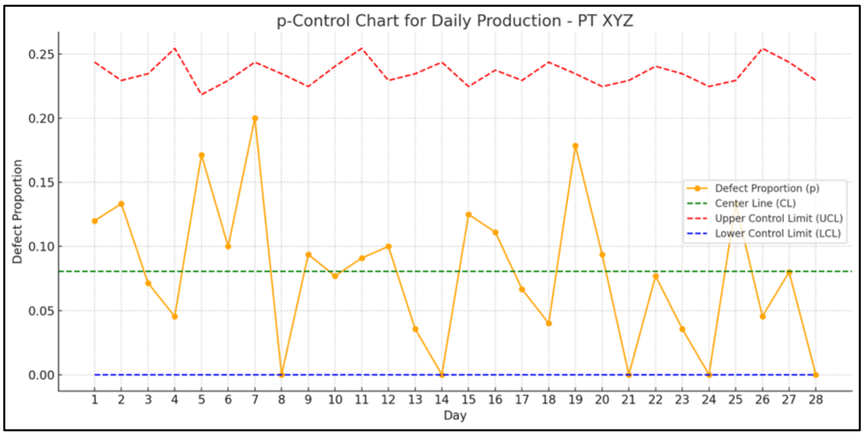

Figure 3. P-control chart of product damage at PT XYZ

Source: Data Processing (2025)

Figure 3 shows that 28 points are out of control. This condition shows that PT XYZ's rendang production quality control is still under control during February 2025. Each daily observation point is between the lower control limit (LCL) and the upper control limit (UCL). In it there are six points where no damage occurs at all during the production process: the 8th, 14th, 21st, 24th, and 28th days. These points are at the base of the control graph, parallel to the lower limit of the control (LCL = 0), which indicates that on those days no defective products were found.

The production process has not been fully completed even though the quality of PT XYZ's products is within statistical control limits. This is indicated by the distribution of the daily damage proportion points that are not completely aligned with the centerline (CL = 0.0805). Several points are close to the upper limit of control (UCL), one of which is on the fifth and 19th days. The value of the proportion of damage is also more than double the average value. This is due to a larger number of defective products compared to the production volume on that day.

This condition indicates that even though the process as a whole is under control, there is still a possibility of errors in quality control. Therefore, in order to improve the production process sustainably, advanced analysis needs to be carried out. This analysis should be done using tools such as a cause-effect diagram, also known as a fishbone diagram.

3.7 The Most Dominant Causal Factors Using a Causal Diagram

In small-scale MSMEs, the fishbone diagram method has proven effective for finding the causes of product defects. In their research on Tansa Tofu MSMEs, [11] showed that the fishbone diagram can systematically categorize root causes into the categories of people, machines, methods, materials, and environment. The results of their analysis succeeded in reducing the product defect rate by 21% after making adjustments based on the results of the diagram. This shows that using fishbone diagrams is not only beneficial on a large industrial scale, but also relevant for food processing MSMEs such as PT XYZ's rendang. Each group can contribute to one impact or problem that occurs. Brainstorming sessions are used to conduct problem analysis; It divides the problem into a number of causal categories that should be studied further. This diagram is designed to help break down complex problems into small pieces, so that the root cause of the problem can be found more easily Figure 4 shows the fishbone diagram used in this study. [12] found that using a combination of p control maps and fishbone diagrams at Arummanis MSMEs can reduce the percentage of product damage from 11.9% to 6.4% during one month of production. In addition, research conducted by [14] on Prapto Tofu MSMEs showed that using fishbone diagrams along with brainstorming between employees on a regular basis can reduce the product defect rate by 19 percent. This method is an excellent tool for continuous improvement processes in traditional food-based MSMEs. This combination of methods is effective in controlling the quality of meat-based products or traditional food preparations at the MSME scale because it is able to find dominant causes quantitatively and qualitatively.

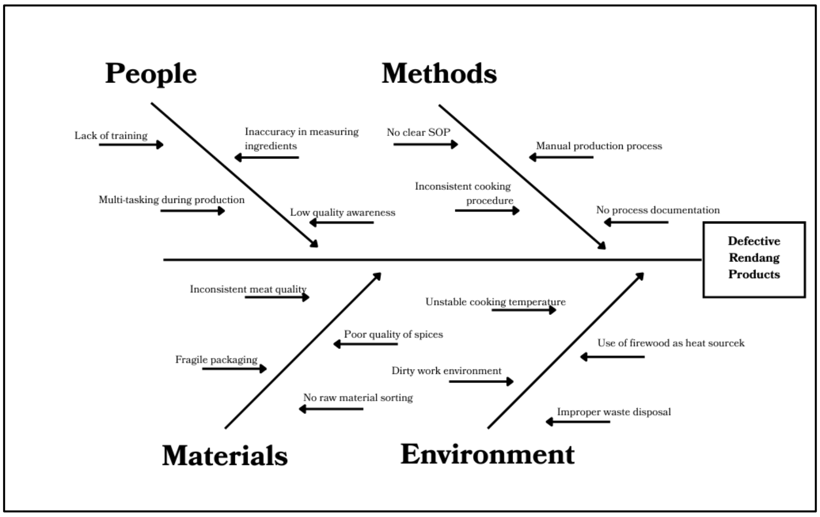

Figure 3. P-control chart of product damage at PT XYZ

Source: Data Processing (2025)

Based on the resuts of the analysis using the Fishbone Diagram, the quality control of rendang production at PT XYZ during February 2025 is still within the control limit, but several causes of product damage have been identified. The four main causes of damage are people, methods, materials, and the environment. One of the main causes is the human factor, as the amount of ingredients is not measured precisely and only relies on the estimates of rendang makers. This results in different products. To address this, work instructions should be discussed regularly before starting production, and clear standard operating procedures (SOPs) should be created and implemented in the production area. This will allow each worker to follow established procedures and keep the quality of the product consistent.

In terms of methods, the difference in product size is caused by the production process that is still carried out manually without using a machine. Therefore, to ensure consistent product quality, the production process must be standardized with clear SOPs for each stage. In addition, in the ingredient category, the selection of meat and spice raw materials that are not always uniform in quality affects the final result of rendang products. Therefore, stricter supervision needs to be carried out on raw materials, by choosing suppliers who can always provide high-quality raw materials.

It is recommended to replace the heating source with more advanced equipment that can control the temperature more consistently as environmental factors are also important. This is because the use of firewood during the cooking process causes unstable temperatures, which causes the product to burn and break frequently. PT XYZ has the ability to improve product quality, reduce the rate of damage, and optimize the production process and efficiency by making improvements in each of these categories. To ensure that the rendang products produced are of the same quality, it is necessary to implement SOPs starting with the identification of business processes that require SOPs, the development of clear SOPs, employee training, and continuous monitoring and evaluation of SOP compliance and effectiveness [6].

4. CONCLUSION

Based on the results of the quality control analysis carried out on the rendang production process at MSKM PT XYZ during February 2025, it can be concluded that the overall production process is still within the range of statistical control, as shown on the p-control map. It was noted that the product damage rate of 8.05% was still below the acceptable tolerance limit. However, some observation points suggest that the level of damage is close to the Upper Control Limit (UCL). Human error, manual production methods that have not been documented by standards, variations in the quality of raw materials, and production environmental conditions that are not yet fully stable are some of the main causes of product damage. The results of the analysis using a fishbone diagram show the main factors that cause product damage. These include improper mixing of ingredients, temperature inconsistencies during the cooking process, and lack of labor instructions. These factors can cause defects such as taste changes, burns, and damage to the product packaging.

Referring to the findings, a number of strategic policies are recommended to improve quality. First, it is important for MSMEs to design and implement standard operating procedures (SOPs) in writing at each stage of the production process to ensure consistency and repeatability of the process. Second, it is necessary to improve structured and sustainable training programs for the workforce, especially related to aspects of sanitation, raw material measurement, and cooking techniques, as an effort to reduce the potential for human error. Third, the procurement and utilization of modern production equipment, such as automatic heaters and special rendang stirring equipment, can support temperature stability and

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