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MZ BAKERY BREAD PRODUCTION QUALITY CONTROL USING SATISTICAL QUALITY CONTROL

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Abstract

This research aims to determine the factors that cause damage to bread production at MZ bakery and to find out whether the bread products produced are under control. The results of this research show that the types of damage that occur in bread production are charred, the filling comes out, and the size of the bread is not appropriate. Judging from the Pareto diagram, the most dominant type of defect is that the bread filling comes out in the chocolate banana bread, while the chocolate flavored bread is dominated by burnt bread. From the fishbone chart, it can be seen the factors that cause defects in bread, namely human factors, machines or equipment, methods, raw materials and the environment. The error proportion control chart (P-chart) shows that statistical quality control in bread production at MZ Company is within statistical control limits.a.

Keywords: Control Chart, Statistical Quality Control, Types of Defects, p-chart

Introduction

Everyone must be familiar with bread, a food made from a mixture of wheat flour, sugar, eggs and water. Making bread using yeast then after complete fermentation the bread dough is baked in the oven until cooked. Over time, bread is made by adding other ingredients such as cheese, butter, milk, chocolate or other ingredients that can add to the taste of the bread. Apart from that, various forms of bread are made to attract consumer interest. Even though bread is not a staple food in

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Indonesia, some Indonesians like bread either as a substitute for rice, as a snack or as a snack to accompany tea or coffee. With more and more people consuming bread, many bread factories are now popping up, both producing bread in large quantities and as home industries. One of the home industries that produces bread in the city of Denpasar is MZ bakery. MZ bakery has been producing bread with various flavors for 23 years. Based on an interview with the bakery owner, the bakery produces approximately 1000 pieces of bread per day, but sometimes it is found that some products are defective so they are not suitable for sale. In order for a company to be able to increase customers, at least retain loyal customers, the quality of the products produced must be maintained. Quality is a very important dimension in the production and production process, good quality can show the superiority of a company or organization compared to its competitors.(Zonnenshain, A., & Kenett, R.S., 2020), while according to(Montgomery D., 2012)Quality is the most important consumer decision factor in choosing between competing products and services. The definition of quality has evolved over time and the development of technology. Currently the quality concept focuses on customer-centricity. The quality perspective is no longer just about meeting customer expectations. The four main perspectives of quality according to(Martin, J. , Elga. M. and Gremyr, I, 2020)are: quality as customer value, quality as ecosystem-integration, quality as agreement-delivery conformity, quality as value in society.

One method that can be used to control the quality of the products produced is statistical quality control, which is often abbreviated as SQC. SQC is a system developed to maintain uniform standards of production quality at minimum costs and is able to help implement an efficient production system. SQC aims to minimize variability in the quality characteristics of products and services(Assuari, 2008). In the SQC method there are 2 ways of quality control, namely by using a control chart and a cause and effect/fishbone diagram. Cause and effect diagrams are useful for showing the main factors that influence the quality of a product or service. Apart from that, you can see more detailed factors that influence and have consequences on the main factors which can be seen in the fishbone-shaped arrows in the cause and effect diagram.(Sakdiyah, SH, Eltivia, N. & Afandi, A, 2022). According to(Russell, RS & Taylor, BW, 2011) "chart is a graph that establishes the control limits of a process" which means a control chart is a graph that reflects the control limits of a process. The control chart that is often used is the error proportion control chart (P-chart). The p control chart is useful in helping supervision or control of the production process, so that it can provide information regarding when and where is the right time to make improvements to quality. Quality control aims to ensure that the quality produced in the form of products and services meets predetermined quality standards at a very economical cost(Chaeriah, 2016).

The use of the SQC method in controlling the quality of bread products has previously been carried out, among others(Hairiyah, N., Amalia, RR, & Luliyanti, E, 2019)used the SQC method to research bread production at the Aremania Bakery company. The results of the research show that there are four types of damage to bread, namely burnt defects, size defects, filling out defects, and peeling skin defects, with the causes of poor bread quality being labor, method and machine factors.

This research applies statistical quality control of attribute data to the MZ company. The aspect chosen to be observed was the quality of chocolate and banana chocolate bread products, because these two types of bread are the best sellers on the market, by calculating defective products based on the size, filling and level of maturity of the bread. MZ Bakery has never carried out quality control on the bread products it produces, so in this research it is hoped that it will be possible to find out whether the bread products produced by MZ Bakery are within quality control limits or not.

Research methods

The research was conducted at MZ Bakery which is located in North Denpasar District. This research will take approximately one month, namely November 2023.

Research Population and Sample

The population in this study is bread produced by MZ Bakery during November 2023 with 25 observations. The samples used consisted of small packaged bread with two types of flavors, namely chocolate flavored bread and chocolate banana flavored bread.Each observation, the number of bread observed was 200 pieces each.

Data analysis method

In this research, the data was analyzed statistically using quality control tools for attribute data, including using Pareto diagrams, cause and effect diagrams, and error proportion control charts (P-charts).

The analysis stages carried out in this research are as follows.

a) Record the number of defective products according to what is found during observations
b) Classifying problems into elements, tabulating data using Pareto diagrams, followed by mapping the root of the problem using cause and effect diagrams.
c) Identify each conditionuncontrolled by using an error proportion control chart (p-chart). The formula used to measure the proportion of errors or defects in a sample or subgroup if the number of samples used is constant each time an observation is made is as follows:

$$p = \frac{x}{n}. \qquad (1)$$

Information :

p =proportion of errors in each sample

x =the number of faulty products in each sample

n =the number of samples taken during the inspection,

With the center line of the error proportion control map

$$CL\ p = \bar{p} = \frac{\sum_{i=1}^{g} pi}{g} = \frac{\sum_{i=1}^{g} xi}{n.g}, \text{ i=1, 2, 3,…, g (2)}$$

Information :

$\bar{p}$ =center line of error proportion control map

pi =the error proportion of each sample or subgroup in each inspection

n =the number of samples taken during each inspection

g =the number of inspections carried out

The upper control limit (BKA) and lower control limit (BKB) for the error proportion control map are:

$$UCL\ p = \bar{p} + 3\sqrt{\frac{\bar{p}(1-\bar{p})}{n}} \qquad (3)$$

$$LCL\ p = \bar{p} - 3\sqrt{\frac{\bar{p}(1-\bar{p})}{n}} \qquad (4)$$

If you see a point that is outside the BKA or BKB line, this shows that there are still variations in production, so quality control still needs to be improved

d) Make recommendations for quality improvement proposals for bakery products.

Research Results and Discussion

The research was conducted at MZ bakery during November 2023 with 25 observations. There were 400 pieces of bread taken as samples during each observation, with details of 200 pieces of chocolate and chocolate banana bread each, so that the total number of breads observed for 25 days was 5000 pieces of chocolate bread and 5000 pieces of chocolate banana bread. Bread defects during the production process are observed and recorded. The types of defects in bread products during the research are presented in table 1

Table 1: Types and Number of Bread Defects

Type of Defect	Number of Defects	
	Chocolate bread	Chocolate Banana Bread
stuffing comes	110	122

out		
size does not match	89	92
scorched	111	111
Total Disability	310	325

Source: data processed in 2023

3.1 Pareto Diagram and Cause and Effect Diagram

To identify parts that require special attention, a Pareto diagram is used. The Pareto diagram is created by sorting from the largest to the smallest frequency and calculating the cumulative (Evans, & Lindsay, 2007).The Pareto diagram for the two types of bread observed is presented in Figure 1

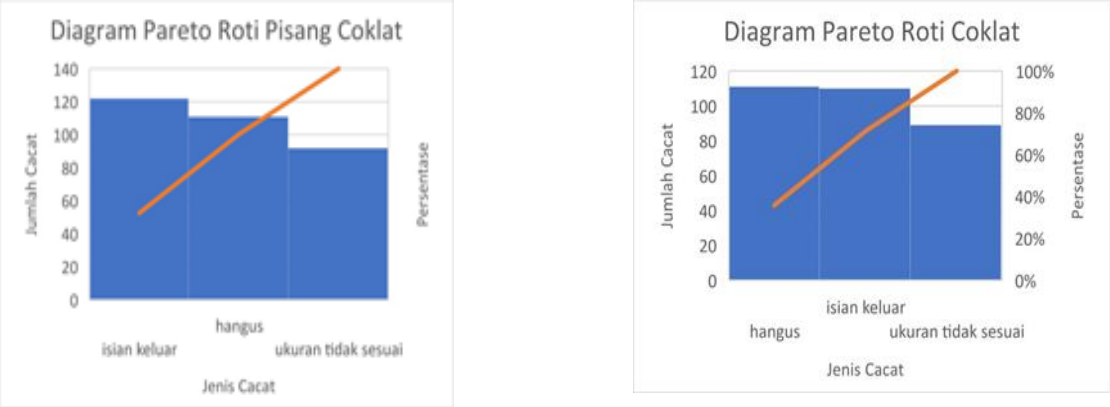

Figure 1: Pareto Diagram of Damage to Bread

From Figure 1, it can be seen that the most failures for chocolate flavored bread occurred when the bread was burnt, the bread filling came out, while the number of breads that were not the right size was the least. Banana chocolate flavored bread with bread filling that comes out is the type of failure that occurs most frequently, followed by burnt bread and the least amount of bread that is not the right size.

Furthermore, based on the Pareto diagram, observations and interviews were carried out with workers at the MZ bakery to find out the causes of defects in the two types of bread. The results of the investigation are expressed in a cause and effect diagram which is often called a fishbone diagram. A cause and effect diagram is a process of identifying the root cause of an undesirable event (e.g. audit failure, defective product, restatement) and preventing the failure from happening again in the future.(Groot, 2021). The cause and effect diagram for each type of bread is shown in Figures 2 and 3, Figures 3 and 4

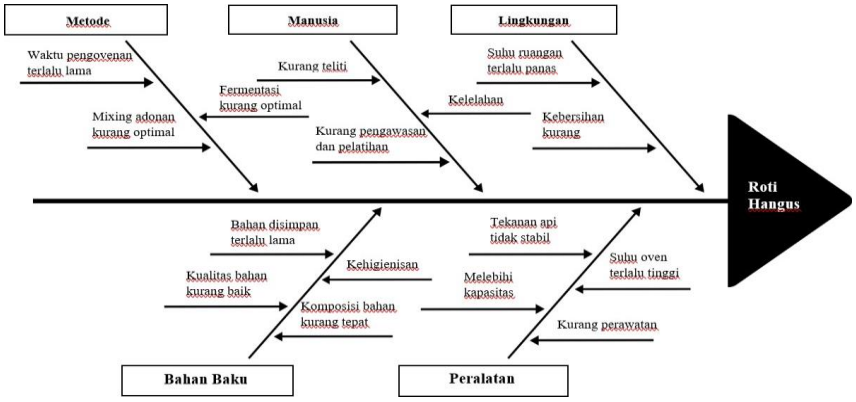

Figure 2. Cause and Effect Diagram of Inappropriate Bread Size

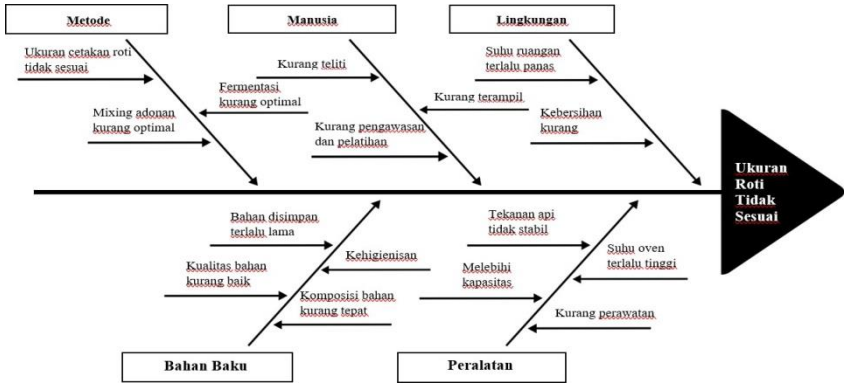

Figure 3 Cause and Effect Diagram of Burnt Bread

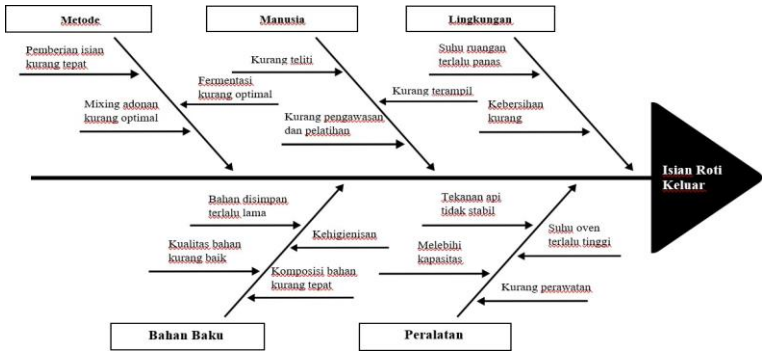

Figure 4. Cause and Effect Diagram of the Bread Filling Coming Out

Observing the cause and effect diagram in Figures 2, 3 and 4, it can be identified that the causes of failure in the two types of bread are:

1) Human factors

Humans, in this case workers, are the biggest factor causing defects in bread. Every new worker in this factory is always equipped with knowledge about materials, processes and how tools work, but there are some workers who don't really understand how to operate the equipment. Workers are also careless and less careful in weighing materials. Apart from that, the fatigue factor also affects the performance of these workers because there are too few workers so there is not enough rest time. The solution that can be given is to regularly provide training to workers and provide rewards to workers who perform well which will create self-awareness and not carry

out activities outside the job description, so as to reduce the number of defective products that occur. The division of work given to workers must also be clear and new workers must be added so that workers don't get tired.

2) Equipment factor

The causes of defective products are machine factors, namely the temperature in the roasting process is too high, the fire pressure is unstable, the machine used in the roasting process is old and there is a lack of maintenance on the machine. The recommended improvement proposal for repairing defective products is to carry out an audit of the production machine and make the necessary improvements related to the machine's function. Companies must carry out routine maintenance by using a maintenance check sheet once a month to avoid causing a decrease in the performance of the machine.

3) Method factors

Baking does not follow standard times, and there are no standard rules for using ovens so the baking process is only based on the workers' work experience. The proposed improvement or solution to repair defective products is to create work instructions regarding oven operating steps and dough mixing techniques so that the time for the mixing and baking processes is in accordance with company standards, thereby avoiding production operators who are too rushed in working. In this way, the product is expected to cook evenly and according to specifications.

4) Raw material factors

This factor focuses on raw materials, namely raw materials that are not suitable for those normally used, or damage to raw materials due to being stored for too long. The solution that can be given is not to store raw materials for too long, especially if they are open, and continue to use raw materials that comply with specifications.

5) Environmental factor

The environment plays an important role in controlling product defects. The process of making this bread uses a high temperature oven, while inadequate ventilation and storage space as well as high room temperatures are the causes of damage. The solution that can be given is adding air conditioning.

3. 2 Error Proportion Control Chart (P-chart)

By using formulas 1), 2), 3) and 4 and the help of MINITAB 17 software, the following results were obtained:

1) Chocolate flavored bread

$$CL\ p = 0.062, ,UCL\ p = 0.113157 LCL\ p = 0.010843$$

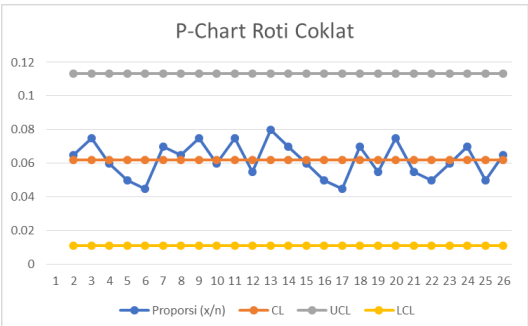

Figure 5. Control Chart p Chocolate bread

2) Chocolate banana bread

$$CL\ p = 0.065, ,UCL\ p = 0.117296 LCL\ p = 0.010843$$

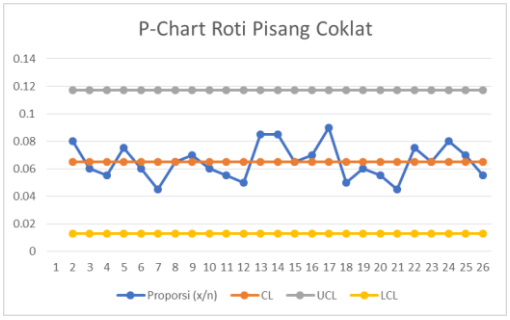

Figure 6 Control Chart p Chocolate banana bread

Figures 5 and 6 show that there is no proportion of defects outside the control limits, either the upper control limits or the lower control limits. It can be said that the production process for these two types of bread is under control.

Conclusion

In general, it can be stated that MZ bakery bread products are within statistical control limits (statistical in control) seen from the error proportion control chart (P-chart). Then, looking at the Pareto diagram, it shows that the most dominant type of defect is that the bread filling comes out in the pineapple and chocolate banana flavored bread, while the chocolate flavored bread is dominated by burnt bread. From the cause and effect diagram or fishbone diagram, it shows that the factors that cause deviations or defects in bread products are human factors, machines or equipment, methods, raw materials and the environment. Quality control for defective bread at MZ bakery can be carried out by controlling the five factors that cause defective products, including by regularly providing training to workers and giving rewards to workers with good performance, carrying out routine maintenance once a month to avoid causing a decrease in the performance of the machine, not storing raw materials for too long, especially when opened, and still using raw materials that comply with specifications.

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