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Analysis of Tempeh Product Quality Control Using the Statistical Quality Control Method

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A B S T R A C T

Product quality is one of the keys to a company's success. Companies that pay little attention to quality will struggle to compete, impacting their future sustainability. This research was conducted at Putra Cendana Tempe Enterprise in Klungkung Regency to determine whether the company's quality control practices are optimal. This study used a quantitative descriptive research method. The data used were production volume, number of defects, and type of product defects for the period July 2025. Data analysis was carried out using the Statistical Quality Control using statistical tools, namely flowchart, check sheet, control chart, and fishbone diagram. The results of data analysis show that there are many points that exceed the upper control limit (UCL) and lower control limit (LCL) which indicates that the company's production process is still out of control. Factors that cause product damage include human factors, methods, materials, and machines/equipment.

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INTRODUCTION

Quality is one of the keys to a company's success. Today's competition in the industrial world is not only about the level of productivity and price of a product or service, but rather the quality of the product or service which includes performance, reliability, features, convenience, convenience, and speed of time in achieving it (Ariani, 2020, p. 3). Quality is a determining factor for consumers in choosing a product or service. The increasing demand for products and services will increase business competition between companies, so companies are always required to increase consumer satisfaction (Ishak et al., 2020). Therefore, companies compete to produce products with the best quality so that companies can win the competition and increase their sales. Companies that do not pay attention to quality will find it difficult to compete and will have an impact on the sustainability of the company in the future (Sahara et al., 2023).

Quality control is an integrated effort by the company to maintain the quality of the products produced (Bakti & Kartika, 2020). Quality control includes a set of managerial activities, ranging from quality planning, organizing, controlling to evaluating quality carried out to maintain product quality. Product quality includes the quality of raw materials and the quality of finished products, while process quality covers all stages in a company's production. Quality control has an important function for companies in maintaining the quality of the products produced by the company. Quality control is carried out by the company to produce products that meet the standards set by the company, as well as to improve the quality of products that do not meet the standards so that they can have adequate quality (Nursyamsi & Momon, 2022).

Quality control aims to provide customer satisfaction and reduce overspending on unnecessary costs (Supardi & Dharmanto, 2020). Lastiawan and Aprilyanti Research (2021) explained that implementing good quality control in the company will have an impact on cost efficiency. Product defects can be suppressed so that there is no waste in carrying out the production process which has an impact on increasing the company's profits. Quality control is also a company's effort to convince consumers that the company can create quality products that reflect quality productivity and performance within the company (Samsinar, 2021).

Statistical Quality Control (SQC) is one of the methods of process quality control using statistical tools to solve problems in the company (Milah & Suseno, 2022). Statistical tools that are often used in the *Statistical Quality Control* that is *Check Sheet* which serves to obtain the disability figure in the form of a form, *Control Chart* used to monitor and evaluate data changes over time, and *Fishbone Diagram* which is useful for further analysis and identification of the various causes of a problem (Putri et al., 2021). This method will ensure that each production process runs optimally, so that the products to be delivered to consumers meet quality standards. SQC works by monitoring the performance of an integrated production process from raw materials to finished products, so that the decisions taken by management are more accurate based on the results of analysis from the data that has been obtained and processed (Wilda et al., 2023).

Quality control using *Statistical Quality Control* has been done by several researchers before. The results of these studies show that quality control with the *Statistical Quality Control* Able to find the root of the quality problems faced by the company and provide recommendations for decisions that can be taken to overcome existing problems. Windayanti & Purnawati Research (2024) stated that the company's quality control is still not good. Judging from the control map p, the level of product defects fluctuates quite a bit until there are several points that are very close to the control limit and one point has passed the upper limit of the control. This indicates that there are still irregularities in the company's production process. The factors that cause product defects are mostly human factors and production methods. Based on the quality cost analysis, the company's quality control is still not optimal because the quality cost incurred for actual damage is greater than the optimal quality cost.

Quality control is closely related to the cost of quality *(Cost of Quality).* Quality cost is an important indicator in assessing a company's quality performance. Quality costs can reflect the extent to which the function of the quality control system has been optimal in maintaining product quality. The lower the quality cost incurred by the company, the more optimal the quality control implemented by the company (Hariono et al., 2021). The quality costs incurred by the company include control costs *(Control Cost)* and failure costs *(Failure Cost).* Control costs are costs related to activities to reduce defects in the production flow, namely prevention costs *(Prevention Cost)* and assessment fees (*Appraisal Cost).* Failure costs are costs incurred in the production process (internal) or after the product is delivered (external), which includes internal failure costs *(Internal Failure Cost)* and external failure costs *(External Failure Cost)* (Heizer et al., 2020, p. 250). Quality cost aims to understand and help minimize costs related to poor quality while maximizing value for customers (Walston et al., 2025).

Tempe Putra Cendana is a tofu and tempeh producer in Klungkung Regency which has been operating since 2018. The company is located at Jl. Sakura 1 No. 5 Kemoning, Semarapura Kelod Village, Klungkung Regency. Based on interviews and direct observations carried out, it was found that there were still product defects in the daily production of the Tempe Putra Cendana company. Defects that occur in tempeh include mushrooms that do not grow evenly or only grow partially, the texture of tempeh is less dense and compact so that when sliced the tempeh is easily destroyed, decay in tempeh so that it causes an unpleasant smell in tempeh or smells of ammonia, and torn tempeh wrapping plastic.

Table 1. Production Report of Tempe Putra Cendana Company in 2024

DEFECTIVE PRODUCT REPORT IN 2024				
No.	Era	Production (pcs)	Damaged (pcs)	Damaged (%)
1	January	27.480	1.367	4,97%
2	February	22.161	1.250	5,64%
3	March	24.939	1.254	5,03%
4	April	26.665	1.285	4,82%

5	May	27.532	1.637	5,95%
6	June	26.709	1.690	6,33%
7	July	27.544	1.775	6,44%
8	August	27.578	1.396	5,06%
9	September	23.156	1.513	6,53%
10	October	24.745	1.578	6,38%
11	November	26.685	1.375	5,15%
12	December	27.513	1.691	6,15%
	Total	**312.707**	**17.811**	**-**

Source: Data Processed, 2025

The table shows the company's total production for one year, which is 312,707 pieces of tempeh with a daily production of around 800 pieces of tempeh. The total number of damaged products was recorded as 17,811 pieces of tempeh with an average daily product damage of more than 50 pieces of tempeh. The rate of product damage fluctuates every month ranging from 4.97% - 6.53% which indicates that the level of product defects in the company's production process is still quite high in accordance with the ISO 2859-1 standard which explains that the level of product defects that are still acceptable for the food industry ranges from 2% - 5% (ISO, 2006). If defective products continue to occur, it will have an impact on the profits obtained by the company. Therefore, quality control is needed to overcome the problem of defects in production.

THEORETICAL REVIEW

Quality

Quality can be defined as the totality of a product's features and characteristics that correspond to its ability to satisfy consumer needs, whether explicitly stated or implied (Heizer et al., 2020, p. 249). Quality is the totality of a product's features and characteristics that are capable of meeting consumer needs, expectations, and hopes, whether explicitly stated or implied, through a combination of design and technical conformance. Quality is a manufacturer's systematic effort to produce products that are valuable and meet consumer expectations.

Quality Control

Quality control is a systematic approach taken by companies to ensure that products and processes meet established standards. Quality control activities involve a set of principles, methodologies, and techniques aimed at achieving and maintaining quality levels (Hasibuan et al., 2023, p. 78). All these activities are aimed at achieving the totality of product and process characteristics to meet consumer needs and expectations. Quality control in companies is typically carried out by the production department.quality control (QC). Departmentquality control plays an important role in controlling and supervising the quality of the products produced so that the percentage of defective products can be reduced and the company's profits can be increased (Arianti et al., 2020).

Quality Control Tools

Quality control has seven basic quality control tools that are widely used by various types of industries which are known as*seven tools.* According to Heizer et al (2017, p. 257) the seven basic quality control tools are explained as follows: (1)*Check sheets*or check sheet is a form designed to record data in such a way that patterns can be easily seen when the data is collected. (2)*Scatter diagrams*or scatter diagrams are used to understand the relationship between two variables. (3)*Cause and Effect Diagrams are used to help identify all possible factors that can cause an effect. (4)Pareto charts are a special type of histogram that includes bar and line graphs, (5) Flowcharts or flow diagrams are tools used to map processes or stages of a process, (6) Histograms show the range of values of a measurement and the frequency of occurrence of each value. (7) Control charts are used to determine whether a process is within the control limits or whether the capabilities of a process are at the expected limits and criteria.*

Quality Cost

Quality costs are costs incurred by a company due to defective products, namely costs incurred to improve product quality or achieve certain standards (Baali et al., 2023, p. 50). Quality costs are divided into two categories: the costs of producing quality products and the costs incurred due to producing defective products.

This research is descriptive with a quantitative approach. This section will explain the research flow for the quality control analysis that will be conducted on Tempe Putra Cendana.

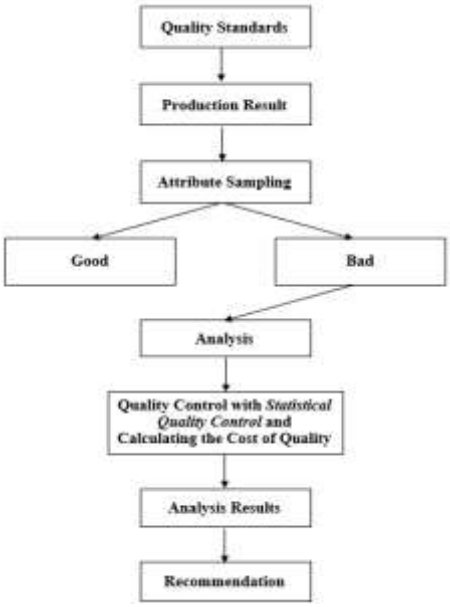


Figure 1. Research Flow of Tempe Product Quality Control Analysis at Tempe Putra Cendana

METHODOLOGY

Based on the problems studied, this research is a descriptive research with a quantitative approach to analyze problems in the company regarding quality control of the production process. This research was conducted in Tempe Putra Cendana which is engaged in the tofu and tempeh industry located on Jl. Sakura Kemoning, Semarapura Kelod Village, Klungkung District, Klungkung Regency, Bali Province, Indonesia. The selection of this research location was due to problems regarding damaged products in the production process of Tempe Putra Cendana. The object of research in this study is the quality control of the production process in Tempe Putra Cendana. The variables identified in this study are product quality standards, the amount of production, the number of products damaged in the production process, and the cost of quality

The population in this study is all tempeh products produced by Tempe Putra Cendana with a production capacity of 800 pieces of tempeh per day, so that the total production in one month is 24,000 pieces of tempeh. The sample withdrawal in this study used a saturated sampling technique by taking all members of the population as a sample, namely as many as 800 pieces of tempeh per day or 26,400 pieces of tempeh in one month.

The data analysis technique is carried out using statistical quality control techniques with the steps as follows: 1) Collecting production data and defective products (check sheet); 2) Making a P-chart Control Map; 3) Quality Cost Analysis; and 4) Making recommendations/proposals for quality improvement. The steps in making a p control map are as follows:

(1) Calculating the proportion of damage

P = ... $\frac{np}{n}$ (1)

Information:
NP: Number of failures in sub groups
n: The number examined in the sub group of the day to – I

(2) Calculating the Center Line (CL)

CL = ... (2) $\frac{\Sigma np}{\Sigma n}$

Information:
ΣNP: Total number of damaged
ΣN: Total quantity inspected

(3) Calculating the Upper Control Limit (UCL)

UCL = P+3..... $\sqrt{\frac{P(1-P)}{n}}$ (3)

Information:
Q: average product non-conformity
n: number of samples examined

(4) Calculating the Lower Control Limit (LCL)

LCL = P-3..... $\sqrt{\frac{P(1-P)}{n}}$ (4)

Information:
Q: average product non-conformity
n: number of samples examined

After analyzing the data on the number of production and the number of damaged products, the next step is to look for the factors that cause product damage with *a fishbone diagram* so that the company can take appropriate actions to reduce the occurrence of product damage in the production process.
The last step is to calculate the cost of quality. The calculation of quality cost consists of quality control fee (QCC), quality assurance fee (QAC), total quality cost (TQC), and minimum cost (q*) with the following formula:
(1) Quality Control Cost
$QCC = \frac{R.o}{q}$..... (5)
Information:
QCC: total cost of quality control
R: the amount of production during the period
o: Testing Fee
Q: The number of products damaged during the period

(2) Quality Assurance Cost
QAC = c.q.....(6)
Information:
QAC: Total Quality Assurance Cost
C: The cost of quality assurance
Q: The number of products damaged during the period

(3) Total Quality Cost
TQC = QCC + QAC.....(7)

RESULTS

Based on the results of data collection through observation at the Tempe Putra Cendana Business, records were obtained in the form of the amount of production and the amount of product damage that occurred during one month as follows:

Table 1. Types and Amounts of Tempeh Damage in July 2025

Produksi Hari Ke-	Sampel	Jenis Kerusakan					Persentase Kerusakan
		Jamur Tidak Merata	Tekstur Kurang Padat	Pembusukan	Kemasan Sobek	Jumlah Kerusakan	
1	861	20	8	5	15	48	5.57%
2	867	19	9	1	5	34	3.92%
3	863	18	7	3	10	38	4.40%
4	861	20	9	3	12	44	5.11%
5	876	17	7	1	9	34	3.88%
6	851	21	9	4	13	47	5.52%
7	869	19	8	2	14	43	4.95%
8	851	22	6	2	14	44	5.17%
9	856	21	7	5	11	44	5.14%
10	869	20	8	5	9	42	4.83%
11	867	18	9	4	8	39	4.50%
12	858	21	8	2	9	40	4.66%
13	873	19	11	3	15	48	5.50%
14	879	20	9	5	10	44	5.01%
15	850	19	6	4	10	39	4.59%
16	870	19	7	2	13	41	4.71%
17	881	18	8	3	8	37	4.20%
18	873	18	7	2	14	41	4.70%
19	859	20	7	2	11	40	4.66%
20	850	23	6	2	9	40	4.71%
21	875	19	7	3	9	38	4.34%
22	860	26	6	3	15	50	5.81%
23	877	18	10	1	14	43	4.90%
24	883	21	8	2	11	42	4.76%
25	857	19	9	3	12	43	5.02%
26	851	20	8	4	11	43	5.05%
27	860	18	7	3	13	41	4.77%
28	876	25	9	4	15	53	6.05%
29	854	24	7	3	12	46	5.39%
30	877	25	8	1	15	49	5.59%
31	873	24	9	2	12	47	5.38%
Total	26.827	631	244	89	358	1.322	4.93%

Source: Appendix 1 (data processed), 2025

Based on the data in table 1, it is known that out of an average of 800 tempeh samples taken per day or as many as 26,827 samples for one month, there are 1,322 pieces of tempeh that have been damaged with an average of 40 pieces of tempeh damaged per day. There are four categories of damage that occurs, namely mold that does not grow evenly, less compact texture, decay that causes an unpleasant smell, and torn tempeh packaging plastic. The highest number of damaged products occurred on the 28th day, which was 53 pieces of tempeh, while the lowest number of products occurred on the 2nd day, which was 34 pieces of tempeh.

The analysis of the quality control of the production process of Tempe Putra Cendana was carried out using the P control map, because the quality standard data of tempeh is attribute data that is measured qualitatively and difficult to express with standard units, products that do not meet the standards that have been set are declared *rejected* and the number of samples used varies.

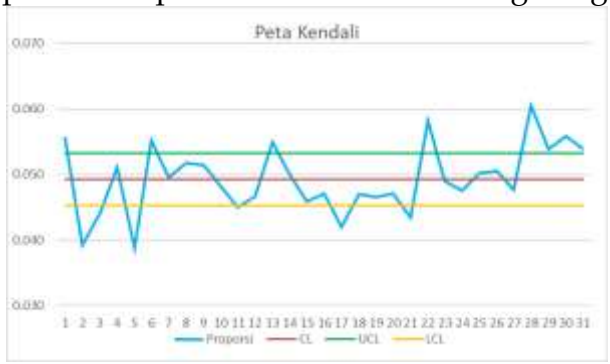
Table 2. Tempeh Damage Control Boundaries in July 2025

Description	**Sum**
Product sample quantity (Cut)	26.827
Amount of Product Damage (cut)	1.322

	CL	0,049
Boundaries of Control	UCL	0,053
	LCL	0,045

Source: Appendix 2 (data processed), 2025

After getting the results of CL, UCL, and LCL, the next step is to make a p-chart control map which is presented in the following image:



Source: Data Processed, 2025

Figure 2. P-Chart of Tempeh Product Damage in July 2025

Based on Figure 2, it can be seen that there is a process that is beyond the control boundary, depicted by a blue line on the graph. On the graph, it can be seen that the dots are very volatile even to the point of crossing the boundaries of upper and lower control. Of the 31 points that exist, there are quite a lot of points that cross the boundaries of control, namely on the 2nd, 5th, 17th, and 21st days that pass the lower control limits and the 1st, 6th, 13th, 22nd, 28th, 29th, 30th, and 31st days that pass the upper control limits. The highest damage rate occurred on the 28th day with a damage proportion of 0.061 or 6.1% of the total daily production and the lowest was on the 5th day with a damage proportion of 0.039 or 3.9% of the total daily production. This fluctuating damage indicates that the company's production process is still not optimal so it is necessary to take action to identify the factors that cause the damage. The first damage identified was that there was no mold growing on tempeh.

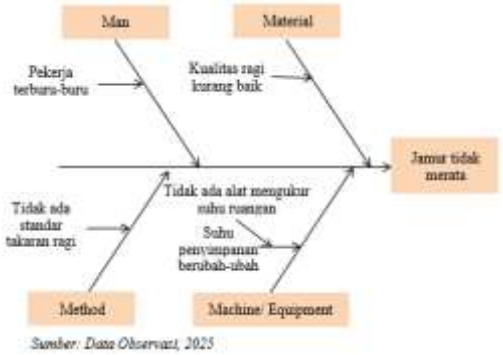
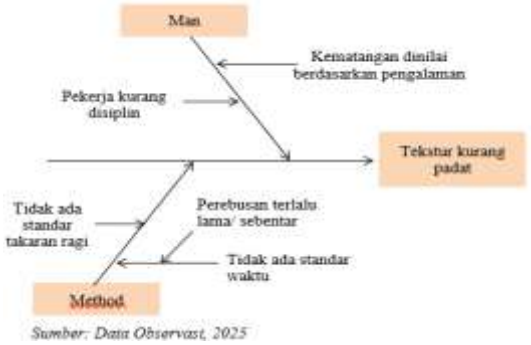


Figure 3. Fishbone Mold Not Growing Products Diagram

It can be seen from figure , tempeh that has been damaged in the form of fungi that do not grow due to several factors including human factors, materials,

methods *and* machines/equipment. The first factor is the human factor, caused by workers who are sometimes in a hurry to do work so that during the fermentation process the results are uneven so that during fermentation the fungus grows unevenly. The second factor is material factors, poor yeast quality can cause mold to have difficulty growing. The third factor is the method, the leavening is done manually and the amount of yeast used varies. The last factor, namely machinery/equipment, weather and variable temperature, greatly affects the growth of mold in tempeh because mold in tempeh is very sensitive to temperature and humidity in the environment, therefore a tool is needed to measure room temperature.

The second damage is that the texture of the tempeh is less dense so that it causes tempeh to crumble easily. This damage is caused by the factors depicted in *the following fishbone diagram* :

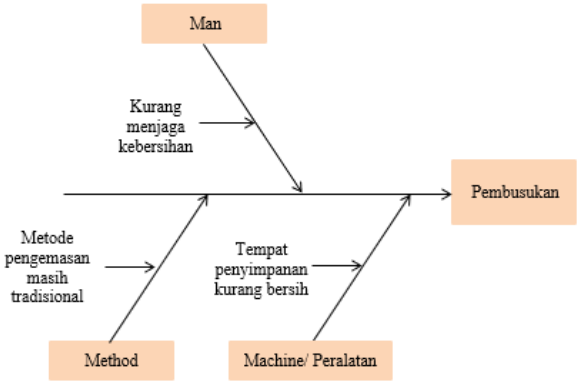


Sumber: Data Observasi, 2025

Figure 4. Fishbone Less Solid Texture Diagram

As can be seen in figure 4, damage to tempeh in the form of a less compact texture is caused by human factors *(man)* and *method (method).* The first factor is humans, the damage is caused by workers who do not measure the boiling time, so the boiling duration is not fixed. In addition, the assessment of soybean maturity during boiling is carried out subjectively based on experience or visual estimation so that it allows for inconsistencies in soybean ripeness. The second factor is the method , the unstable boiling time causes the soybeans to boil for too long or too short. Boiling for too long will make the soybeans soften and the soybeans break so that it is difficult for the fungus to make solid tissues. Meanwhile, boiling that is too short results in undercooked soybeans so that the growth of mushrooms is not optimal. In addition, the amount of yeast also has a great effect on the texture, giving too little or too much yeast causes the texture of tempeh to be less dense and compact.

The third damage is the decay of tempeh. This damage is caused by the factors depicted in *the following fishbone diagram* :

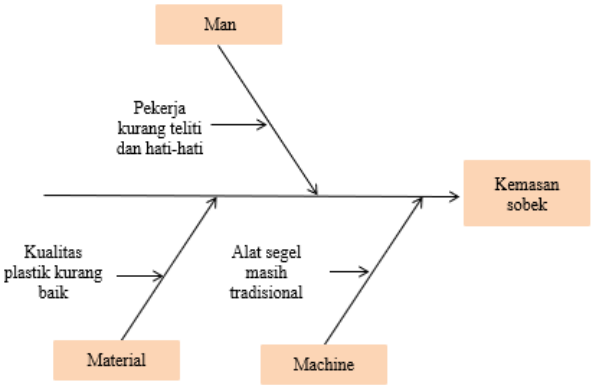


Sumber: Data Observasi, 2025

Figure 5. ***Fishbone Rot Diagram***

As can be seen in figure 5, the damage to tempeh in the form of a less compact texture is caused by human factors, methods, and machines/equipment. The first factor is humans, the decay in tempeh is caused by workers who do not maintain cleanliness during the production process. The second factor is the method, decay in tempeh is caused because the plastic packaging of tempeh is not sealed tightly so that air and microbes can enter. The third factor is machinery/equipment, decay is caused by a poorly clean storage place.

The fourth damage is the wrapper on torn tempeh. This damage is caused by the factors depicted in *the following fishbone diagram* :



Sumber: Data Observasi, 2025

Figure 6. ***Fishbone Rip*** **Packaging Diagram**

As can be seen in the picture above, damage to tempeh in the form of tears is caused by human, material and mechanical factors. The first factor is humans, torn packaging is caused by workers who are not careful when packaging and lack of care when taking tempeh because indeed the plastic wrapping used is very thin. The second factor is the material, the poor quality of plastic so that plastic packaging is easily torn. The third factor is the machine, the sealing of tempeh packaging is done by fire so that it allows the packaging not to be sealed neatly and easily torn.

After creating *P-chart* and analyze the factors with *fishbone diagram*, the next step is to conduct an analysis of the company's quality costs. Based on the P

control map that has been made, it is known that the level of product damage is still fluctuating so quality control is needed. To find out whether the quality control carried out is optimal or not, it is necessary to analyze the cost of quality control.

The Tempe Putra Cendana company uses modern tools such as boilers, stainless drums, and grinding tools. The maintenance fee incurred by the company for simple tools is IDR 100,000.00 per month. The inspection is carried out by a worker in the production section, so that the cost of inspection of the production process incurred by the Tempe Putra Cendana company is in the form of the salary of the production department employees, which is Rp 3,000,000.00 per month. The amount of quality assurance costs borne by the company is equal to the selling price of each damaged tempeh product, which is Rp 4,000.00

(1) Actual cost calculation

a) The amount of production for one year (R) is as follows:

R = 25,500 x 12

= 306,000

b) One-year maintenance cost of the appliance

IDR 100,000,00 x 12 = IDR 1,200,000.00

c) Production inspection costs

3,000,000.00 x 12 = IDR 36,000,000.00

d) Quality control activities are carried out every day. In a period of one year, quality control was carried out 350 times because the holidays of Galungan and Kuningan and Nyepi were cut.

So the test cost is (o) is

$$o = \frac{1.200.000 + 36.000.000}{350}$$

o = Rp 106,285.00/ day

(a) Quality control fee (QCC)

$$QCC = \frac{R.o}{q}$$

$$QCC = \frac{306.000\ x\ 106.285}{15.864}$$

QCC = IDR 2,050,126.00

(b) Quality Assurance Fee (QAC)

$QAC = c.q$

QAC = 4,000 x 15,864

QAC = IDR 63,456,000.00

(c) Total quality cost (TQC)

TQC = QCC + QAC

TQC = 2,050,126.00 + 63,456,000.00

TQC = IDR 65,506,126,00

(2) Calculation of the cost of optimal damage

Based on the calculation of quality control costs, it can be determined that the number of damaged tempeh products that bear the minimum cost (q*) can be determined as follows:

$q^* = \sqrt{\frac{R.o}{c}}$

$q^* = \sqrt{\frac{306.000 \text{ x } 106.285}{4.000}}$

q* = 2,851 temples

a) Quality control fee (QCC)

$QCC = \frac{R.o}{q}$

$QCC = \frac{306.000 \; x \; 106.285}{2.851}$

QCC = IDR 11,407,650.00

b) Quality Assurance Fee (QAC)

QAC = *c.q*

QAC = 4,000 *x* 2,851

QAC = IDR 11,404,000.00

c) Total cost of quality

TQC = QCC + QAC

TQC = 11,407,650.00 + 11,404,000.00

TQC = IDR 22,811,650.00

Based on the calculation of the amount of product damage as well as the actual quality cost and optimal damage cost, then it can be known the comparison of the results of the calculation which will be presented in the table

Table 3. Comparison of Actual Quality Cost and Optimum Damage Cost

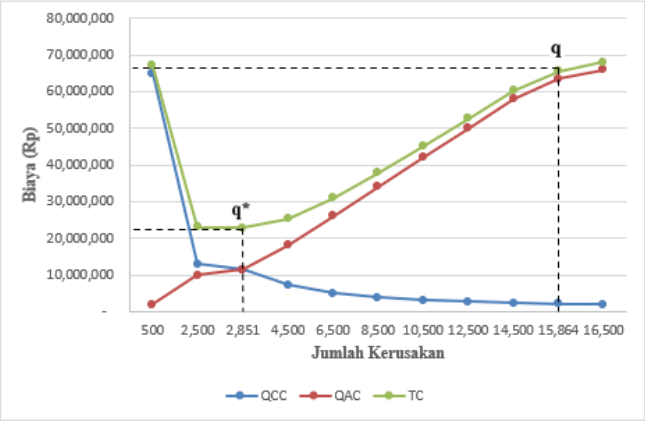
Indicators	Current	Optimum	Difference
Amount of damage	15.864 p.m.	2.851 p.m.	13.013 p.m.
Quality control costs	IDR 2.050.126,00	IDR 11,407,650,00	IDR 9,357,524,00
Quality Assurance Cost	IDR 63,456,000,00	IDR 11,404,000,00	IDR 52.052.000.00
Total cost of quality	IDR 65,506,126,00	IDR 22,811,650,00	IDR 42,683,946,00

Source: Processed Data , 2025

Based on table 3, it can be seen that there is a difference between the amount of damage and the quality costs. The optimal amount of tempeh damage was 2,851 pieces, much smaller than the actual amount of damage of 15,864 pieces of tempeh. The actual quality control cost of IDR 2,050,126.00 is smaller than the optimal quality control cost of IDR 11,407,650.00 with a difference of IDR 9,357,524.00. The company's optimal quality assurance cost is IDR 11,404,000.00, this value is much smaller than the actual quality assurance cost incurred by the company, which is IDR 63,456,000.00 with a difference of IDR 52,052,000.00. The total actual quality cost incurred by the company is IDR 65,506,126.00, greater than the total optimal damage cost of IDR 22,811,650.00 with a considerable difference of IDR 42,683,946.00. This shows that the quality control carried out by

the company is not optimal because the company incurs a greater quality cost of Rp 42,683,946.00. than should be spent so that it will have an impact on the company's profits.

Based on table 3, a graph can be made regarding the total cost of quality and the level of damage to tempeh incurred by the company as follows.



Sumber: Data Diolah, 2025

Gambar 4.8 Grafik Biaya Kualitas Produk Usaha Tempe Putra Cendana

Figure. 7 Tempe Putra Cendana Business Product Quality Cost Graph

After the cause of the damage is known, the next step is to make a general action proposal to suppress product damage. The improvements that can be made by the company to overcome the damage are:

1) The Human Factor
   a) Provide regular briefings to workers on work procedures and instructions before the process begins.
   b) Remind workers to always maintain cleanliness during the production process.
   c) Make rules so that workers are more disciplined in their work.
2) Method factor
   a) Implementing standard production process procedures so that the production process runs more regularly
   b) Setting the daily production amount to make it easier for companies to measure and monitor production quality.
3) Material factors
   a) Conducting research on the quality of yeast and soybean raw materials used.
4) Machine factor
   a) The use of a *sealer* machine can be a consideration to make the seals of tempeh packaging stick stronger.
   b) Perform routine cleaning of the shelves used to store tempeh.
5) Environmental factors
   a) Pay attention to the temperature and humidity of the tempeh storage area so that the growth of mushrooms can be optimal.

DISCUSSION

Analysis of Production Process Quality Control Using Statistical Quality Control

Control charts are used to determine whether a process is stable and under control or not. Based on the analysis results using the P-chart control chart, it shows that the company's production process is still out of control. The blue line on the graph shows the proportion of product defects ranging from 3.92% to 6.05% with an average of 4.93% indicated by the red line (CL). The green line shows the upper control limit (UCL) with a value of 5.3% and the yellow line shows the lower control limit (LCL) with a value of 4.5%. The blue line on the graph appears to fluctuate with several points outside the control limits. This indicates that the company's production activities are out of control.

The results of the analysis using a fishbone diagram show that the causes of product damage are caused by several factors, namely humans.*(man)*, method*(method)*,materials and machines*(machine)* .The first factor is human factors, with workers sometimes being less thorough and careful, and maintaining hygiene during the production process. The second factor is the method, which involves inconsistent processing times and loosely sealing the plastic packaging. The third factor is materials; the quality of the yeast also significantly impacts mold growth in tempeh. The fourth factor is machinery or equipment. Traditional sealing tools can easily tear the packaging, unclean storage areas can lead to spoilage, and fluctuating temperatures in the storage room can lead to suboptimal mold growth.

Quality Cost Analysis

The results of the quality cost analysis show that the actual quality costs incurred by the company are greater than the optimal costs. The total actual quality costs incurred by the company reached Rp 65,506,126.00, there is a difference of Rp 42,683,946.00 from the total optimal damage costs of Rp 22,811,650.00. These expenses should be able to be reduced by increasing the allocation of quality control costs from Rp 2,050,126.00 to Rp 11,407,650.00 so that quality control can be carried out better so that defective products can be reduced. This will also have an impact on the company's quality assurance costs which are reduced because product damage can be reduced.

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the research that has been carried out on Tempe Putra Cendana, it can be concluded that:

1) The tempeh production process carried out is still not optimal with the rate of tempeh damage fluctuating. Based on the analysis using the control map P, it can be seen that the production process is still uncontrollable which is characterized by many points that are still outside the boundaries of control so that it requires corrective action. The highest damage percentage is 6.1% and the lowest is 3.9%. The factors that cause damage are influenced by human factors, methods, materials, and machinery/equipment.

2) The company's quality cost expenditure is also still not optimal. The results of the quality cost analysis show that there is a difference between the amount of damage and the total cost of quality. The actual amount of damage can be reduced from the original 15,864 pieces of tempeh to 2,851 pieces of tempeh if quality control is carried out optimally. The total actual quality cost will also shrink by IDR 42,683,946.00 so that the company's profits increase.

The advice that can be given to the company is that the company needs to pay attention to the factors that cause damage to the product, namely:

1) Companies need to create and implement clear standard operating procedures (SOPs) for each critical stage. Such as the timing of soybean boiling, precise yeast dosage, and correct sealing techniques to minimize potential product damage. The company also needs to improve the cleanliness of the production and storage area periodically and always control the humidity of the fermentation site to make it more stable so that the growth of mushrooms in tempeh is more optimal.
2) Companies should increase quality supervisors so that they are more intensive in order to reduce the number of defective products. The additional cost of quality control is expected to be smaller than the decrease in quality assurance costs.

FURTHER STUDY

Further studies, quality control can be developed with Statistical Quality Control into a module so that it is easy to implement in MSMEs.

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