



## Quality Control of Defective Products of Pucuk Harum Tea 350 ml Using the Seven Tools Method at PT. TFJ Pasuruan

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### ABSTRACT

The advancement of time has shifted consumer perspectives in product selection, where quality now plays a crucial role alongside competitive pricing. Achieving near-zero product defects requires significant investment through comprehensive improvements in both quality and production processes. PT. TFJ, a beverage manufacturing company established in 2012 and located on Jl. Raya Pasuruan-Malang, specializes in producing 350ml Teh Pucuk Harum. The company currently faces product defects such as loose caps, underfilled bottles, and dented bottles. This study applies the Seven Tools method to identify and analyze the root causes of these defects. The analysis reveals that the most dominant defect is the loose cap (66.69%), followed by underfilling (17.87%) and dents (15.43%). Proposed corrective actions include regular inspection and replacement of magnets, providing daily briefings and operator training, and testing new, higher-quality materials. These improvements aim to reduce product defects and enhance overall production quality.

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### 1. Introduction

Technological advancement and globalisation have brought significant changes in the industrial world, especially in terms of product competition. Manufacturing companies are now not only required to produce goods in large quantities, but also to maintain high quality standards. Product quality is one of the main factors that consumers consider in choosing goods, in addition to competitive prices. Therefore, companies need to pay attention to every detail in the production process to ensure the products produced meet consumer expectations. The process of improving product quality does not only focus on the end result, but also on improving the existing process. One way to achieve this is to reduce the product defect rate to near zero, which is often referred to as zero defect. This process requires a lot of money and a systematic approach. (Kotler & Keller, 2016).

PT TFJ is a manufacturing company engaged in the production of tea beverages under the brand name "Teh Pucuk Harum" 350 ml size, which was established in 2012 and located on Jl. Raya Pasuruan-Malang. Teh Pucuk Harum is a selected tea product that is available in tea is packaged in 350 ml PET bottles with caps made of HDPE material, which are designed to maintain the quality and freshness of the product. The company's success in producing high-quality tea is highly dependent on

the smoothness and accuracy in every stage of production, especially in the packaging stage. One of the most crucial production stages is filling, which plays an important role in avoiding product defects. (Kumar et al., 2017).

However, although the company has made every effort to maintain quality, during the production process, product defects such as cap nangkring, lack of volume, and dented bottles often occur. Based on production data obtained from 1 to 12 December 2022, the largest defect occurred in the type of cap nangkring, which reached 66.69%, followed by volume less (17.87%) and dented bottles (15.43%). This data shows that product quality is still a big challenge for PT TFJ, especially at the filling stage. Various factors that can affect these defects include filling machines, packaging materials, production environment, and operator skills (Heizer et al., 2020).

To overcome this problem, the company needs to conduct an in-depth analysis of the main causes of the defects that occur. One method that can be used to analyse quality problems is the Seven Tools method. This method consists of basic tools that can be used to identify, analyse, and solve quality problems, namely check sheets, stratification, histograms, Pareto diagrams, cause and effect diagrams, scatter diagrams, and control charts (Ishikawa, 1986). By using this method, companies can map the causes of defects, group defect data, and take appropriate corrective action.

Based on the description above, this research aims to analyse the factors causing defects in Pucuk Harum 350 ml tea products at the filling stage using the Seven Tools method. This research is expected to provide recommendations for effective corrective actions in reducing defect rates and improving overall product quality.

## 1. Literature Review

Product quality control is an important aspect in any manufacturing industry, especially to ensure that the products produced meet the quality standards expected by consumers. In recent years, many companies have focused on quality improvement efforts to create products with minimal or even near-zero defect rates. To achieve this goal, companies use various methods to analyse and improve product quality, one of which is the Seven Tools method which has been widely used in various studies.

The Seven Tools method is a set of tools used to identify and solve quality problems in a production process. These tools include check sheets, stratification, histograms, Pareto diagrams, cause and effect diagrams, scatter diagrams, and control charts. The use of this method aims to improve processes and enhance product quality through systematic data collection and analysis (Gandhi & Bansal, 2020). In a manufacturing context, this method is useful for identifying the main causes of product defects, and designing solutions that can reduce or eliminate these defects.

One of the tools in the Seven Tools that is often used is the Pareto Diagram. This diagram helps to identify the most significant problems in production by comparing the frequency of defects from different categories. The principle underlying this diagram is Pareto's law which states that 80% of problems are caused by 20% of causes. In a study conducted by Zhang et al. (2021), the application of Pareto Diagrams in the manufacturing industry shows that companies can identify key quality issues that need to be addressed immediately. As a result, companies can focus on solving the most impactful problems, improve process efficiency, and reduce production costs.

In addition, the use of Cause and Effect Diagrams (also known as fishbone diagrams) is very effective in analysing the factors that cause defects. This diagram makes it possible to map out the various factors that contribute to quality problems, such as machines, people, methods, and materials. According to research by Singh and Sahu (2020), this tool helps identify the root of problems in production, which can then be fixed with more focused and targeted steps.

On the other hand, in the development of the modern manufacturing industry, companies are also increasingly paying attention to the role of technology in quality control. For example, the use of Internet of Things (IoT) technology in production process monitoring has proven effective in improving real-time quality control. This technology enables automatic data collection from various sensors attached to production machines, which are then analysed to detect defects early (Rajendran et al., 2020). By doing so, companies can reduce the defect rate before the product reaches the consumer.

Quality improvement also relies heavily on operator skills and training. The company must ensure that each operator fully understands the correct work procedures and is able to identify problems that occur during the production process. Research by Kumar et al. (2022) showed that proper training for operators can improve production performance and significantly reduce product defect rates.

Overall, effective quality control requires a comprehensive approach, involving the use of appropriate analytical tools, the utilisation of technology, as well as the improvement of operator skills. By doing so, companies can not only reduce product defects, but also improve efficiency and competitiveness in an increasingly competitive market.

## 1. Methodology

This research was conducted at a manufacturing company engaged in the mainuman sector, namely PT TFJ, which is located at Jl. Pasuruan-Malang, Kurung Village, Kejayan District, Pasuruan Regency. This research took place from March to June 2020. The subjects in this study were the company management and production employees of Teh Pucuk Harum. While the object in this study is the product of tea pucuk harum 350 ml packaging. This type of research used is quantitative research. This research was conducted by directly analysing and identifying the product quality control system at PT Mayora Indah Tbk Kejayan Factory. This research aims to collect data needed for the analysis and identification process. This research is a type of descriptive research that uses *seven tools* approach. In this study, researchers used the type of observation research, namely by directly observing cases that occur in the field and with a descriptive qualitative approach. This is because based on the level of depth of understanding of the object of research. This research describes a case of occurrence or activity in accordance with the results of observations in the field. Where the data obtained is in the form of written data and oral data from employees who work that can be observed.

The type of data used in this study is to use two types of data, namely primary data and secondary data. Primary data used in this study is data obtained directly during direct observation when the researcher is at the company. Primary data is obtained by directly observing the object of research to find the actual data needed. In addition to observation, primary data was obtained by interviewing company management and employees working in the production area of fragrant tea. Secondary data is obtained by finding reference sources from journals, books, experts and the internet. Information about secondary data related to the research topic is used as a theoretical basis, information, and concepts that can be used as reference material in research.

The data collection methods and techniques used in this research are observation method, interview method, and literature study. The observation method is carried out by direct observation of the object of research, namely in the form of data on the number of rejects of fragrant tea products in 350 ml packaging. The interview method is carried out by seeking information by asking the company management and employees who work in the production department of PT TFJ about the existing conditions of the company. One of the tools in the *seven tools* method used for the data collection process in this study is the *checksheet* and *stratification*. While the data analysis technique in this study uses a pareto diagram, and *cause and effect* diagram.

Data processing in this study uses instruments in the *seven tools* method, namely the *control chart* or commonly called the *p-control map*. *Control charts* are used to process data that has been obtained by finding normal or middle limits, upper control limits, and lower control limits with the following steps:

1. Calculating the percentage of damage

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

$np$  : number of failures in the subgroup

$\Sigma p$  : total number examined

2. Calculating the centre line (CL)

$$CL = P = \frac{\Sigma np}{\Sigma p}$$

$\Sigma np$  : total number damaged

$\Sigma p$  : total number examined

3. Calculating the upper control limit (UCL)

$$UCL = p^- + 2 \frac{\sqrt{p^-(1-p^-)}}{n}$$

$p^-$  : average product damage

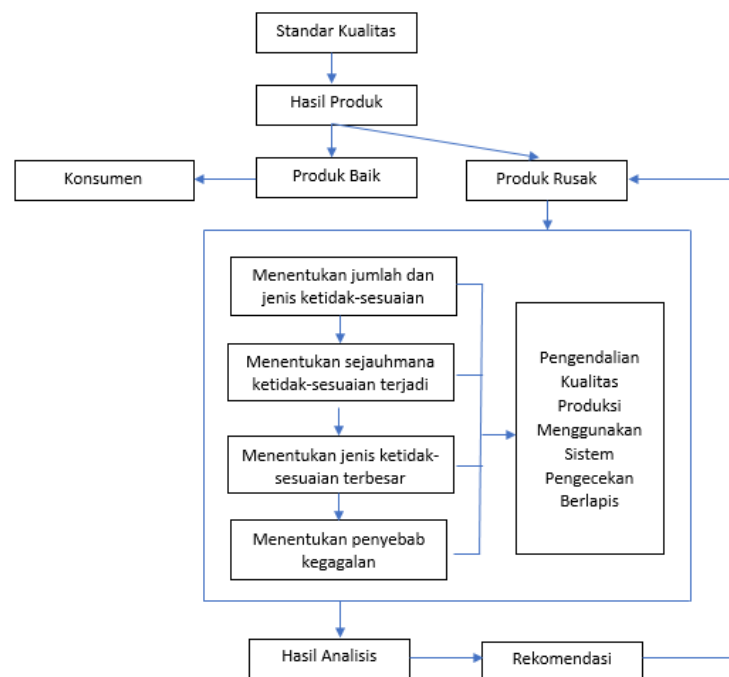
$n$  : total groups or samples

4. Calculating the lower control limit (LCL)

$$LCL = p^- - 2 \frac{\sqrt{p^-(1-p^-)}}{n}$$

$p^-$  : average product damage

$n$  : number of products



**Figure 1.** Research conceptual framework

## 1. Results and Discussion

*Checksheets* is an observation frequency sheet and defect frequency in which the number of defectivesheets recorded each month. Frequency sheet data for fragrant top tea products can be seen in table 4.2.

Table 1. Number of Product Defects on 01 December 2022 - 12 December 2022

No	Hasil produksi	Products disabled (pcs)	Products no disabled	Close Nanking		Volume Less	Bottle Dent
1	277409	157	277252	117		20	20
2	184195	250	183945	180		35	35
3	227219	249	226970	164		55	30
4	255794	261	255533	205		46	10
5	231948	336	231612	221		34	81
6	203686	268	203418	134		41	93
7	179655	247	179408	125		81	41
8	265786	366	265420	259		95	12
9	234123	357	233766	208		82	67
10	247005	531	246474	410		65	56
11	239675	291	239384	178		60	53
12	251230	245	250985	172		22	51
<b>TOTAL</b>				<b>2373</b>		<b>636</b>	<b>549</b>

Source: Data Processing, 2022

Stratification is the process of grouping defect data that occurs in the production area. In addition to grouping defect data, stratification also records the number of defects that occur in each type of defect. The stratification of defects in fragrant tea products can be seen in the following table.

Product Defect Stratification Date 01 December 2022 – 12 December 2022

Tanggal	Hasil produksi	Jenis cacat			Produk cacat (pcs)	Total cacat (%)
		Close Nanking	Volume Less	Bottle Dent		
1	277409	117	20	20	157	0.05
2	184195	180	35	35	250	0.13
3	227219	164	55	30	249	0.1
4	255794	205	46	10	261	0.1
5	231948	221	34	81	336	0.14
6	203686	134	41	93	268	0.13
7	179655	125	81	41	247	0.01
8	265786	259	95	12	366	0.13
9	234123	208	82	67	357	0.15
10	247005	410	65	56	531	0.21
11	239675	178	60	53	291	0.12
12	251230	172	22	51	245	0.09
<b>TOTAL</b>		<b>2373</b>	<b>636</b>	<b>549</b>	<b>3558</b>	

Source: Data Processing, 2022

Histogram is a bar chart that shows a tabulation of the overall data organised by defects. The data collected from the observations will be made into a histogram that gives an overview of the

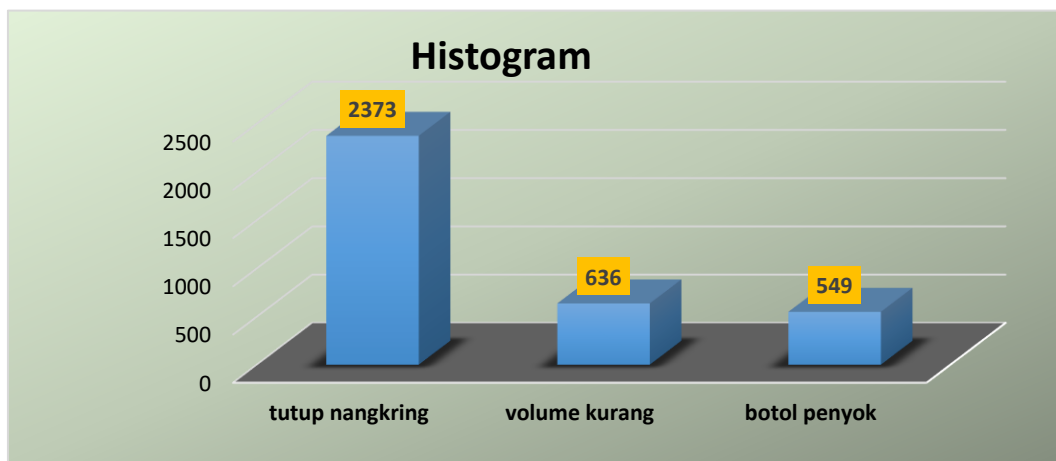
frequency of each type of defect, namely, cap nangkring, volume less and bottle dents. The histogram of total defects can be seen in the table below. 3.

Table 3. Number of Product Defects Dated 01 December 2022 - 12 December 2022

No	Jenis cacat		
	Tutup Nangkring	Volume Kurang	Botol Penyok
1	117	20	20
2	180	35	35
3	164	55	30
4	205	46	10
5	221	34	81
6	134	41	93
7	125	81	41
8	259	95	12
9	208	82	67
10	410	65	56
11	178	60	53
12	172	22	51
<b>TOAL</b>	<b>2373</b>	<b>636</b>	<b>549</b>

Source: Data Processing

From the table above, a histogram graph can be made showing the number of defects for the quality of fragrant shoot tea, which can be seen in the following image.



Gambar 2. Histogram Produk Cacat

The histogram graph in Figure 4.22 shows that amount disability product the biggest owned by a disabled person closed perched with amount defect 2373pcs and total disability the smallest owned by the bottle dent with total 549pcs.

A Pareto diagram is a diagram that describes comparison between product disabled closed perched, volume is low and bottle dents, to the total product defects that occur are sorted based on amount product disabled the biggest. Then counted presentation and presentation cumulative. Comparison presentation can be seen in the table following.

Table 4. Percentage Defective Product

Types of defects	Amount defect (pcs)	Presentation disability (%)	Presentation cumulative (%)
Closed perched	2373	66.69	67
Volume is low	636	17.87	85
Dented bottle	549	15.43	100
<b>Amount</b>	<b>3558</b>	<b>100.00</b>	

Source: Data Processing , 2022

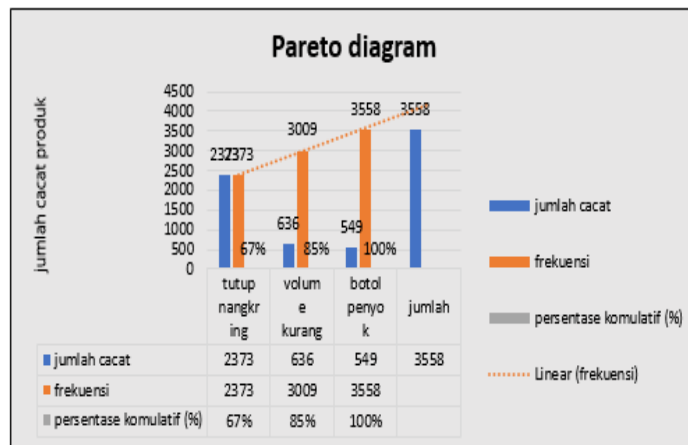
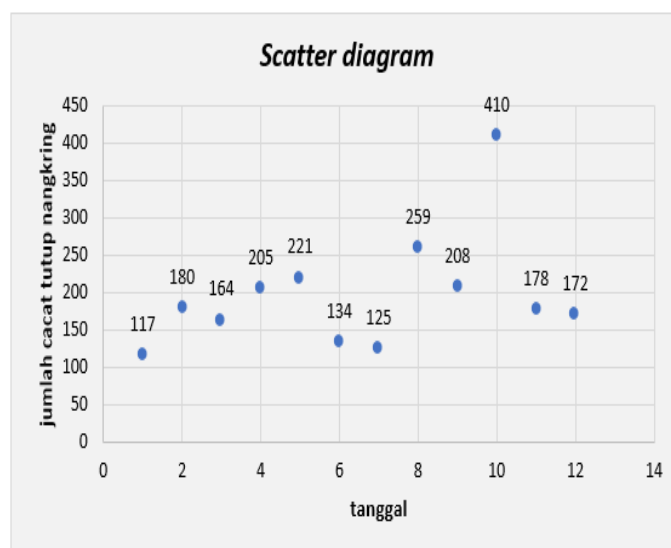


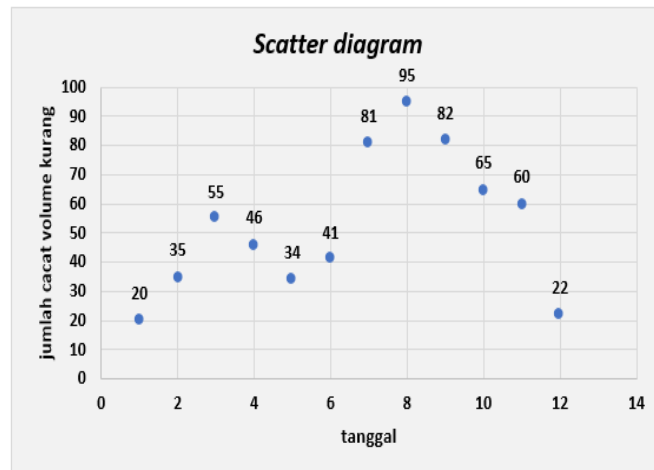
Figure 3. Pareto Diagram of Defective Products

This Pareto diagram used For identify defects that need to be fixed get priority For handled . Based on the Pareto diagram in Figure 4.23 , the defects that occurred priority repair is closed perched 67 % and volume less than 85% with a total percentage of 100%.

Scatter diagram show possibility relationship ( correlation ) between two kinds of couple variable , usually explain existence connection between two variables and shows closeness connection which is realized as coefficient correlation .



Scatter Diagram Tea Pucuk Harum Which Has a Defective Cover Perched



Scatter Diagram Tea Pucuk Harum Which Has a Defect of Lack of Volume

Influence amount product tea shoot the fragrance produced to amount defects and shapes connection or the correlation as seen in the picture can counted with use formula coefficient correlation amount production with disabled closed perched and volume is low can seen in the table .

Table 5. Calculation Correlation of Production Amount With Closed Hanging out

date	Production result (pcs) (X)	Closed perched (pcs) (Y)	X <sup>2</sup>	Y <sup>2</sup>	XY
1	277409	117	76955753281	13689	32456853
2	184195	180	33927798025	32400	33155100
3	227219	164	51628473961	26896	37263916
4	255794	205	65430570436	42025	52437770
5	231948	221	53799874704	48841	21260508
6	203686	134	41487986596	17956	27293924
7	179655	125	32275919025	15625	22456875
8	265786	259	70642197796	67081	68838574
9	234123	208	54813579129	43264	48697584
10	247005	410	61011470025	168100	101272050
11	239675	178	57444105625	31684	42662150
12	251230	172	63116512900	29584	43211560
<b>Total</b>	<b>2797725</b>	<b>2373</b>	<b>662534281503</b>	<b>537145</b>	<b>531006864</b>

Source: Data Processing , 2022

$$r = \frac{n \sum xy - \sum x \sum y}{\sqrt{[n(\sum x^2) - (\sum x)^2][n(\sum y^2) - (\sum y)^2]}}$$

$$r = \frac{12(531006864) - (2797725)(2373)}{\sqrt{[12(662534281503) - (2797725)^2][12(537145) - (2373)^2]}}$$

$$r = -7,28$$

Table 6. Calculation Correlation of Production Amount With Less Volume

date	Production result (pcs) (X)	Volume is low (pcs) (Y)	X <sup>2</sup>	Y <sup>2</sup>	XY
1	277409	20	76955753281	400	5548180
2	184195	35	33927798025	1225	6446825
3	227219	55	51628473961	3025	12497045
4	255794	46	65430570436	2116	11766524
5	231948	34	53799874704	1156	7886232
6	203686	41	41487986596	1681	8351126
7	179655	81	32275919025	6561	14552055
8	265786	95	70642197796	9025	25249670
9	234123	82	54813579129	6724	19198086
10	247005	65	61011470025	4225	16055325
11	239675	60	57444105625	3600	14380500
12	251230	22	63116512900	484	5527060
<b>Total</b>	<b>2797725</b>	<b>636</b>	<b>662534281503</b>	<b>40222</b>	<b>147458628</b>

Source: Data Processing, 2022

$$r = \frac{n \sum xy - \sum x \sum y}{\sqrt{[n(\sum x^2) - (\sum x)^2][n(\sum y^2) - (\sum y)^2]}}$$

$$r = \frac{12(147458628) - (2797725)(636)}{\sqrt{[12(662534281503) - (2797725)^2][12(40222) - (636)^2]}}$$

$$r = -0,1$$

Table 7. Calculation Results Proportion Disability Products, UCL, and LCL

SUBGROUP	Production result (pcs) (n)	Closed perched (np)	Proposition disability closed perched (p)	p	UCL	LCL
1	277409	117	0.000422	0.000848	0.00101	0.000682
2	184195	180	0.000977	0.000848	0.00105	0.000645
3	227219	164	0.000722	0.000848	0.00103	0.000665

<b>4</b>	255794	205	0.000801	0.000848	0.00102	0.000675
<b>5</b>	231948	221	0.000953	0.000848	0.00103	0.000665
<b>6</b>	203686	134	0.000658	0.000848	0.00104	0.000653
<b>7</b>	179655	125	0.000696	0.000848	0.00105	0.000642
<b>8</b>	265786	259	0.000974	0.000848	0.00102	0.000679
<b>9</b>	234123	208	0.000888	0.000848	0.00103	0.000668
<b>10</b>	247005	410	0.000166	0.000848	0.00102	0.000673
<b>11</b>	239675	178	0.000743	0.000848	0.00103	0.000670
<b>12</b>	251230	172	0.000685	0.000848	0.00102	0.000674
<b>Total</b>	<b>2797725</b>	<b>2373</b>				

Source: Data Processing , 2022

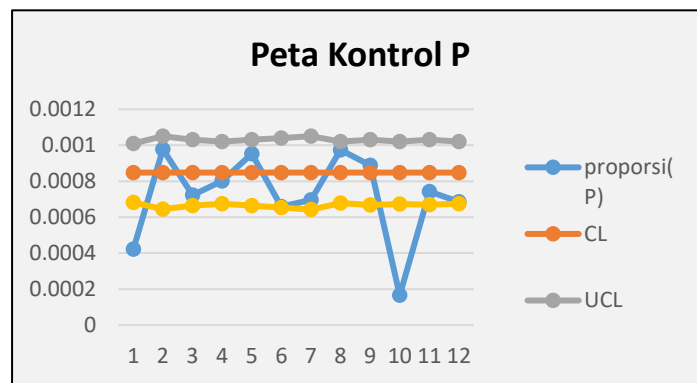


Figure 6. P Control Map for Disability Closed Hanging out

From the results map control mentioned , it is seen that defects that occur Still is at within control limits ( no there are some that *are out of control* ) .

Table 8. Calculation Results Proportion Disability Products , UCL, and LCL

SUBGROUP	Production result (pcs) (n)	Volume is low (np)	Proposition disability closed perched (p)	p	UCL	LCL
<b>1</b>	277409	20	0.000072	0.000227	0.000311	0.000142
<b>2</b>	184195	35	0.000190	0.000227	0.000332	0.000122
<b>3</b>	227219	55	0.000242	0.000227	0.000322	0.000132
<b>4</b>	255794	46	0.000179	0.000227	0.000317	0.000137
<b>5</b>	231948	34	0.000146	0.000227	0.000322	0.000132
<b>6</b>	203686	41	0.000201	0.000227	0.000327	0.000127
<b>7</b>	179655	81	0.000451	0.000227	0.000334	0.000120
<b>8</b>	265786	95	0.000357	0.000227	0.000317	0.000137
<b>9</b>	234123	82	0.000350	0.000227	0.000322	0.000132
<b>10</b>	247005	65	0.000263	0.000227	0.000317	0.000137
<b>11</b>	239675	60	0.000250	0.000227	0.000317	0.000137
<b>12</b>	251230	22	0.000087	0.000227	0.000317	0.000137
<b>Total</b>	<b>2797725</b>	<b>636</b>				

Source: Data Processing , 2022

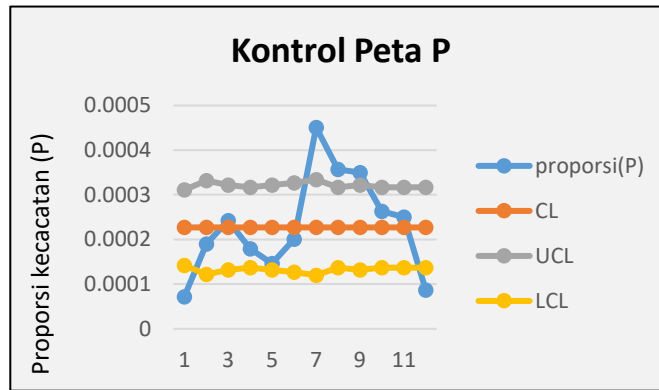


Figure 7. P Control Map for Disability Closed Hanging out

From the results map control mentioned, it is seen that defects that occur still is at within control limits (no there is something *out of control*)

At the stage this, is done analysis reason the occurrence disabled closed perched and volume is low with use *fish bone*. In case this, the cause problem reviewed from man, method, machine and material. Here there is description of each cause problem:

- a. Man  
 In this case, there is a lack of operator accuracy regarding proper machine operation and a lack of operator understanding regarding machine settings and machine parameters.
- b. Method  
 The absence of standard machine parameters in determining machine settings, resulting in errors in producing Pucuk Harum tea.
- c. Machine  
 In this case, there is no standard time for replacing parts on the Pucuk Harum tea filling machine.
- d. Material  
 The lack of cleanliness of the raw materials causes dirt to stick, resulting in defects in the Pucuk Harum tea product.

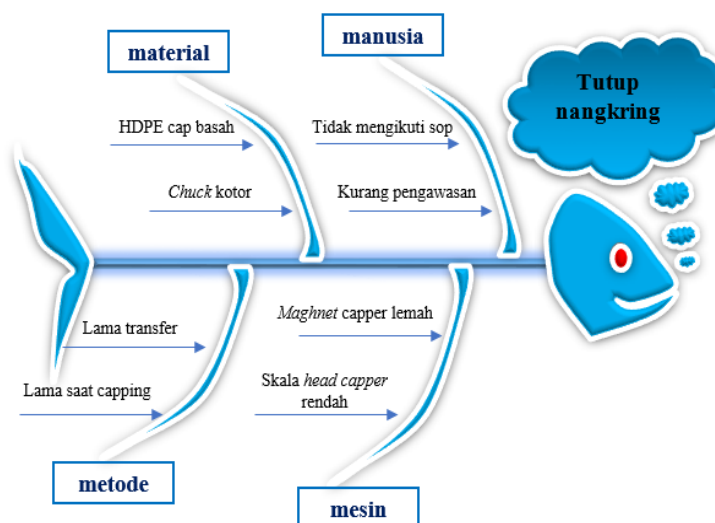


Figure 8. Cause and Effect Diagram of Defects Closed Hanging out



Figure 9. Cause and Effect Diagram of Low Volume Defects

## 1. Conclusion

Based on results processing and discussion that has been done, then got a number of conclusion that is amount defect in the product tea shoot fragrant closed perched namely 2373 pcs (66.69%) and for disability product tea shoot less volume fragrance namely 636 pcs (17.87%). Causal factors disability closed perched and volume is low caused by factors man that is the operator does not following SOP, the material factor, namely the chuck, is present dirt, factors machine that is magnet capper that has been start weak, factor method that is the length of time of transfer. Suggestion improvements provided is do check and replace magnet in a way periodic so that machine still in normal condition, giving briefing to the operator at the time beginning enter work and provide training for operators For give addition knowledge about machine, addition more transfer paths practical and fast so that not long or late in the transfer process, conducting trials of new materials for the rubber nozzle so that the rubber nozzle has good quality.

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