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PACKAGING DEFECTS ANALYSIS IN CHEESE PRODUCTS AT PT MAZARAAT LOKANATURA INDONESIA

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ABSTRACT

PT Mazaraat Lokanatura Indonesia is a company operating in the milk fermentation industry, especially in the organic cheese sector. PT Mazaraat Lokantura Indonesia is better known as Mazaraat Artisan Cheese. This company produces freesh cheese and aged cheese products. This research aims to analyze packaging defects, the number of product packaging defects and factors that influence packaging defects in PT Mazaraat Lokanatura Indonesia cheese. Data collection methods use observation and interview methods. The packaging defects found in this company were sloppy packaging and leaking packaging. Packaging is an important thing in a product because packaging can affect shelf life, the quality of the product contained in the packaging and can increase a company's expenses if there are a large number of packaging defects. One method used in quality control can be a method called Statistical Process Control (SPC). The seven tools method used is control charts and histograms. Control charts consist of Upper Control Limit (UCL), Central Line (CL), and Lower Control Limit (LCL). The results obtained after carrying out analysis using the P-Chart control chart on fresh cheese and aging cheese were less controllable because there were three exit points from the UCL limit which made the process less controllable. Based on the results of the Pareto fresh cheese diagram, the highest cumulative value is in leaky packaging. The results of the Pareto diagram for aging cheese have the highest percentage in leaky packaging. The causes of packaging damage are human factors, product factors, method factors and environmental factors.

Keywords: *Aging cheese, Control chart, Fresh cheese*

Introduction

Packaging is a place or media used to package an item which aims to make the item safe, attractive, and has an appeal as an effort to increase product competitiveness (Indrasari et al., 2021). A package is the face of a product and often is the only product exposure consumers experience prior to purchase (Marsh & Bugusu, 2007). The main function of packaging is to protect the product from damage while undergoing the process of transportation, storage, and product sales (Putu Suardana et al., 2019). A wide variety of materials are used for food packaging, such as paper, metal (e.g. steel and aluminum), glass, wood, and plastic (Chakori, S., Aziz, A. A., Smith, C., & Dargusch, 2021). The appearance of the packaging has an influence in the eyes of consumers, because the packaging contains information about the product contained in it. Consumers buy a product by looking at the packaging first with the criteria that the packaging is not defective. Packaging is an important thing in a product because packaging can affect the shelf life, the quality of the product contained in the packaging

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and can increase the expenses of a company if defect packaging with a large amount. The determining factor for product quality and shelf life is the packaging used. Packaging materials can have on product quality and shelf life (Brown at al., 2003). Packaging can be a determinant of shelf life because the packaging material is right if the packaging can maintain quality and extend product shelf life (Muhammad Anjasmoro & Topik Hidayat, 2023). Packaging quality control is very important to produce quality products and meet safety standards.

Quality is an important factor in determining the satisfaction obtained by consumers after buying a product because good product quality will be able to meet the wants and needs of consumers so that it is very important for companies to maintain the quality of the products produced in order to be able to compete with other companies in maintaining customer satisfaction (Herlina et al., 2021). A product with good quality is a picture of a company with products that are in great demand by the public. A product is quality if it meets the needs and desires of consumers. The era of globalization is an era in which all human activities are related to technology. This era is a very rapid development of technology that can help human work. In this era of globalization, competition in every industry is very tight. In this era, it is not only the quality of the product that is assessed by consumers but the quality of the packaging is also assessed by consumers. If the packaging displayed is damaged, buyers indirectly judge that the product inside has low quality. Damaged packaging triggers many customer complaints due to the low quality of packaging. This can affect consumer assessment of the company. Therefore, packaging is an important thing to build a product image in order to win the market, especially the hearts of consumers.

The food industry in the current era is growing rapidly and has many competitors. Cheese is one of the food products that has its own charm. Cheese is a curd formed as a result of the coagulation process of milk casein using rennet, lactic acid or other enzymes that can coagulate milk casein, then undergoes a ripening process or without ripening (Estikomah, 2017). Fresh cheese is soft cheese that is consumed without going through a long storage or aging process (Wulandari, 2021). Aging cheese is cheese that is consumed through a maturation process with a predetermined RH and temperature (Ivens et al., 2017). One of the cheese producers located in Yogyakarta is PT Mazaraat Lokanatura Indonesia. PT Mazaraat Lokanatura Indonesia produces organic cheese located on the slopes of Mount Merapi. One of the problems of cheese products occurs in the packaging. The packaging used is PE (Polyethylene) plastic, a type of plastic that is flexible and has a strong resistance to heat. The weakness of polyethylene plastic is that the oxygen permeability of PE tends to be high and is not resistant to oil (Windarti & Saidi, 2021). There are still some products that are not in accordance with company standards. One of them is defects in cheese product packaging. A defective product is a manufactured product that does not meet the standards of the procedure, is of low quality, is not well received by consumers, and there is a possibility that it cannot be repaired into a good product (Lestari & Mahbubah, 2021). The types of defects

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encountered in this company are untidy and leaky packaging. Therefore, action is needed to improve the quality of the packaging.

Research Method

Material

The ingredients used in cheese making at PT Mazaraat Lokanatura Indonesia are fresh cow's milk, Renco NZ rennet, TA71 culture, MA4002 culture, annatto, Renco NZ lipase, and PE (Polyethylene) plastic. Fresh cow's milk was used with no more than 5% water added. Rennet and lipase used were imported from New Zealand.

Tools

The tools used in the cheese production process are milk can, latoscan, cheese vat Dairy O'matic, curd cutter, pre-press vat Dairy O'matic, cheese press Dairy O'matic, cheesecloth, molding, load, stainless bowl, cheese basket, cream separator Slavic Beauty, thermometer Joil Tipe KT1, pH meter lutron model pH-212, scales, stirrer, stirring rod, filter, glass stainless steel, chiller, vacuum machine DZ-400/2E dan freight trolley.

Research Design

This research was conducted at PT Mazaraat Lokanatura Indonesia for one month with the method used quantitative. Research conducted by observing whether or not there are defects in the packaging. This research uses P-Chart diagrams, pareto diagrams, and causal factors. Defect packaging found leaking packaging and untidy packaging.

Research Stages

The research stages were carried out at PT Mazaraat Lokanatura Indonesia by subjectively observing packaging defect data. The stages carried out are collecting all defect data, observing defects, processing data, knowing the factors that cause defects. Pictures of packaging defects can be seen in Figure 1 and Figure 2.

Figure 1. Leaky Packaging
Source: Personal Documentation, 2024

Figure 2. Untidy Packaging
Source: Personal Documentation, 2024

Methods

The research method used is quantitative method with observation and interviews. Observations were made by direct observation at the practical work location of PT Mazaraat Lokanatura Indonesia. Interviews were

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conducted to obtain information related to the company and the topic taken. Interviews at PT Mazaraat Lokanatura Indonesia were conducted with the head of production as a resource person. There are two types of data obtained, namely primary data in the form of packaging defect data on cheese products with 10 observations made from 29 January 2024 to 29 February 2024 and secondary data in the form of literature studies.

Analysis Procedure

1. P-Chart

   P-Chart means that the statistical value of output defects is equipped with an upper control limit (UCL), Centerline (CL) and lower control limit (LCL) (Riyanthi et al., 2014). Making a control chart p is carried out in several stages, namely (Khomah & Siti Rahayu, 2015):

a. Calculating the Defect Proportion

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

   Description:

   P : Percentage of defects

   np : Number of defective products in a subgroup

b. Calculating the Centerline (CL)

   $CL = \bar{p} = \frac{\sum np}{\sum n}$

   Description:

   $\sum np$: Total number of nonconformities (defects)

   $\sum n$: Total number of products inspected

   CL : Center Line

c. Calculating the Upper Control Limit (UCL)

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

   Description:

   n : Production quantity

   $\bar{p}$: Average product damage

d. Calculating the Lower Control Limit (LCL)

   $LCL = \bar{p} - 3\sqrt{\bar{p}(1-\bar{p})/n}$

   Description:

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n : Production quantity

$\bar{p}$: Average product damage

2. Pareto Diagram

   The packaging defect data that has been obtained is sought for the cumulative percentage value to make a graph and know the most dominant defect (Idris et al., 2021)

3. Causal Factors (Fishbone diagram)

   The causal factors of packaging defects obtained are human, product, environmental, and method factors. The causal factors are used to identify solutions for future improvement. This diagram serves to analyze and find factors that influence or have a significant impact to determine the quality characteristics of the output (Malabay, 2016).

Results and Discussion

1. P-Chart Diagram

P-Chart is a tool that can be used for statistical process control (SPC). SPC is an instrument made up of statistical procedures that aim to measure and analyze variations in processes (Jesus et al., 2022). The most commonly used charts in SPC are run charts, mean chart, range chart, histogram, Pareto chart etc (Suman & Prajapati, 2018). Control charts usually use P-Chart control maps. P-Chart has the advantage of being able to help control packaging defects and can provide information about when and where the company should make quality improvements (Ahadya Silka Fajaranie & Khairi, 2022). The selection of the P-Chart control map as quality control because quality control is an attribute (Khomah & Siti Rahayu, 2015). The control chart is probably the most widely used of the seven basic quality control tools. It is the main tool in the process of statistical process control within defined control limits (Edossa & Singh, 2016). Control Chart is one of the seven tools quality control methods in the form of a graph that serves to monitor the stability of a process (Fadhilah & Wahyudi, 2022). Seven Tools is a tool in quality management that is useful for mapping the scope of the problem, organizing data in diagrams to make it easier to understand, exploring various possible causes of the problem and clarifying the reality or authentic phenomena in the problem (Muhammad Anjasmoro & Topik Hidayat, 2023). These may affect performance because they make it possible to determine the root cause of quality problems in order to identify and solve such problems or to identify opportunities for improvement (Pramono et al., 2018). The control chart uses a center line (CL) and two control limits, namely the upper control limit (denoted UCL) and the lower control limit (denoted LCL) (Odunayo Braimah et al., 2015). The center line between the UCL and LCL is called the center line (CL). This center line is a line that represents the average level of damage in a production process. UCL and LCL are statistical size indices that can be said to deviate or not (Shiyamy et al., 2021). Observations are made by monitoring or observing the product whether the product has a defect or not.

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This control map shows changes in data over time by showing the maximum and minimum limits which are the limits of the quality control area. This P-Chart is to see whether quality control in the company is under control or not (Khomah & Siti Rahayu, 2015). Data on the number of defects in fresh cheese packaging can be seen in Table 1.

Table 1. Data on the Number of Defects of Fresh Cheese Packaging

Observation Day-	Number of samples	Defects of untidy packaging (pcs)	Leaky packaging defects (pcs)	Many Defects	Defect Proportion	CL	UCL	LCL
1	59	4	0	4	0.07	0.05	0.07	0.03
2	96	1	2	3	0.03	0.05	0.07	0.03
3	20	1	0	1	0.05	0.05	0.07	0.03
4	149	12	1	13	0.09	0.05	0.07	0.03
5	148	4	0	4	0.03	0.05	0.07	0.03
6	16	3	0	3	0.19	0.05	0.07	0.03
7	63	0	2	2	0.03	0.05	0.07	0.03
8	120	3	0	3	0.03	0.05	0.07	0.03
9	119	5	0	5	0.04	0.05	0.07	0.03
10	12	0	1	1	0.08	0.05	0.07	0.03
Total	802	33	6	39				

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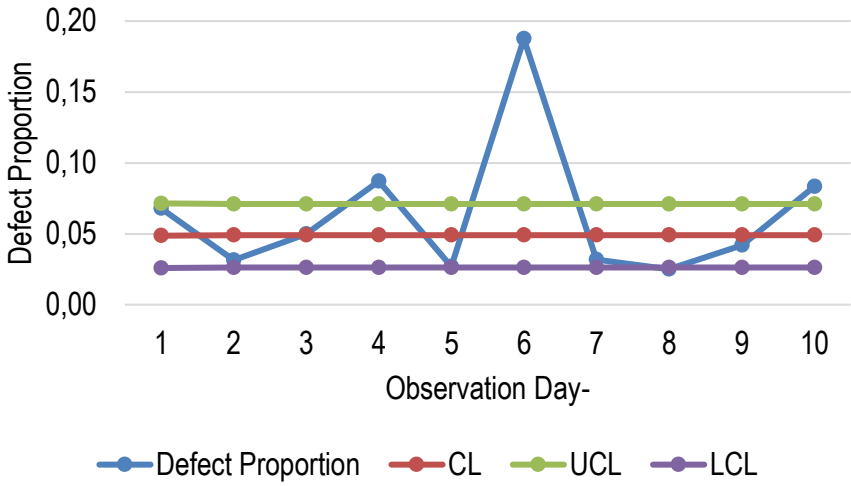

Figure 3. Fresh Cheese P-Chart Graph
Source: Personal Documentation, 2024

Based on Figure 3. the P-Chart graph above, it can be seen that the UCL value is 0.07. The CL value is 0.05 and the LCL value is 0.03. The data is outside the controlled control limits. This is because the 4th day data with a sample size of 149 with a defect proportion value of 0.087 where the defect proportion point passes the upper control limit (UCL). Day 6 data with a sample size of 6 with a defect proportion value of 0.188 which exceeds the upper control limit (UCL). The 10th day data with a sample size of 12 has a defect proportion of 0.083 where the defect proportion point exceeds the upper control limit (UCL). It can be seen that if there are three points that cross the UCL limit, it is considered that the packaging process is not perfect because there are still points that cross the upper control limit (UCL). This is in accordance with Riyanthi et al., (2014) which states UCL ≤ p ≤ LCL that p is greater than or equal to the UCL and p is less than or equal to the LCL. If defective or damaged products reach or are above the upper control limit (UCL), the production process carried out is considered less efficient (Nitafiyah et al., 2020). The cause of the three points passing the UCL limit is the inconsistent number of samples because it depends on consumer demand and also the number of defects is not so much that makes the proportion of defects obtained high. To get all processes under control requires control and anticipatory steps. These efforts can reduce the cost of expenses from the company due to damage that can harm the company.

Table 2. Data on the Number of Defects of Cheese Aging Packaging

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Observation Day-	Number of samples	Defects of untidy packaging (pcs)	Leaky packaging defects (pcs)	Many Defects	Defect Proportion	CL	UCL	LCL
1	14	0	1	1	0.07	0.12	0.18	0.05
2	35	3	0	3	0.09	0.12	0.18	0.05
3	81	2	2	4	0.05	0.12	0.18	0.05
4	12	1	2	3	0.25	0.12	0.18	0.05
5	18	1	2	3	0.17	0.12	0.18	0.05
6	6	0	1	1	0.17	0.12	0.18	0.05
7	5	0	2	2	0.40	0.12	0.18	0.05
8	20	3	1	4	0.20	0.12	0.18	0.05
9	18	0	2	2	0.11	0.12	0.18	0.05
10	25	1	3	4	0.16	0.12	0.18	0.05
Total	234	11	16	27				

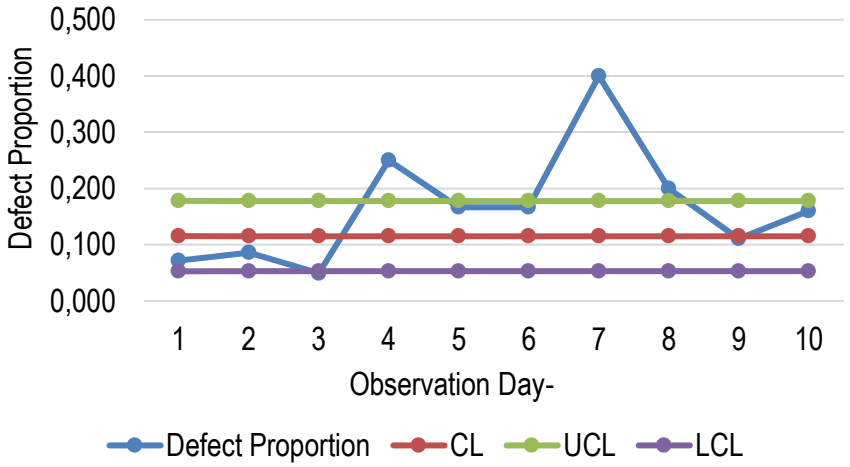

Figure 4. Cheese Aging P-Chart Graph
Source: Personal Documentation, 2024

Based on Figure 4 of the P-Chart graph above, the UCL value is 0.18. The value of CL is 0.12 and the value of LCL is 0.05. From these data it can be seen that the data is outside the control limits. This is because on day 4 with a sample size of 12 with a defect proportion value of 0.250 where the point crosses the upper control limit (UCL). The 7th day data with a sample size of 5 has a defect proportion of 0.400. The 8th day data with a sample size of 20 has a defect proportion of 0.200 which crosses the upper control limit (UCL). Data for days 1, 2, 3, 5, 6, 9, and 10 are still within the upper control limit (UCL) and lower control limit (LCL), it can be said that the data is still under control. It can be seen if there are three points that cross the UCL limit, which is

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considered an imperfect packaging process because there are still points that cross the UCL limit. This is in accordance with Riyanthi et al., (2014) which states UCL ≤ p ≤ LCL that p is greater or equal to UCL and p is smaller or equal to LCL. If defective or damaged products reach or are above the upper control limit (UCL), the production process carried out is considered less efficient (Nitafiyah et al., 2020). The cause of the three points passing the UCL limit is the inconsistent number of samples because it depends on consumer demand and also the number of defects is not so much that makes the proportion of defects obtained high. Efforts to get all processes under control require control and anticipatory steps. These efforts can reduce the cost of expenses from the company due to damage that can harm the company.

2. Diagram

Histogram is a bar chart that has a function to describe the shape of the distribution of a group of data which is usually a quality characteristic (Ginting & Fattah, 2020). A Pareto analysis adalah that helps to highlight the most frequently occurring defects, highest number of total defectives (Idris et al., 2021). Pareto Chart is a graph containing a bar graph and line graph. The most common problem will be the highest bar chart, while the least common problem will be represented by the lowest bar chart (Yemima et al., 2014). Pareto diagrams are used to compare categories arranged by percentage height from the largest on the left to the smallest on the right (Alfie Oktavia, 2021). The method taken in making a pareto diagram is by grouping data according to its type so that the amount and percentage can be obtained. Bar charts show the classification and value of data, while line charts represent the total cumulative data. The goal is to find out the largest percentage of the data obtained.

Table 3. Percentage of Defect Types of Fresh Cheese packaging

Defect Type	Number of Defects (pcs)	Percentage (%)	Cumulative Percentage (%)
Untidy packaging	33	85%	85%
Leaky packaging	6	15%	100%
Totally	39	100%	

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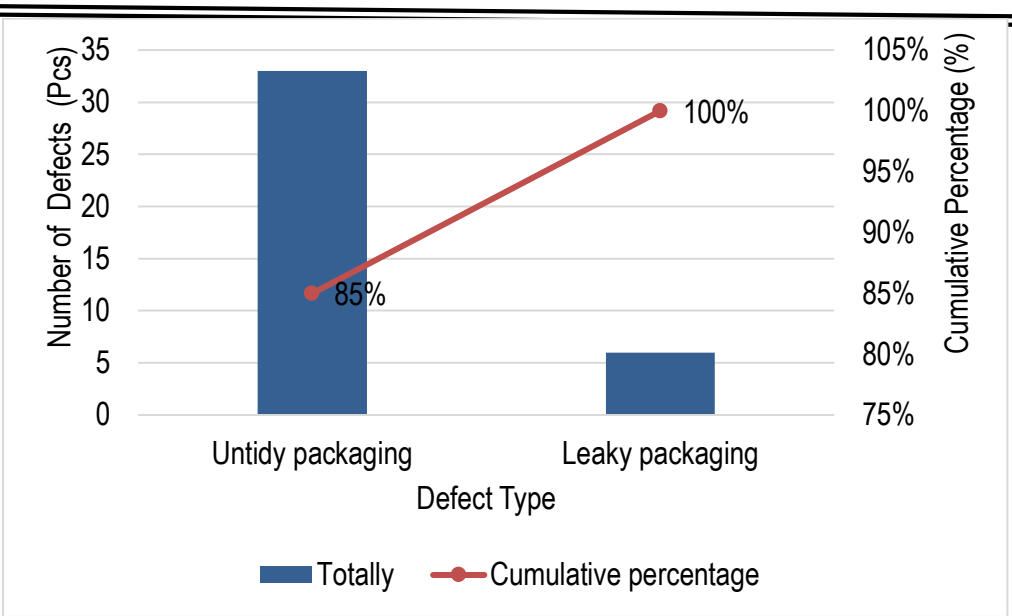

Figure 5. Pareto Diagram of Fresh Cheese
Source: Personal Documentation, 2024

Based on Table 3 above that the type of untidy packaging defect the percentage obtained is greater than the type of leaky packaging defect. Based on Figure 5, the highest cumulative percentage in leaky packaging is 100%. Pareto diagram can be known the most dominant type of defect from its cumulative value. In accordance with the pareto principle which says that the 80/20 rule means that 80% of quality problems are caused by 20% of the causes of defects (Gunawan & Tannady, 2016). The dominant defects seen from the cumulative percentage are untidy packaging 85%, leaky packaging 100%. The percentage of untidy packaging is 85% and leaking packaging is 15%. Fresh cheese is more often found in untidy packaging such as folded plastic ends and skewed sealing. These packaging defects can be caused by errors when placing the cheese in the vacuum machine and lack of care in placing the cheese in the vacuum machine. The type of defect categorized as dominant is the type of defect with a cumulative value on the Pareto diagram that reaches 80%. The 80% cumulative value of the selected defect type is considered to represent other defect types (Gunawan & Tannady, 2016). The factors that cause packaging damage at PT Mazaraat Lokanatura Indonesia for fresh cheese are humans, products, and the environment. Damage is more dominant due to humans and products because many interns hold vaccum machines and do not know the packaging standards of the company. Damage due to the product is the release of fat in the product which results in the vacuum process, the sealing is not perfectly tight.

Table 4. Percentage of Defect Types of Aging Cheese Packaging

Defect Type	Number of Defects (pcs)	Percentage (%)	Cumulative Percentage (%)

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Untidy packaging	11	41%	41%
Leaky packaging	16	59%	100%
Totally	27	100%	

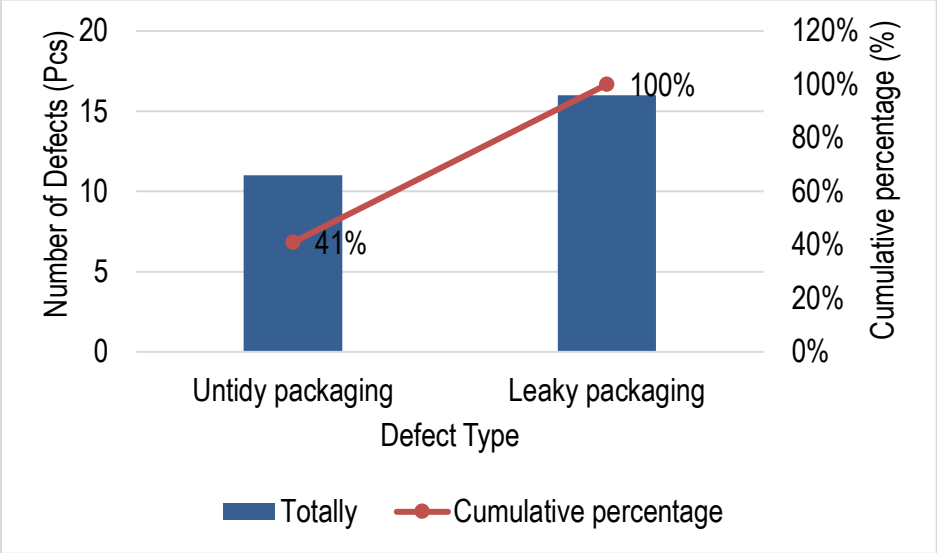

Figure 6. Pareto Diagram of Cheese Aging
Source: Personal Documentation, 2024

Based on Table 4 above, it can be seen that the percentage of leaky packaging is greater than untidy packaging. Based on Figure 6, the highest cumulative percentage in leaky packaging is 100%. Pareto diagram can be known the most dominant type of defect from the cumulative value. In accordance with the pareto principle which says that the 80/20 rule means that 80% of quality problems are caused by 20% of the causes of defects (Gunawan & Tannady, 2016). It can be seen that the dominant defects that occur are leaky packaging at 100%, untidy packaging 41%. Leaky packaging in aging cheese has a higher percentage because it can be caused by sharp pieces of cheese. Untidy packaging can be caused by cheese pieces that are shaped similar to triangles that make the cheese placed in the vacuum machine. The type of defect categorized as dominant is the type of defect with a cumulative value on the Pareto diagram that reaches 80%. With a cumulative value of 80%, the selected defect type is considered to represent other defect types (Gunawan & Tannady, 2016). The factors causing damage to aging cheese at PT Mazaraat Lokanatura Indonesia are human, product, and environment. The packaging damage factor that occurs in aging cheese is due to the type of cheese that is hard with sharp pieces of cheese that can damage the packaging when vacuumed. The untidy packaging can also be affected by the shape of the product that is difficult to place in the vacuum machine.

3. Causal Factors (Fishbone Diagram)

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A cause and effect diagram is a schematic in the form of a fishbone that contains the causes and sub-causes associated with a problem called a fishbone diagram (Perera & Navaratne, 2016). A fishbone diagram is a graphical technique for showing multiple causes of a particular event Fishbone diagram is a way of improving quality (Coccia, 2021). The impact or effect is written as the snout of the head. The fishbone is filled in by causes according to the problem approach (Ahadya Silka Fajaranie & Khairi, 2022). Cause-and-effect diagrams are used to identify and evaluate various defects and the causes of those defects (Hossen et al., 2017). The causes of packaging damage at PT Mazaraat Lokanatura Indonesia are categorized into four categories, namely humans, products, methods, and the environment. The most dominant factors of damage are human factors, products, and methods. The causal factors are depicted from the fishbone diagram. Fishbone diagram to analyze what factors are the cause of product defects. A picture of the fishbone diagram can be seen in Figure 7.

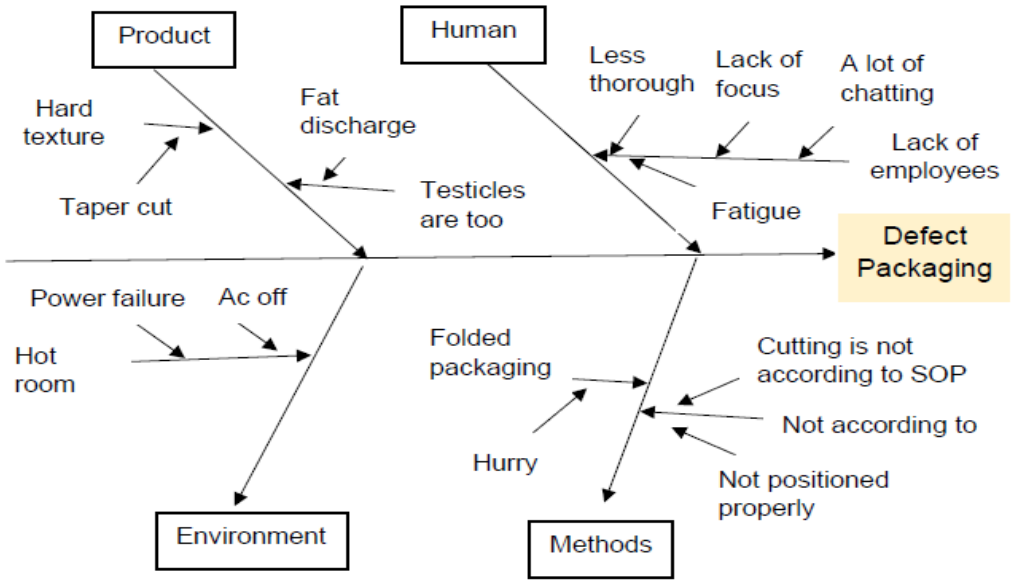

Figure 7. Fishbone *Diagram*
Source: Personal Documentation, 2024

One of the causes or influences of damage to products in general is the human factor is the first factor, humans in this case are operators and who hold vacuum machines. The operator here influences the progress of the packaging process. If the operator does not carry out his duties properly, it can result in packaging damage. Humans are one of the causes of the damage that occurs. The human factor is caused by lack of focus in the production process, lack of accuracy, and too many people holding vacuum machines such as apprentices. The causes that make operators less focused are hot room temperature, lots of chatting, many interns holding so that operators are less comfortable and free to work. In addition, most of the damage that occurs during the packaging process is held by interns because the company has not yet standardized packaging and the lack of employees who can become QC (Quality Control). Quality control is a management activity that is carried out in

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the construction process to achieve goals (Sahil et al., 2020). The effort to overcome this is that it should be supervised by the operator if the apprentice is doing the packaging.

The second factor is the product, which is a factor causing damage because fresh cheese and aging cheese products have different textures. Fresh cheese has a block shape and smooth texture, while aging cheese has a shape similar to a triangle, sharp, and hard, which can damage the plastic used during the vacuum process. Packaging damage that occurs can increase company expenses. In addition, damage to fresh cheese packaging is also due to the release of fat so that the vacuum process is not maximally sealed. Efforts to overcome this can be in cutting the aging cheese not too sharp.

The third factor is the method, the method used is not in accordance with the SOP. SOPs are a set of written instructions on how the recruitment and study staff involved carry out tasks and what materials are used. These detailed instructions include step-by-step process breakdowns and provide instructions for performing tasks consistently (Moreno-Villanueva et al., 2015). Methods that are not in accordance with the SOP, for example, the packaging is not positioned properly, resulting in the vacuum not being able to reach the packaging properly. Then this packaging will not be positioned properly in the vacuum sealer so that the packaging can be damaged. The cutting of plastic after vacuuming can also affect damage if it is not in accordance with the specified provisions. So there needs to be supervision from the company or its operators.

The fourth factor is the environment, the environment in question is a power failure that can disrupt the packaging process. Plastic packaging that is exposed to liquid, vacuum cannot reach the plastic properly. This can make the packaging damaged during the packaging process. Efforts should be made to store plastic packaging away from liquids.

Conclusion

The conclusions obtained from the analysis of packaging defects at PT Mazaraat Lokanatura Indonesia are:

1. Analysis of packaging defects in cheese at PT Mazaraat Lokanatura Indonesia using SPC (Statistical Process Control), with the results of calculations using P-Chart and Pareto Diagrams and P-Chart data fresh cheese and aging cheese using 10 observations there are 3 points that exceed the upper control limit (UCL).
2. Based on the analysis of packaging defects, it is known that the number of fresh cheese defects in untidy packaging is 33 and leaking packaging is 6 with an LC value of 0.049, UCL 0.071, and LCL 0.026 with the number of aging cheese defects in untidy packaging 11 and leaking packaging 16 with an LC value of 0.115, UCL 0178, and LCL 0.053 the condition of the packaging process is less stable.
3. Based on the influence of cheese (product), namely the release of fat and sharp pieces of cheese that make packaging damage with methods that do not carry out the company's SOP and human influence, namely the lack of thoroughness and focus of operators and people holding vacuum machines.

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