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IMPLEMENTATION OF TOTAL QUALITY CONTROL AND KAIZEN METHOD IN ANALYZING THE QUALITY CONTROL OF ORANGE JUICE SYRUP AT PT. XYZ

Isna Nugraha[1], Bagas Aryaseta[2], Tivani Nava Arier[3] & Achmad Gufron[4]*

Address:
[1,3,4] Department of Industrial Engineering, Faculty of Engineering and Sains, Universitas Pembangunan Nasional Veteran Jawa Timur, Surabaya 60294, Indonesia
[2] Department of Civil Engineering, Faculty of Engineering and Sains, Universitas Pembangunan Nasional Veteran Jawa Timur, Surabaya 60294, Indonesia
*Corresponding author: isna.nugraha.ti@upnjatim.ac.id

ABSTRACT
In the manufacturing industry, quality is very important. To maintain quality, a company must pay close attention to the production processes. In this research, the product under analysis is Orange Juice Syrup. The aim of this study is to determine the quality standards applied by PT. XYZ and identify the factors causing defective products. Total Quality Control (TQC) is employed in analyzing the quality control of Orange Juice Syrup in this research. The research method used is quantitative, with data processing using analysis techniques like the Seven Basic Tools and Kaizen. With the assistance of Microsoft Excel software, the Control Chart (C-Chart) reveals that there are still some products falling outside the control limits. Out of 1000 syrup units produced overall, 99 faults were found based on the histogram that was constructed. According to the cause-and-effect diagram analysis, elements like labor, production equipment, work procedures, materials, and the working environment are the root causes of faults in the manufacturing process. The results of this research are expected to help the company reduce the percentage of defects in Orange Juice Syrup products and enhance the quality standards and overall quality of the product.

Keywords: Orange Juice Syrup, Quality Control, Kaizen, Seven Basic Tools.

INTRODUCTION
In order to improve their worth in this globalized world, companies need to boost their output dramatically. Businesses are forced to continuously compare themselves to other industries, especially those operating in the same industry (**Alfadilah, 2022**). Enhancing the caliber of a company's offerings to guarantee client happiness is one strategy for maintaining competitiveness (**Ashari, 2022**). Because it converts raw resources into semi-finished or finished goods, production is the most important activity in a manufacturing organization, or perhaps the most important component (**Harma, 2022**). To deliver the highest quality, efforts must be made to continually enhance the environment, processes, human resources, and product capabilities (**Qothrunnada, 2022**). Quality is one of the assurances a company offers to its customers because quality is a critical factor in the decision-making process (**Shania, 2022**). Consequently, to meet client criteria and demands, companies must continuously improve their quality (**Latifah, 2022**).

Measuring a product's quality attributes is the engineering and management practice known as quality control (**Mahaputra, 2021**). After that, it is contrasted with the specifications or requirements (**Napitu, 2022**), and if there is a difference between the real appearance and the standard, the required action is taken (**Nursyamsi, 2022**). Quality, whether it is in terms of product quality, pricing, safety, service time, or any other area, is crucial to an organization's survival and expansion, and it must constantly be improved (**Permono, 2022**). In order to increase a company's competitiveness, quality is essential. Selling a company's products becomes difficult when there is doubt about the quality of those products since customers become less trusting of them (**Rofieq, 2021**).

A product's quality is correlated with its manufacturing process, and a company's quality can affect its customers' perceptions, leading to their happiness and loyalty (**Winasis, 2022**). Consequently, the results of quality control initiatives can genuinely improve the product's quality and align it with customer expectations (**Sulaiman, 2018**). Quality control is a team activity rather than a solo one (**Nugraha, 2022**). Quality programs will flourish when all stakeholders collaborate, including company executives, staff members, and sales representatives (**Layasina, 2015**). A few factors that affect quality control are operators, raw materials, and equipment (**Adila, 2023**). According to **Wicaksono (2018)**, The Seven Tools are essential quality inspection instruments that assist businesses and organizations in problem-solving and process improvement. A

company's products or market may have quality concerns that may be found and fixed with the use of these Seven Tools (**Rochmoeljati, 2022**). Through a sustainable Kaizen process, businesses can continuously increase the productivity and quality of their production, leading to notable increases over time (**Nugraha, 2022**). In order to produce meaningful outcomes throughout time, kaizen is a continuous process that aims to increase productivity and quality of output (**Hamdani, 2020**).

One of the factories that makes syrup, PT XYZ specializes in making orange syrup. There is no denying that during the production of orange syrup, product flaws can happen. The purpose of this study is to determine the root causes of manufacturing process flaws in order to generate superior orange syrup that satisfies quality requirements. Therefore, in order to lower the production of faulty orange syrup and maintain market competitiveness, quality control must reevaluate the manufacturing process while taking a number of aspects into account.

MATERIAL AND METHODS

This research uses a quantitative research method by collecting numerical data to measure, identify, and analyze the relationships between the variables being studied. This type of research is employed to investigate a specific population or sample. Data collection is carried out quantitatively using statistical methods and secondary data analysis to produce measurable, objective findings.

A. The tools used in quality control are as follows:

1. Check Sheet
   A check sheet can be defined as a simple-designed sheet that contains a list of items needed for data recording purposes. It allows users to collect data easily, systematically, and regularly when an event occurs. This tool is used to gather data and record how often certain processes occur. Data collected through check sheets can be utilized in other tools like Pareto charts and histograms.
2. Fishbone (Cause-and-Effect) Diagram
   The Fishbone Diagram, often called the Cause and Effect diagram, resembles a fish's skeleton and can illustrate the cause and effect of a problem. It was developed by a Japanese professor named Dr. Ishikawa. This tool is also known as the Ishikawa or fishbone diagram due to its graphical structure. The Fishbone Diagram is an essential tool for identifying the root causes of problems. It considers all possible causes and attempts to discover why each cause contributes to the occurrence of a problem.
3. Pareto Chart
   The Pareto Principle, also known as the "80/20 Rule," states that in many events, 80% of the effects result from 20% of the causes. The term "Pareto" is derived from the name of the Italian economist Vilfredo Pareto, who found that 80% of the land in Italy was owned by 20% of the population. Interestingly, this principle can be applied to various aspects, including business activities.
4. Histogram
   A histogram is a graphical representation of the distribution of colors in a digital image. The vertical ordinate axis represents pixel values, while the horizontal axis is a commonly used chart among quality tools. Histograms are used to determine the shape of a data set. Histograms work best when dealing with a small amount of data. For larger data sets, a Pareto chart is preferred since it also arranges data in descending order.
5. Control Chart
   A control chart is one of the tools for performing Statistical Process Control (SPC). It is used to analyze the output of a process. Control charts show changes in data over time but do not reveal the causes of variations, although those causes become apparent on the chart. According to **(Pratama et al., 2023)**, the benefit of control charts is to continuously monitor the production process to keep it stable and determine the capability of the process.

B. Kaizen Method

Kaizen is not a new concept, first introduced in the late 1950s and early 1960s by experts like W.E. Deming and J.M. Juran. The Kaizen concept is process-oriented, as opposed to the outcome-oriented thinking of Western countries. Continuous Improvement (Kaizen) means ongoing improvement, involving everyone. This includes top-level management, managers, and low-cost employees **(Nugraha, 2022)**.

Four valuable areas for organizations to consider when striving to achieve their goals through human resource development using Kaizen are:

1. Recruitment and selection policies involving all employees.
2. Inauguration programs that involve the company, department, teams, and individual members.
3. Reward systems that motivate and unify.
4. Continuous improvement programs (Kaizen) that enhance every job area and involve everyone **(Anggarini, 2019)**.

RESULTS AND DISCUSSION

A. *Check Sheet*

Table 1. Check Sheet for Syrup Production

Defect Types	Dates							Total
	January	February	March	September	October	November	December	
Content defects	III	IIII	IIIIIIII	IIII	III	IIII	IIIIII	32
Viscosity level	III	IIIIII	IIII	IIIIII	IIIIIII	III	IIIII	34
Cloudy color	IIIII	IIIIIII	IIII	IIII	III	IIIIIII	III	33
Total	11	17	16	14	13	14	14	99

Table 1 is a check sheet for the defects in syrup production. There are three types of defects: content defects, viscosity level defects, and cloudy color defects.

B. Stratification

Table 2. Stratification

NO	Defect Types	Total Unit	Presentation of Defect	Cumulative Presentation
1	Content defects	1000	9,80%	9,80%
2	Viscosity level	1000	10,27%	10,27%
3	Cloudy color	1000	9,51%	9,51%
	Total		29,58%	

C. Histogram

R : Xmax – Xmin = 500 – 342 = 158
K= 1+3,22 log n = 1+3,22log50 = 6,47 →7
L= R/ K = 158/7 = 22,5714285714 →23
Lower limit = Xmin - $\frac{1}{2}$L = 342 – 11,5 = 330,5
Limit 1 = Lower limit + L = 330,5 + 23 = 353,5
Limit 2 = Lower limit + L = 353,5 + 23 = 376,5
Limit 3 = Lower limit + L = 376,5 + 23 = 399,5
Limit 4 = Lower limit + L = 399,5 + 23 = 422,5
Limit 5 = Lower limit + L = 422,5 + 23 = 445,5
Limit 6 = Lower limit + L = 445,5 + 23 = 468,5
Limit 7 = Lower limit + L = 468,5 + 23 = 491,5
Limit 8 = Lower limit + L = 491,5 + 23 = 500

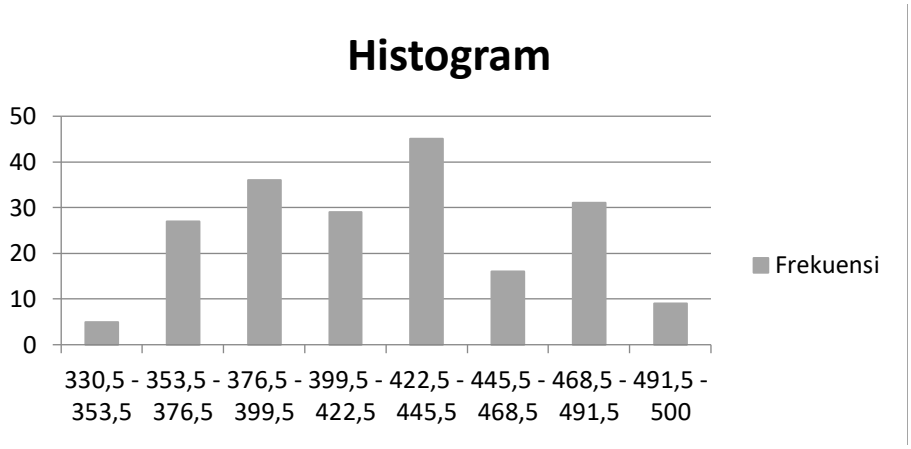

Figure 1. Histogram

Analysis:
Based on 200 samples of syrup characteristic data, it is processed into a frequency distribution table which produces a bar chart or histogram.

D. Diagram Pareto

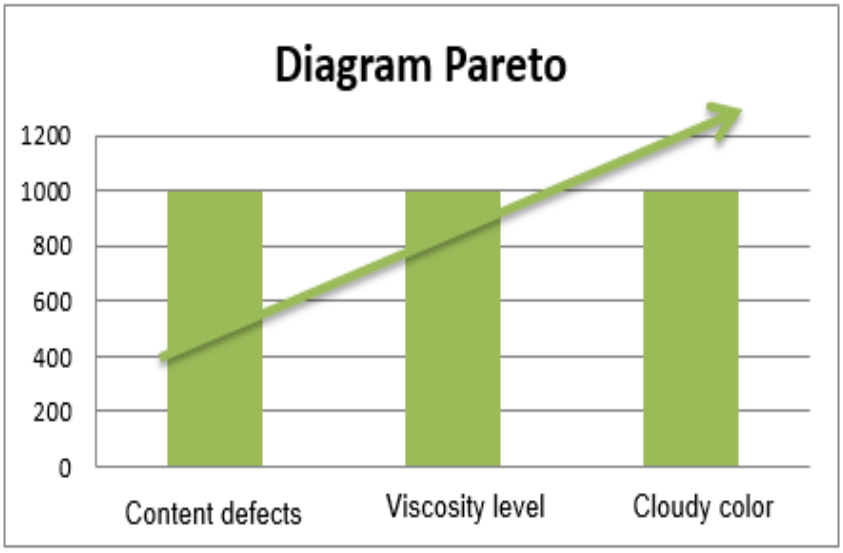

Figure 2. Pareto diagram

Viscosity level defects are the most common form of defect, accounting for 10.27% of all defects. The content defect type comes in second with a rate of 9.80%. The foggy color fault comes in last or at the bottom, with a percentage of 9.51%.

E. Calculation of the C-Chart Control Chart

$\bar{C}$ = 510/50 = 10,2

$LKA_C = \bar{C} + 3\sqrt{\bar{C}}$ = 10,2 + 2,1687 = 12,3687

$LKB_C = \bar{C} - 3\sqrt{\bar{C}}$ = 10,2 - 2.1687 = 8,0313

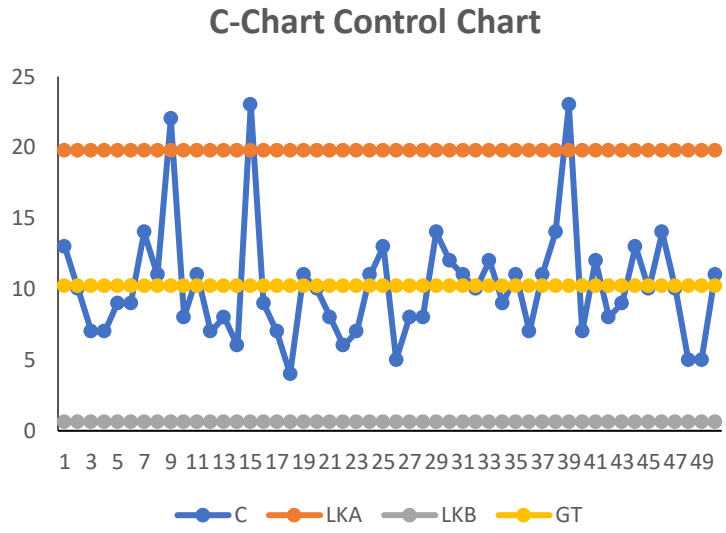

Figure 3. C-Chart Control Chart

Analysis:

The C-control chart demonstrates from the observational data that there are values that surpass the upper control limit, showing that there are mistakes made during the production of "Orange Syrup." It was discovered that the C values for data points 9, 15, and 39, with values of 22, 23, and 23 faults, respectively, exceeded the UCL (Upper Control Limit). A fishbone diagram will then be made to examine the origin and consequences of these product flaws.

F. Diagram *Fishbone*

Here is the use of a cause-and-effect diagram for defects in Content defects, Viscosity level and Cloudy color. Below is the result of the cause-and-effect analysis:

1. Content Defects

Analysis of the cause-and-effect diagram for content defects in orange syrup quality:

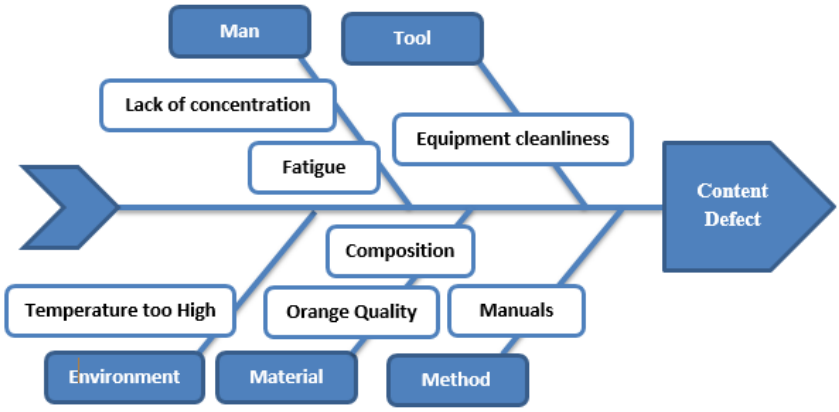

Figure 4. Fishbone Diagram Content Defects

a. Human
Lack of focus during the production process and inspection results in an inappropriate taste in the Orange Syrup product.
b. Material
Poor raw materials and low-quality oranges lead to a deteriorated taste in the Orange Syrup product.
c. Method
Inaccurate mixing proportions and improper timing result in a change in taste in the Orange Syrup product.
d. Environment
Inappropriate room temperature can lead to reduced shelf life quality in the Orange Syrup product.

2. Viscosity Level Defects

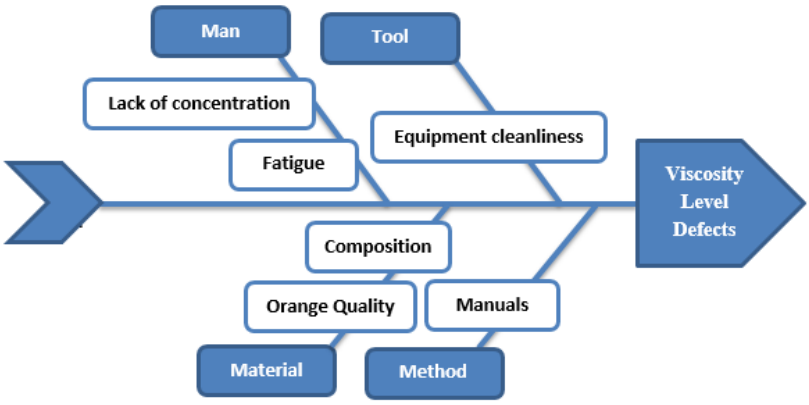

Figure 5. Fishbone Diagram Viscosity Level Defects

Analysis of the cause-and-effect diagram for defects in the viscosity level of orange syrup quality:

a. Human
Lack of focus during the production process, mixing, and inspection results in inappropriate viscosity levels in the Orange Syrup product.
b. Material
The composition of raw materials and low-quality oranges leads to viscosity levels that are not suitable for the Orange Syrup product.
c. Method

Inaccurate mixing proportions and improper timing result in viscosity level changes that are not suitable for the Orange Syrup product.

3. Cloudy Color Defects

Analysis of the cause-and-effect diagram for defects in the cloudy color of orange syrup quality:

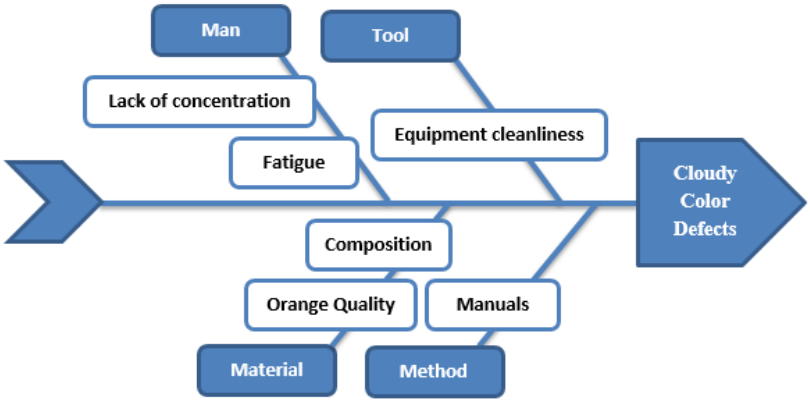

Figure 6. Fishbone Diagram Cloudy Color Defects

a. Human
Lack of focus during the production process and inspection results in inappropriate color in the Orange Syrup product.

b. Material
Poor quality raw materials and low-standard oranges lead to a cloudy color in the Orange Syrup product.

c. Method
Inaccurate mixing proportions and improper timing result in color outcomes that are not suitable for the Orange Syrup product.

G. Kaizen Implementation for Defect Improvement

Use the Kaizen approach to resolve the problems revealed by the cause-and-effect diagram. The Kaizen approach is frequently employed to reduce expenses and accelerate the production of high-quality goods. A crucial component of putting the Kaizen methodology into practice is the 5S (Seiri, Seiton, Seiso, Seiketsu, and Shitsuke). This is an example of a five-S strategy to defect improvement:

1. Seiri (Sort):
Implementing Seiri can be used to address viscosity level defects. The application of the Seiri concept should help avoid viscosity level problems. Suppliers should sort and group items by type and function, such as paying attention to damaged tools, cleaning items used for harvesting, and organizing oranges of good quality.
2. Seiton (Set in Order):
Seiton means arranging or placing materials and items in their designated locations for easy retrieval when needed. This concept can be applied to address cloudy color defects. Workers should apply Seiton to arrange and place materials used for syrup production, saving time, maintaining cleanliness, and facilitating the maintenance of items.
3. Seiso (Shine):
Implementing the Seiso concept can reduce cloudy color defects in syrup. Mistakes such as unclean surfaces and dirty drying areas can be avoided if this concept is properly applied. Seiso, in essence, involves cleaning all facilities and the workspace.
4. Seiketsu (Standardize):
Applying the Seiketsu concept helps minimize defects caused by maintaining cleanliness in the syrup production process. It also ensures compliance with the three previous stages: Seiri, Seiton, and Seiso.
4. Shitsuke (Sustain):
Shitsuke means forming an attitude of compliance with rules. If all employees apply the Shitsuke concept, forms of errors leading to defects can be avoided.

By implementing the 5S methodology within the Kaizen approach, you can enhance product quality and optimize production processes.

CONCLUSION

According to the research, some aspects of the product quality continue to be outside of the scope of control. This shows that the procedure is out of control and straying from the anticipated norms. In the same

way, 99 out of a total production of 1000 units of syrup were discovered to be defective, according to the histogram that was developed. The variables underlying these production process flaws were found through the application of cause-and-effect analysis. These elements come from a variety of sources, such as workers, production equipment, work processes, raw materials, and the workplace environment. The business can use the Kaizen idea to optimize the production process and maintain product quality in order to reduce the sources of faults. The company hopes that by using these techniques, it will be able to maintain and raise the syrup's quality standards.

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