Analysis of Quality Control of Tea Products Using the Fishbone Diagram Approach at Pt Candi Loka, Indonesia

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Original Research Article

ABSTRACT

In the current era of globalization, there are many similar products on the market and most of them have same prices and functions. Thus, the only factor that can be used as a differentiator from similar products is the quality of the products. This research was conducted at PT Candi Loka, which is engaged in agribusiness, namely tea processing. This research aims to (1) determine the problems faced by PT Candi Loka as related to the quality of tea production, (2) identify the factors that most influence the quality of tea at PT Candi Loka, and (3) formulate the most appropriate solution to be applied in an effort to improve the quality of tea production at PT Candi Loka. The basic method in this research was the descriptive method with a qualitative approach. Data analysis was performed through using the techniques of check sheet, stratification, pareto charts, and fishbone charts. The results of this study comprised the Pareto diagram that showed the existence of deviations in the quality of dry tea products produced in March 2022, namely the pekoe products

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had lower quality than the standards set by the company. Check sheets and stratification showed the factors that influenced the quality of tea products at PT Candi Loka, namely (a) human factor, which included: lack of care in applying drying temperature, inadequacy of labor knowledge, lack of worker discipline, the large number of workers who were at unproductive age, lack of work contracts between the plantation foreman and the pickers; (b) raw materials, which included: damaged and rough (old) materials, the large number of plants that were not productive; (c) work method, which included: unstable withering and drying temperatures, non-specialized work systems, sales based on order system; (d) machine, which included: overly old machines, dirty machine conditions; (e) environment, which included: uncertain weather and temperature, decreasing soil fertility. Fishbone analysis was used to determine the most dominant factors in the final product, namely pekoe with inferior standard. The factors that influenced the pekoe products with lower standard consisted of damaged and rough (old) shoots and unstable temperature during processing (withering and drying). From the results of the analysis, recommendations are offered for improvements that can be implemented by PT Candi Loka, namely improving its picking system to improve the quality of raw materials, providing appropriate temperatures at the processing stage (withering and drying) and making quality manuals based on performance.

Keywords: Green tea; quality control; fishbone analysis.

1. INTRODUCTION

Quality is now a major consideration for consumers in meeting their needs. In this era of globalization, there are many similar products on the market and most of them have same prices and functions. Thus, the only factor that can be used as a differentiator from similar products is the quality of the products. Business owners without exception are now competing to attract the attention of consumers by producing or manufacturing a quality product [1]. PT Candi Loka is one of the companies engaged in the tea processing industry, where the raw material, in the form of tea leaves, is produced from its own plantation [2-5]. The production of tea shoots produced by PT Candi Loka from the last few months can be seen in Table 1.

Table 1. Data on tea shoots at PT Candi Loka from July to December 2021

Month	Target (Kg)	Realization (Kg)
July	127,473	192,798
August	132,988	106,946
September	136,575	115,793
October	163,368	100,974
November	189,356	112,126
December	174,698	208.555

From the table it can be seen that the production of tea shoots from July to November 2021 reveals a decreasing number. This was influenced by the lack of control on the quality of tea production, such as the lack of supervision in plant maintenance, so that tea yields decreased. Therefore, the role of the quality control group

[*Gugus Kendali Mutu (GKM)*] needs to be developed to ensure that the quality of tea production is in accordance with predetermined standards, so that the tea produced can continue to increase. The quality of tea production must be improved and maintained regularly and sustainably in order to produce superior quality tea at high prices in the market, both locally and internationally [6-9]. One way to find out the problem causing the decline in the quality of the tea produced is with fishbone analysis. With fishbone analysis, in general analysis could be made of the factors that trigger the occurrence of an effect [10,11]. The effect is influenced by several factors, namely management, people, maintenance, machines, methods, measurements and materials.

2. RESEARCH METHODS

2.1 Data Types and Sources

Primary data constitute the data collected from the first party, usually through interview, questionnaire and others. In this study, the primary data were obtained through interviews using interview guidelines for the parties involved in determining product quality [12].

The secondary data comprised the data that were recorded systematically and quoted directly from the documentation from PT Candi Loka or other institutions that were related to this research to determine the problems at PT Candi Loka. The secondary data we are looking for is data on the quality of tea products for July to Desember 2021, and data on tea quality standards, while the primary data we are looking

for is regarding problems that occur in tea production at PT, Candi Loka.

2.2 Method of Collecting Data

Observation is a data collection technique and it was carried out by studying and making observations directly into the company to obtain evidence that could support and complement the results of research at PT Candi Loka.

Interview is an activity carried out to obtain information directly by asking questions to respondents [13].

Recording was used to collect secondary data, namely by recording existing data from the documentations from PT Candi Loka, government agencies or other institutions related to the research.

2.3 Data Analysis Method

Data analysis in this study was carried out by using four tools, namely check sheets, stratification, pareto charts, and fishbone charts. Pareto charts were used to determine the problems faced. Check sheets and stratification were used to analyze what factors influenced tea quality at PT Candi Loka. Fishbone analysis was used to identify which factors had the most dominant effect on the quality of tea at PT Candi Loka.

2.4 Steps in Data Analysis

The main problem to be investigated at PT Candi Loka consisted of determining the theme and subject matter of the qualities of tea pick and finished tea products that were inferior than standard. The required data were the data on tea production and the data on dry tea analysis at PT Candi Loka.

Analysis was performed on the cause and effect, based on the data, by using fishbone analysis.
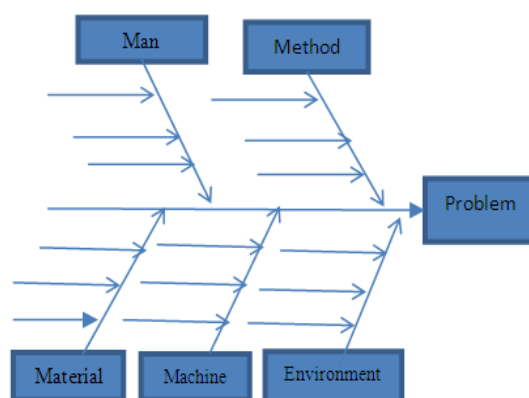The steps in making a fishbone chart

1) Drawing a horizontal line with the arrow tip on the right side and a box containing the problem to be investigated

2) Writing the main causes in the boxes that are connected to the main arrow line
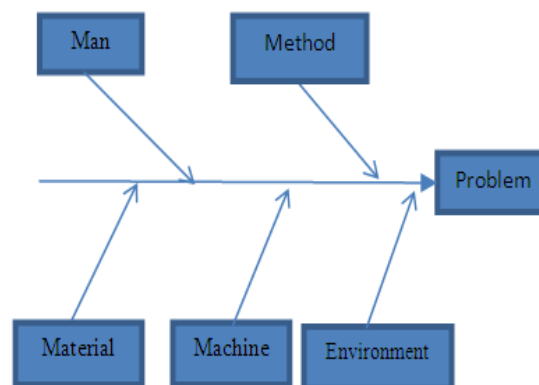
3) Writing the minor causes around the major causes and connecting them with the major causes

The next step was to determine the potential causes of the problems and deciding on the most dominant causes for the encountered problem.

Table 2. Blank data entry of causes of the problems and deciding on the most dominant causes for the encountered problem

No	Observed factors	Occurring problem
1	Man	
2	Method	
3	Machine	
4	Material	
5	Environment	

4)   The last was to determine a solution plan to solve the existing problem.

Table 3. Blank data entry of solution plan to solve the existing problem

No	Observed factors	Occurring problem	Solution plan
1	Man		
2	Method		
3	Machine		
4	Material		
5	Environment		

3. RESULTS AND DISCUSSION

3.1 Research Results and Discussion

The first step was taken to find out the problems with the quality of tea products produced at PT Candi Loka, namely by looking at the quality control of dry tea products and also the control for water content of dry tea. The data on tea product control at PT Candi Loka can be seen in Table 4.

3.2 Determination of Problem (Pareto Diagram)

According to Gitlow and Shelly, in Dita Setyanita, [14], the concept of Pareto pays more attention to important problems, and thus the 80% - 20% concept is formed, in which 80% of the dominant problems come from 20% of the causes of the existing overall causes, where this 20% indicates that the causes of the problem constitutes only a small part of the total causes of the existing problem, and thus the causes that must be corrected are few but could have a big impact.

3.3 Determination of Control Alternatives (Fishbone Diagram)

Fishbone diagram is a graphical technique that is used to sequence and relate the interactions between factors that influence a process.

This diagram is useful for analyzing and finding factors that influence or have a significant effect in determining the quality characteristics of work output.

Table 4. Data on analysis on quality product in June

Standard		Average of Analysis in June (%)
Quality of product	Total (%)	
Pekoe	25	13.36
Jikeng	55	57.14
Kempring	10	13.67
Tulang	10	15.83
Water content	3 – 5	4.58
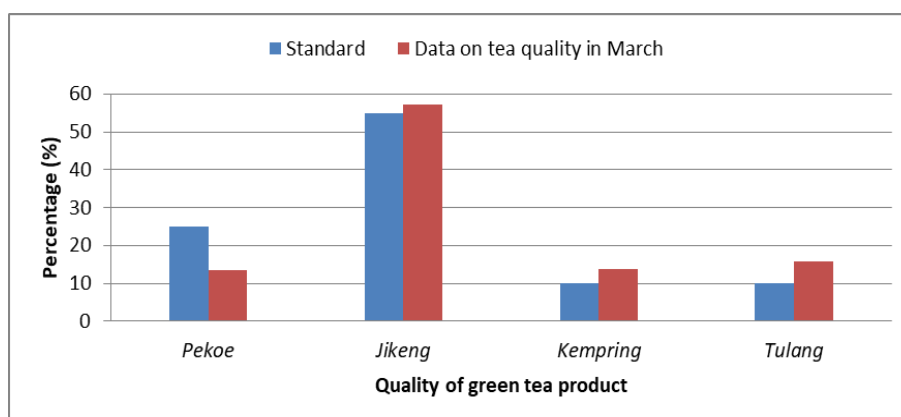
Fig. 1. Pareto diagram on the quality of dry product in March at PT Candi Loka

3.3.1 Pekoe Product was inferior to standard

Fig. 2. Fishbone diagram of Pekoe product that was inferior to standard

Workers were not careful in applying the drying temperature. This was related to the provision of temperature in the drying process. The setting up of this drying temperature also depended on the material to be dried. If the material coming out of the withering machine was too dry, then the material would tend to crumble after leaving the drying process.

Inadequate workforce knowledge. Workers, especially pickers and factory employees, still made many mistakes in picking and processing tea. This was caused by a lack of knowledge among the inadequate workforce.

Lack of Discipline among workers. Many workers and employees often took time off for personal reasons. It also often happened that the pickers came first before the plantation foreman, and thus there was a lack of supervision in picking, which resulted in picking results that did not conform to standards.

Many workers were unproductive. Many of the workers, especially the pickers, were old or no longer in productive age (56 years and over). This greatly affected the productivity of the picks produced. The yields of picks produced by older workers were less than those of workers who were still productive.

Lack of work contracts between the plantation foreman and the pickers. The plantation foreman did not establish work contracts with the tea pickers. Thus, when the tea plants were ready to be picked, the foreman just contacted the pickers, and thus it was not uncommon for the pickers to be unable to work on the appointed day. This resulted in decreased tea production, due to a shortage of pickers. In addition, if a picker usually used was unable to work, the plantation foreman took another who was less skilled and did not know how to pick with good standard.

Raw materials were damaged and rough (old). The method of inserting shoot raw materials and the careless method of transportation caused the shoots to be damaged or torn, making it difficult for the shoots to roll up. In addition, the shoots received preliminary treatment before entering the withering process, namely by spreading the shoots on the floor; as a result, many shoots were damaged due to being stepped on by the workers. The old or rough raw material production was caused by the pickers who paid less attention to the recommended picking system [15,16]. They only cared about the volumes of products in order to get high wages. They often picked arbitrarily and paid less attention to the smoothness and dryness of the leaves.

Many plants were not productive. This was due to the lack of supervision from the plantation foreman to each plant, and the fact that most of the plants were passed on from the Dutch era. These had an impact on the results on the picking of the shoots, in that the tea shoots that were produced were few [17,18].

Withering and drying temperatures were unstable. The application of temperatures that were too high would cause the product to crumble and also cause the product to shrink. In addition, drying temperatures that were too high would also cause the product to burn (case hardening).

Unspecialized work system. Absent workers were often replaced by other employees. This resulted in ineffective and unspecialized work. This could lead to chaotic work because work that should be completed quickly took too long to finish and the results were not optimal.

Sales based on order system. Sales by PT Candi Loka were based on order system or orders from buyers. Sales with order system were not very effective, because PT Candi Loka processed tea every day. Therefore, if there was excess product, it would only be stored in the warehouse and this could lead to a decrease in the quality of the tea.

Overly old machine. Old machines could affect the resulting product. These machines often did not function optimally; for example, a machine could suddenly jam, so that the product stayed in the machine for too long and this caused the tea product to burn.

Dirty engine condition. The dirtiness of the machine was caused by the presence of dust that stuck to the machine and, eventually, deposit occurred on the machine [19,20]. This settled dust would indirectly increase the heat of the machine, generated the temperature to be too high inside the machine and caused the product to burn after coming out of the drying process.

Uncertain weather and temperature. Lack of sunlight or overly hot weather would inhibit the metabolic processes in the plant body. Meanwhile, the desired rainfall for tea plants is at least 60 mm/month, and thus long dry spells could cause the plants to be deprived of water and thus the resulting productions were low and some were not even producing.

Soil conditions that were decreasing in fertility. This was influenced by erratic weather. Late application of fertilizer would also affect the production of these plants. This had an impact on the continuity and quality of the raw materials (tea shoots) produced.

3.4 The Most Dominant Causes and Mitigation Plans

After investigating the causal factors of the problems that occurred at PT Candi Loka, the next step was to determine the potential causes of the problems and decide on the most dominant causes of the problems. Based on the

results of interviews and small discussions carried out by the researchers with the company, the most dominant causes of some of the existing problems were obtained.

The most dominant causative factors were damaged and rough (old) shoots and unstable temperature during processing (withering and drying). Then, the countermeasures plan, based on these factors, which could be taken by the company, is as follows.

3.4.1 Reducing damaged and rough (old) shoots

In order to reduce the number of damaged and rough (old) shoots, it is necessary to improve the picking system, namely by increasing supervision by the picking foreman -through giving advice, or reprimand if necessary, to pickers to carry out the picking of shoots according to what has been recommended by the company, as well as imposing deductions for workers for picking results that do not follow predetermined picking standards. In addition, it is also necessary to improve the system for transporting the shoots from the plantations to the factories; specifically, in carrying out the transportation the workers should not be allowed to sit on or step on the shoots that are transported, so as not to damage the picked tea shoots.

3.4.2 Applying unstable temperature at the processing stage (withering and drying)

Control needs to be done so that the temperature remains stable, through measures such as using a *thermo control* (device for measuring and maintaining temperature) and giving the appropriate temperature. The temperature used in the withering process is 90ºC - 110ºC, while for the drying process, the initial/inlet temperature is 130ºC – 140ºC and the outlet temperature is 50ºC – 60ºC. In addition, what needs to be considered is to avoid putting in the dried shoots that have just come out from the ECP (Endless Chain Pressure Dryer) machine or the initial drying machine, because the dried shoots that enter first will dry faster and the drying will be uneven, and this will affect the quality of resulting dryness. It would be good if the dried shoots that come out of the ECP machine could be laid out first and when the dried shoot amount has reached the capacity of the final drying machine, then the dried shoot material is put into the final drying machine.

4. CONCLUSION

The pareto chart shows that there were deviations in the quality of dry tea products produced in June 2021, namely, that the *pekoe* products fell below the standards set by the company.

The factors that influenced the quality of tea production at PT Candi Loka consisted of: (a) man (human), which included: lack of caution in applying drying temperature, inadequate knowledge of the workforce, lack of worker's discipline, large number of unproductive workers, lack of work contracts between plantation foreman with pickers; (b) material (raw material), which included: damaged and rough (old) raw material, large number of unproductive plants; (c) method (work procedure), which included: unstable withering and drying temperatures, non-specialized work system, sales based on order system; (d) machinery, which included: overly old machines, dirty machine condition; (e) environment, which included: uncertain weather and temperature, soil condition that was decreasing in fertility.

Fishbone analysis was used to determine the most dominant factor in the final product, namely *pekoe*, which was inferior to the standard. Factors that influenced sub-standard *pekoe* products were damaged and rough (old) shoots and unstable temperature during processing (withering and drying). From the results of this analysis, recommendations are offered for improvements that can be implemented by PT Candi Loka, namely, improving its picking system to improve the quality of raw materials, providing appropriate temperatures at the processing stage (withering and drying) and making quality manuals based on performance.

5. SUGGESTION

There should be an increase in the provision of advice, reprimand (if necessary), as well as supervision from the picking foreman to improve the quality of the raw materials produced. There should be improvements in processing such as temperature control, so that dry tea is obtained according to predetermined standards. It is necessary to make graphs for controlling the quality of tea products manufactured, to

make it easier to monitor the process from time to time. There is a need to make a quality manual based on performance, so that all aspects of the company can run well and as expected.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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