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The combination of the kaizen approach with the Design of Experiment (DoE) method for improving quality of the bread and donut products in SMEs

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ABSTRACT

Competition for Small and Medium Enterprise (SME) products is currently getting tougher, in terms of quality, timely delivery, and competitive prices. SME customers of bread and donut products sometimes complain about the visual quality of bread and donut products that are stale, burnt, and dirty. The purpose of this research is to reduce product defects during the production process and improve the quality of the bread and donut products. This research method uses a Kaizen approach combined with the Design of Experiment (DoE) one-shoot case study method and uses organoleptic tests to assess the quality of bread and donut products. This study found that there were 3 product defect problems, namely bread and donut defects that failed to rise, dirty bread and donuts, and burnt donuts. This research resulted in a decrease in defects of 65% from 3.84% to 1.07%. While the best DoE test results used dough type C with 10 grams fermipan/yeast composition and 15 grams bread improver, stove 165-175^{0}C, equipment cleaning frequency 1 time for each dough, and organoleptic test with 10% beetroot extract addition resulted in a color aspect score of 70 %, 65% aroma aspect, 68.5% texture aspect, and 70% taste aspect which is liked by many people.

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1. INTRODUCTION

Competition for Small and Medium Enterprise (SME) products is currently getting tougher, in terms of quality, timely delivery, and competitive prices [1]. SME customers of bread and donut products sometimes complain about the quality of bread and donut products. Complaints from customers are in the form of information through several media, for example in the form of photos, via Short Massage Service (SMS), and verbal information when there is a product reorder [2].

Delivery of SME product types of bread and donuts works together with the marketplace application or you can directly contact the marketing department of the SME [3]. The purchasing service work system uses the First Order First Delivery (FOFD) system [4]. So far, there have not been too many complaints about shipping because the SME marketing department is always on standby and ready to take good action in

responding to customers or delivery strategies [5]. Meanwhile, regarding the price of bread and donut SME products, they have prices that are affordable to the nearest community, around 4-5 km from the bread and donut SME products.

This research focuses on improving the quality of bread and donut products which experience a decline in quality in terms of products that fail to rise, dirty products, and burnt donuts. This can be seen in the problem phenomenon that has occurred in bread and donut SMEs so far which has resulted in defects of 3.84% every day (Table 1). Therefore, researchers working with bread and donut SMEs are enthusiastic about trying to reduce defects in bread and donut products with a target of reducing them by 65%.

The quality of a product is very important for the development of a company and is the main key for the company to obtain large sales and profits [6-7]. However, problems often arise in the production process, usually, there are damaged/defective products. So it requires steps or efforts to solve these problems so that product quality can be maintained properly [8].

Quality is needed by every company that processes raw materials into a product that can later meet consumer needs. Companies need to prioritize the quality of the products they make so that they can be accepted by end consumers [9]. Quality is also one of the most important consumer decision factors in choosing the product they want, choosing a quality product or service will increase customer loyalty [10].

Henceforth, in addition to the many product defects, the quality of taste, color, texture, and aroma must be improved. Therefore, the researchers also conducted experimental designs on dough using beet juice [11]. The bits used are in the form of juice obtained from crushing beets to produce beet juice with a semi-liquid texture. Wild beet species are believed to originate from parts of the Mediterranean and North Africa with an eastward distribution to the western regions of India westward to the Canary Islands and the west coast of Europe including the British and Danish islands. The beet used in this study was a type of Beta vulgaris L whose root is red. The beetroot is round or resembles a top, but some are oval, and the end of the beetroot has roots [12].

Formulation of the problem of the causes of product defects in bread and donuts, it is not yet known how to prevent product defects in bread and donuts from occurring, and quality improvements must be made to attract more consumers. The new approach of this research on SME product types of bread and donuts is to improve the quality using a combination of the Kaizen approach and the Design of Experiment (DoE) method. The Kaizen approach uses several improvement tools including Pareto diagrams, Fishbone diagrams, why-why analysis, and 5W+1H. The DoE method for quality improvement uses a one-shot case study experimental design, organoleptic tests, and radar diagrams. Another study to control the quality of bread products in the manufacturing process using the Statistical Quality Control (SQC) method [13]. The reason for choosing the Kaizen approach is compared to the SQC method because, with the Kaizen approach, researchers can start identifying problems by tidying up the workplace, finding potential defects, and expressing ideas for improvement. Meanwhile, the use of SQC is only a data collection and processing technique so it is less effective in solving problems and taking corrective action. The purpose of this research is to reduce product defects during the production process and improve quality based on aspects of color, aroma, texture, and taste of the bread and donut products.

2. MATERIALS AND METHODS

This research method uses the Kaizen approach which consists of improvement tools such as Pareto diagrams, Fishbone diagrams, why-why analysis, and 5W+1H. This Kaizen approach is combined with DoE and organoleptic. This type of research includes the type of mixed method research in which data collection is in the form of quantitative and qualitative [14]. Quantitative research methods emphasize the objective and scientific measurement aspects of the phenomena or problems found [15]. The data obtained comes from primary data in the form of experimental data on direct field observations [16]. Secondary data was obtained from the population who filled out the organoleptic test questionnaire, totaling 40 respondents.

The proper research design in this research is exploratory descriptive research which aims to describe the state of a phenomenon [17]. The exploratory descriptive research method is obtained by describing a situation where production defects occur to comprehensive corrective actions using the Kaizen approach in reducing defects and using the DoE method to find out the results of a combination of experiments on dough composition, oven temperature, and equipment cleaning frequency.

The method/technique needed in data collection used in this study is observation, because the type of data is primary data and the type of defect attributed to the failure of the bread and donut production process, so the data obtained is in the form of quantitative data. Qualitative data was obtained from brainstorming or interviews when conducting a cause-and-effect analysis using a Fishbone diagram [18]. The limitation of this research is that it was conducted on UKM Bagus Bakery products with types of bread and donuts located in Klari, Karawang, West Java. Meanwhile, sample data for rejected products was only taken 12 working days, both before and after repairs, and the number of respondents was only 40 people who came from the community closest to the UKM location. This research also has the limitation of only considering the production process of making bread and donuts before adding flavoring. The research steps can be seen in Figure 1.

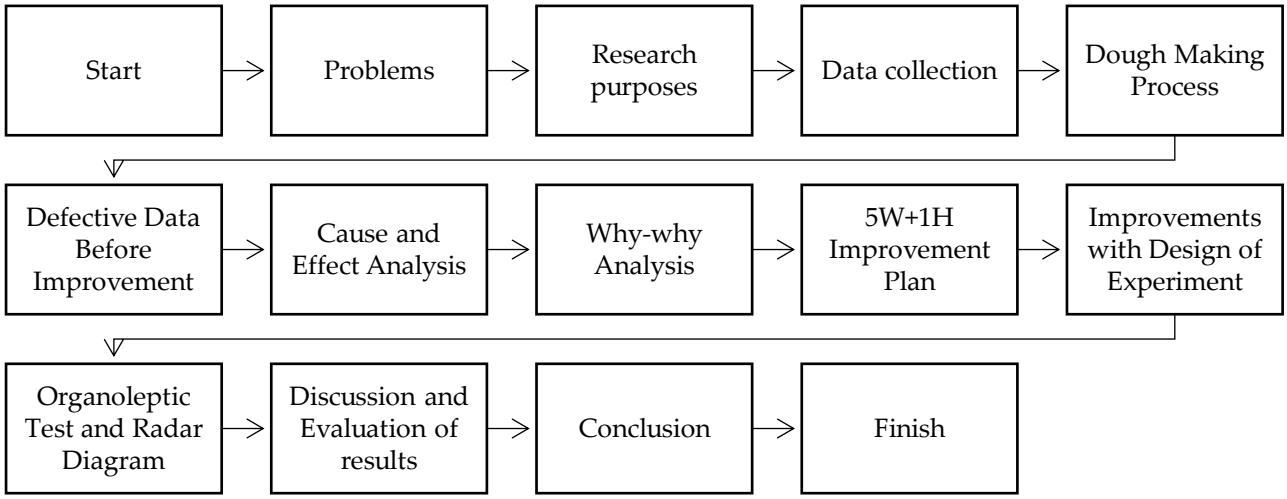

Figure 1. Research Framework

Based on Figure 1 after determining the problem and research objectives, the next step is data collection in the form of a dough-making process, defective data before improvement using a Pareto diagram to determine the dominant problem, causal analysis using a Fishbone diagram [19-20]. To find out the percentage of product defects obtained, the formula used is:

$$\text{Defect (\%)} = \frac{\text{Defect (pcs)}}{\text{Defect (pcs)} + \text{Production (pcs)}} \quad (1)$$

In equation 1, calculating the % of defects must include dividing total defects by total production. This is because defects (pcs) are products that fail to be produced so they must be supplemented with good production (pcs). The next step is to analyze some of the causes of the problem by using why-why analysis to find out the root of the problem. After that, a countermeasures plan was carried out using the 5W + 1H method. The next stage is to carry out experiments using the one-shot DoE method, with three variable combinations of dough composition, oven temperature, and equipment cleaning frequency. The first experiment was by varying the dough composition with three different fermipan/yeast and bread raiser compositions for three days. The second experiment involved varying the frequency of cleaning equipment for making bread and donut dough for six days and finally, the third experiment involved varying 3 temperatures for ten days. After that, organoleptic tests were carried out to determine the level of product preference from the composition of the dough made, and then a radar diagram to make it easier to determine which composition would be best [21].

The procedure for experimenting is the steps that have been determined in experimenting with bread and donut dough with the addition of beetroot extract of 5%, 10%, and 15%. Subjective assessment is an assessment of the quality or characteristics of a commodity by using panelists as instruments or tools. This method is also used to collect data about the preference level of bread and donuts. The subjective assessment was used using 1 method, namely the organoleptic test. This organoleptic test uses five categories of preferences and gives a score. The assessment criteria can be seen as follows: Score 5 is very like, Score 4 is like, Score 3 is quite like, Score 2 is not like enough, and Score 1 is not like. To find out the number of scores obtained, the formula used:

$$\text{Total Score} = \text{Number of Respondents x Score} \quad (2)$$

The final step is the discussion and evaluation of the results by comparing the data before and after the improvement [22].

3. RESULTS

This section will discuss the results of several analyses that have been carried out, as well as discussions regarding the results that have been achieved.

3.1 Sequence of Bread Dough and Donut-Making Process

The dough for bread and donuts was originally the same, consisting of ingredients such as flour, sugar, sucrose, chicken eggs, butter, yeast, water, salt, and condensed milk. Some of the equipment used includes mixers, ovens, digital scales, basins, stoves, spatulas, measuring cups, and breadproofers [23]. The process of making bread dough and donuts can be seen in Figure 2.

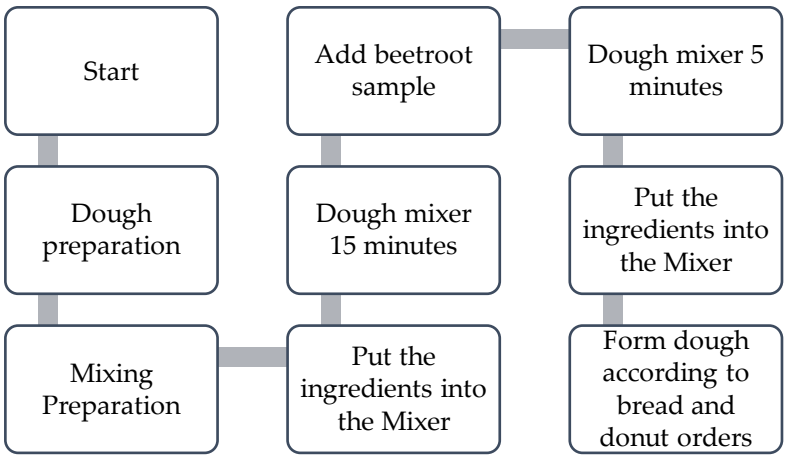

Figure 2. The Flow of Bread Dough and Donut-Making Process

In Figure 2, the process of making donuts and bread is carried out by three people and once they make the dough, which weighs 3 kg for 50 dough and is divided by two for donuts and bread. The process of making bread is 1 hour. The process of making donuts is 1 hour and 20 minutes. After the dough form is prepared, the next step is making bread. First, put the bread filling according to the order, steam the bread for 10 minutes, after rising the bread in the oven for 10 minutes, after it is in the oven, spread the bread with a liquid blue band, then check the bread for defects. If the product looks defective, then let it stand for 5 minutes, fix it and pack it. If the bread product is OK then let it rest for 5 minutes and pack it. Meanwhile, for the donut dough that has been formed donuts, the next step is to let stand for 30 minutes, after expanding, fry the donuts to a golden brown color, drain the donuts for 10 minutes, spread the donuts with a liquid blue band, then top the finished donuts according to the order. After that, check the quality of the donuts, if the donuts are defective, let them rest for 5 minutes, fix them, and pack them. Meanwhile, if the donut product is OK, then let it rest for 5 minutes and pack it.

3.2 Defective Data Before Improvement

This section collects data on the results of bread and donut quality inspections, which are carried out for 12 working days. The results of the quality inspection of bread and donut products can be seen in Table 1.

Based on Table 1, 12 days resulted in defects of 3.84% per day. This is very detrimental to the MSME types of bread and donuts. In order from the largest defect to the smallest defect, the bread and donuts failed to rise by 1.47%, dirty bread and donuts by 1.31%, and burnt donuts by 1.16%.

After obtaining the types of defects in bakery and donut products, a Pareto diagram is made to facilitate the most dominant defects and then all defects can be improved [24]. The Pareto diagram can be seen in Figure 3.

Table 1. Defect Data Before Improvement

Working days	Number of production (pcs)	Criteria reject (pcs)				% Daily Defect
		Dirty	Failed to rise	Burnt donuts	Number of defective products	
1	317	2	7	4	13	3.94%
2	410	6	8	3	17	3.98%
3	285	3	6	4	13	4.36%
4	515	5	3	5	13	2.46%
5	420	4	4	2	10	2.33%
6	410	10	7	6	23	5.31%
7	319	7	4	3	14	4.20%
8	355	6	6	4	16	4.31%
9	327	4	3	7	14	4.11%
10	412	5	7	2	14	3.29%
11	420	3	6	8	17	3.89%
12	420	6	8	6	20	4.55%
Amount	4,610	61	69	54	184	3.84%
% Total		1.31%	1.47%	1.16%	3.84%	

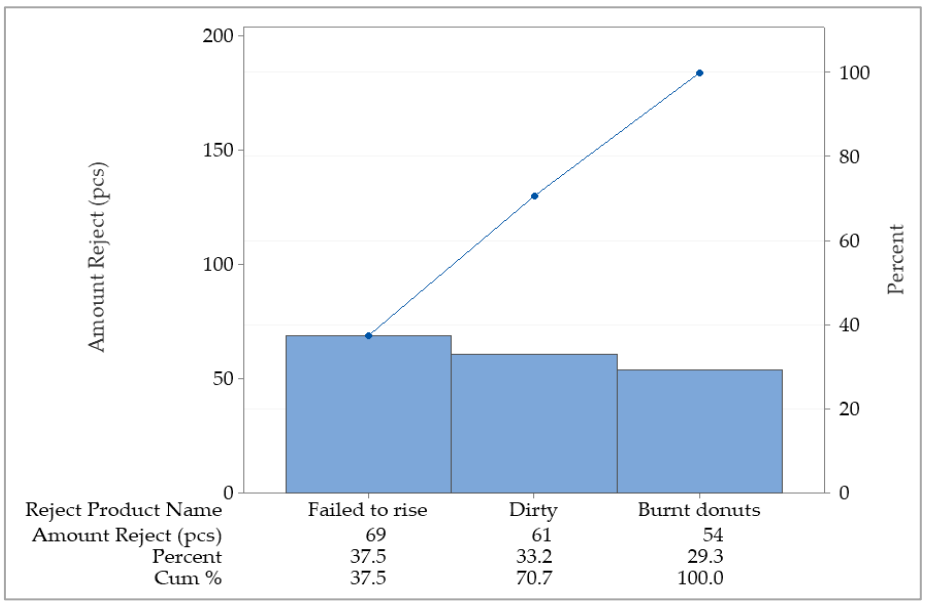

Figure 3. The Bread and Donut Defects Before Improvement

3.3 Cause and Effect Analysis

In this section, we will discuss the causes and effects of defective products from any problems that arise during the production of bread and donuts. For the Fishbone diagram, the bread and donuts failed to rise (Figure 4), the dirty bread and donuts (Figure 5), and the burnt donuts (Figure 6).

Based on Figure 4, the material factor, namely the use of yeast and bread improver as a dough developer, is not always according to the dosage [25]. Environmental factors, namely the temperature of the dough are too hot due to placing the dough near the stove and oven that is on. The engine factor is the problematic oven, using an ordinary oven, the result is that the oven temperature is out of control because it is not known what temperature is used.

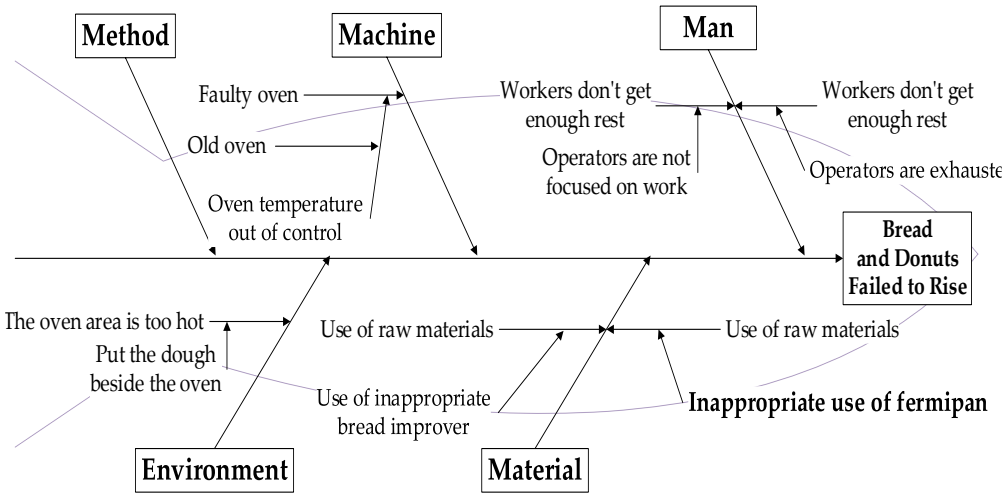

Figure 4. The Bread and Donuts Failed to Rise

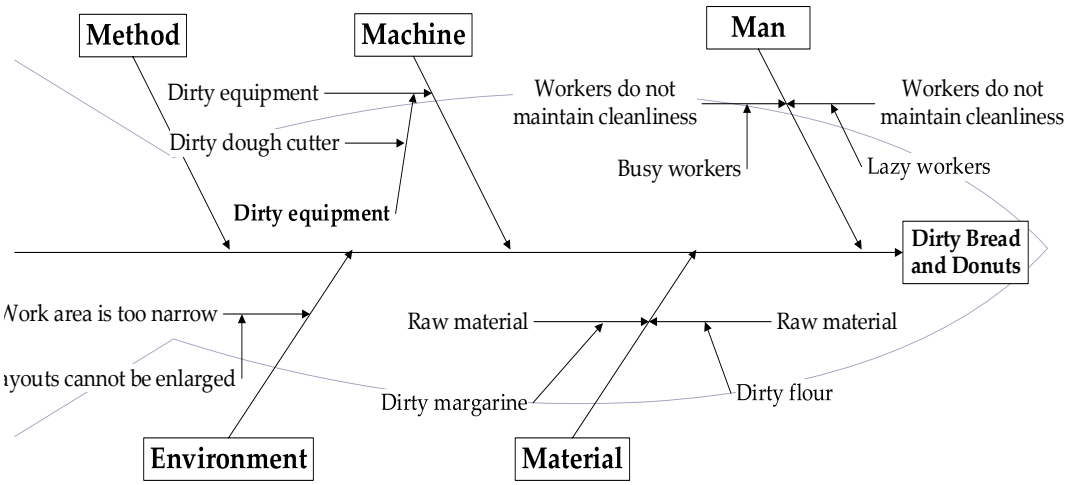

Figure 5. The Dirty Bread and Donuts

Based on Figure 5, the environmental factor of the workplace is too cramped in the home kitchen, the dough and the finished bread are placed close together, near the work tools that are still dirty, causing the bread and donuts to be dirty. The production flow should always be cleaned in the production area every time you want to make new dough and make the initial process new so that the dirt in the machine and work area is not too dirty. Machine factors, namely equipment such as dirty mixers, dirty knives for cutting dough, and dirty bread containers cause dirty bread [26].

Based on Figure 6, the engine factor is equipment, when turning on the stove, make sure the flame temperature used is balanced with the oil used so that the oil temperature is not too high. The method factor is the method of frying the donuts, using less oil can cause the oil to heat up quickly and the donuts burn quickly because the oil is too hot the temperature used when you want to fry the donuts must always be checked because if the temperature used is too hot it can cause the surface of the bread to burn quickly [27].

3.4 Why-Why Analisis

After conducting a causal analysis through a Fishbone diagram, the next step is to analyze each factor that causes the problem by using why-why analysis [28]. Why-why analysis needs to be done when making a Fishbone diagram, the more causes discussed, the better the potential for finding the root of the problem. The results of the why-why analysis can be seen in Table 2.

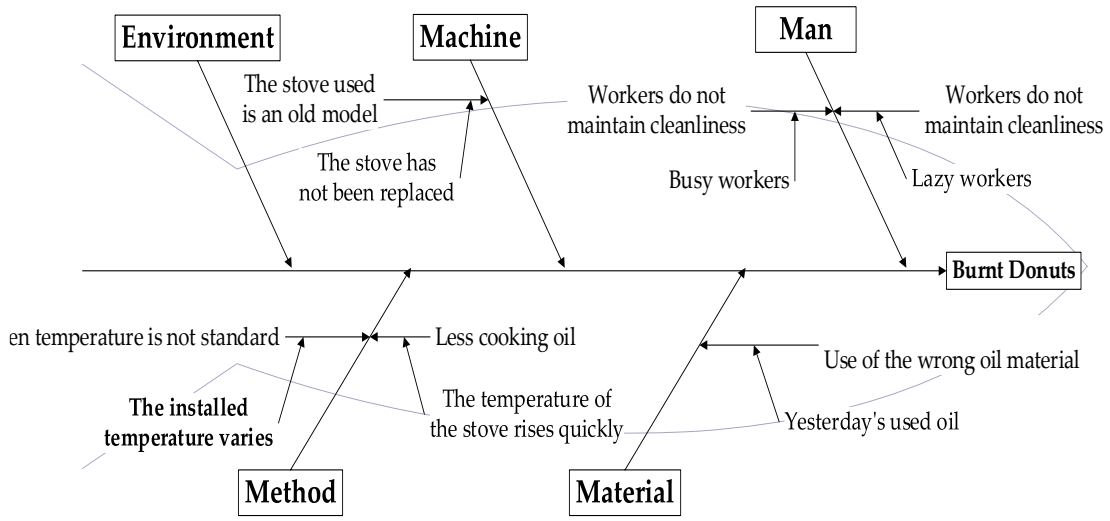

Figure 6. The Burnt Donuts

Table 2. Why-Why Analysis of the Fishbone Diagram

Problem Description	5M	Potential Causes				
		Why 1	Why 2	Why 3	Why 4	Why 5
The bread and donuts failed to rise	Material	The yeast composition is not suitable	The use of yeast has not been measured	Trials of yeast compositions have not been carried out	It is necessary to trial the composition of the yeast	Yeast composition reference has not been established
Dirty bread and donuts	Environment	Narrow work area	Equipment is stored near the production area	Equipment inspection has not been carried out	Need to trial the washing frequency of the tool	Reference in equipment cleanliness
Burnt donuts	Machine	Heater temperature varies	The stove is old	Haven't done a temperature trial yet	Need to trial temperature variations	Temperate temperature references have not been made

3.5 5W+1H Improvement Plan

The 5W+1H method is a structured method, a tool to generate ideas by using a series of questions related to the problems or objectives set [29]. This tool encourages the team to pay attention and inquire about every aspect of a problem or goal to be solved [30]. The results of the countermeasures plan can be seen in Table 3.

3.6 Improvements with Design of Experiment (DoE)

DoE is used to plan and conduct experiments as well as analyze and interpret data obtained from experiments [31], [32]. In this research, the DoE one-shot case study method was used, and experiments were carried out on 3 variables. The first experiment varied the composition of the dough with 3 conditions, namely 7 grams, 8 grams, and 10 grams of fermipan/yeast. The second experiment was with variable frequency of cleaning equipment for making bread and donut dough. which consists of 1 day x 1 net clean, 3

dough x 1 clean, 2 dough x 1 cleaning, and 1 dough x 1 clean. The third experiment was a combination of 3 temperature variations including 165~175°C, 175~185°C, and 200~210°C.

Table 3. 5W+1H Improvement Plan

No	What What is the problem?	Why Why must be handled?	When When will it be implemented?	Where Where is it implemented?	Who Who is in charge?	How How to deal with it
1	The bread and donuts failed to rise	Due to the use of 20 grams of yeast and 7 grams of bread improver	Jan 2023	When making the dough	Hariyanto	Changing the dosage of yeast into several variations by experimenting with 3 variations
2	Dirty bread and donuts	Because he cleans the work area after a day's production	Mar 2023	During the process of washing the means of production	Sri Wahyuni	Carry out cleaning of work equipment and try several washing frequencies on product quality
3	Burnt donuts	Due to the previous use of oil temperatures from 175~185°C	Feb 2023	During the process of frying donuts	Bagus	Checked the oil temperature, and used to try the oil temperature into 3 temperature variations

3.6.1 Material Factor Trial on Bread and Donuts Failed to Rise

In the trial, the material factors that affected the development of the dough were yeast and bread improver where in each dough making the use of yeast was 20 grams, and 7 grams of bread improver in 1 dough = 50 bread doughs. Then a material factor trial was carried out, namely by making a dough composition **(**Table 4).

Table 4. Result of Reject Test of Material Factors

Dough	Fermipan /yeast	Bread Improver	Days to	Production amount (pcs)	Number of rejects (pcs)	% Defects
A	7 gram	20 gram	1	300	14	4.46%
B	8 gram	22 gram	2	320	20	5.88%
C	10 gram	15 gram	3	380	3	0.78%

Based on Table 4 that the trial was carried out for 3 days of production with 3 different compositions of fermipan/yeast and bread improver, it can be ascertained that the composition of Dough C with 10 grams of fermipan/yeast and 15 grams of bread improver produces a slight reject compared to Doughs A and B.

3.6.2 Environmental Factor Trial on Dirty Bread and Donuts

In this trial the researchers will add activities to clean the equipment and work area every time the production of dough C is finished, usually what is done in this SME is cleaning the equipment and work area after one day's production is finished. then a trial was carried out with 4 different conditions which can be seen in Table 5.

Based on Table 5, carrying out a schedule for cleaning the work area at 1 time and making the dough process produces the least rejects compared to other cleaning schedules. The more often the work equipment is cleaned, the smaller the potential for defects in the product

Table 5. Result of Reject Trial of Environmental Factors

Working days	Day to 1	Days to 2	Days to 3	Days to 4	Days to 5	Days to 6	Total Reject (pcs)
Clean schedule	Amount Reject (pcs)						
1 day x 1 net clean	10	9	9	8	6	7	49
3 dough x 1 cleaning up	6	8	4	5	6	7	36
2 dough x 1 cleaning up	4	2	2	3	5	3	19
1 dough x 1 cleaning up	1	2	1	0	1	2	7

3.6.3 Machine Factor Trial on Burnt Donuts

In this trial, measurements were made at the temperature of the oil when frying the donas, the normal temperature used was 175~185°C using Dough C. The three temperature variations can be seen in Table 6.

Table 6. Stove Temperature Trial on Dough C

Dough	Total Production	165~175°C	175~185°C	200~210°C
1	20	1	2	20
2	20	1	2	10
3	20	0	3	5
4	20	1	1	16
5	20	1	2	6
6	20	0	1	15
7	20	1	1	6
8	20	1	2	15
9	20	1	1	6
10	20	0	2	18
Total	200	7	17	117

Based on Table 6, explains that the number of defects based on temperature consists of the number of defects in donuts baked in dough C using a temperature of 165~175°C with several defects totaling 7 pcs for 10 dough making.

3.7 Organoleptic Test and Radar Diagram

The organoleptic test was carried out to determine the level of people's preference for dough C bread and donuts using a variation of the test beet juice where panelists were asked to provide personal responses about likes or dislikes and their levels. Based on the test results of 40 untrained panelists, can be seen in Table 7.

Based on Table 7, the best composition of beet juice is 10% which results in a preference level for this product of 68%. The use of beetroot extract can also function as a substitute for potassium levels, and betalain pigment levels to determine organoleptic quality which includes texture, color, taste, and aroma in jelly candy products [33]. The Radar diagram for each composition of beet juice and the assessment of 4 variables namely color, aroma, texture, and taste can be seen in Figure 7.

Based on Figure 7, the color and aroma variables produce beetroot extract 10% better than other beetroot extracts. Meanwhile, other assessment levels such as texture and flavor can be seen in Figure 8.

Based on Figure 8, the composition of 10% beetroot extract produces a better total preference score than the other compositions of beetroot extract. The use of Radar diagrams as a comparison of several variables that are close to the target, so that the results can be easily observed and decided [21].

Table 7. The Organoleptic Test Result

Assessment (Score)	Sari Bits 5%				Sari Bits 10%				Sari Bits 15%			
	Color	Aroma	Texture	Flavor	Color	Aroma	Texture	Flavor	Color	Aroma	Texture	Flavor
1												
2	2	4	3	8		4			2	1	2	2
3	28	22	31	22	25	23	29	20	30	28	28	26
4	10	14	4	7	10	12	5	20	8	11	10	8
5			2	3	5	1	6					4
Total	40	40	40	40	40	40	40	40	40	40	40	40
Total score	128	130	125	125	140	130	137	140	126	130	128	134
% Score	64%	65%	63%	63%	70%	65%	69%	70%	63%	65%	64%	67%
Average	64%				68%				65%			

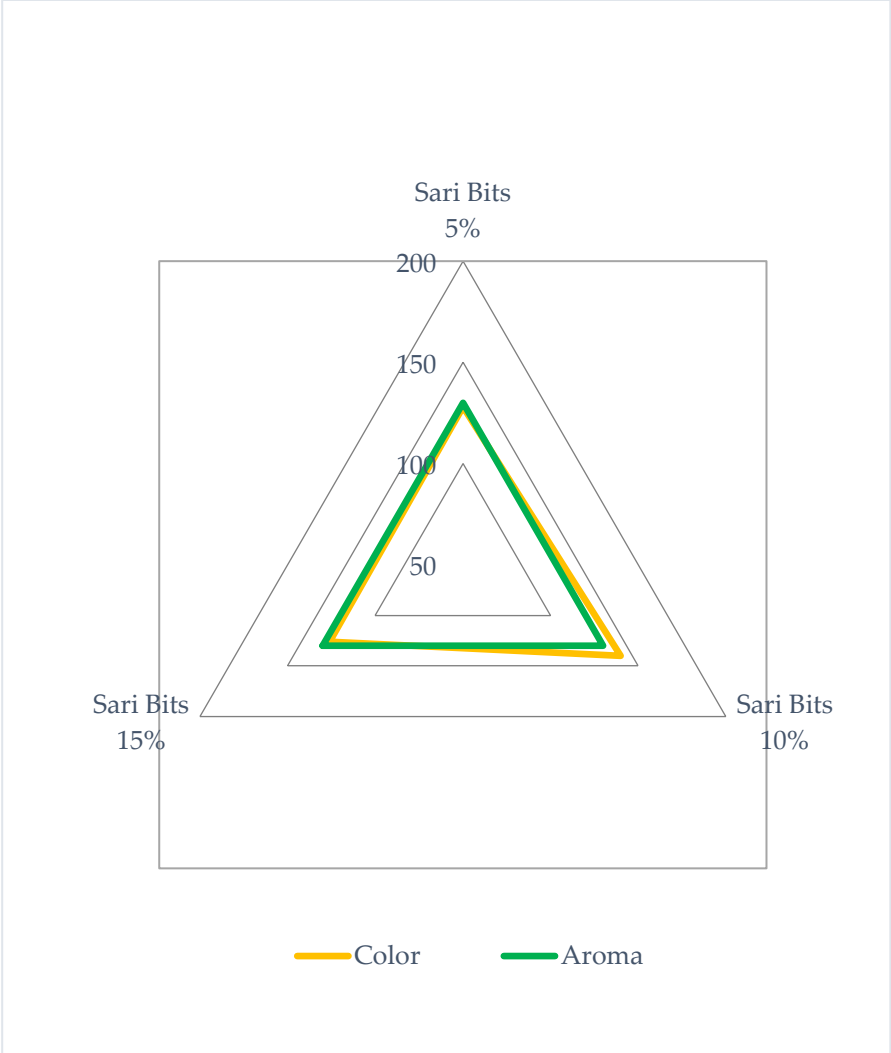

Figure 7. Radar Diagram of Color and Aroma

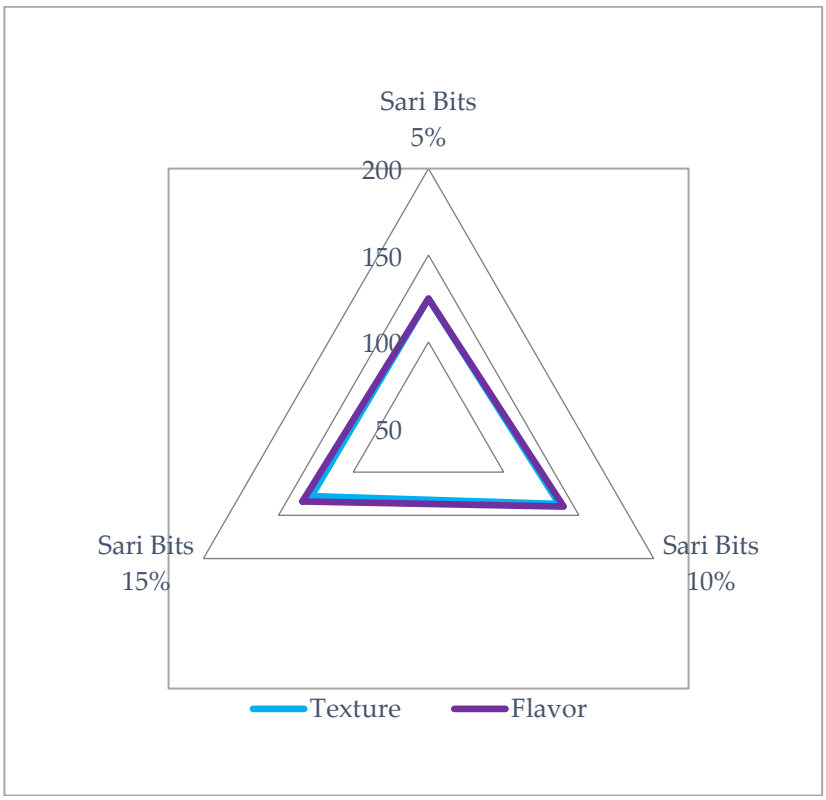

Figure 8. Radar Diagram of Texture and Flavor

Table 8. Total Score of Dough C Assessment Using Sari Bits Variation

Indicator	Sari Bits 5%		Sari Bits 10%		Sari Bits 15%	
	% Score	Criteria	% Score	Criteria	% Score	Criteria
Color	64.0	Enough like	70.0	Like	63.0	Enough like
Aroma	65.0	Enough like	65.0	Enough like	65.0	Enough like
Texture	62.5	Enough like	68.5	Like	64.0	Enough like
Flavor	62.5	Enough like	70.0	Like	67.0	Enough like

4. DISCUSSION

4.1 The Comparison of Community Organoleptic Tests on Bread and Donuts with 10% Sari Bits Composition

On the color indicator, it can be seen that many people prefer dough (B) due to the addition of beet juice which changes the color of the bread and donut dough to reddish purple. This is caused by betalain pigments which are a combination of betacyanin pigments and betaxanthin yellow pigments. The content of betalain pigments present in beets will result in the final color of the experimental results of bread and donut products. Color is the first appearance that greatly influences consumers to choose a product. The function of color in a portion of food is very important because it can affect consumer tastes and can arouse appetite [33].

In the aroma indicator, it can be seen that the community has the same value on the aroma. This is due to the use of yeast in the same dough, namely using 10 grams of yeast for each dough, this 10 grams of yeast was obtained from a composition test to reduce the previous NG. Yeast Alone Functions as a developer, is essential for fermentation, and produces alcohol, heat, and flavor. Lactic acid and acetic acid produced during fermentation make the dough more pliable (mellowing) or conditioning gluten fermentation will also produce a characteristic aroma of bread [25].

In the texture indicator, it can be seen that many people prefer Dough (B). but the value is not much different from the other dough because the addition of beet juice in the process of making bread and donuts does not affect the results of the bread and donuts produced, especially for the quality of the texture.

On the taste indicator, many people like dough (B). This is due to dough (B), the addition of beet juice is moderate compared to other samples, so it does not affect the taste of the experimental results of bread and donuts. Beetroot juice has a slightly astringent taste, so if used in small amounts it does not affect the taste of the bread and donuts, conversely, if you add a lot of beetroot juice, it will affect the taste of the bread and donuts. This is because the use of excess eggs can give a savory taste when mixed with sugar. on the dough if too little can give a bland taste to the dough [23].

4.1 Outcome Evaluation

This section will discuss the evaluation of the results of the percentage of production defects after improvement using dough composition C with 10 grams of fermipan and 15 grams of bread improver, stove temperature with a setting of 165~175°C, washing work equipment every time the dough is made and the use of bits extract as much as 10%. The results of the inspection of product defects on bread and donuts carried out for 12 days can be seen in Table 10.

Table 10. Product Defect Inspection Results After Improvement

Working days	Number of production (pcs)	Criteria reject (pcs)				% Daily Defect
		Dirty	Failed to rise	Burnt donuts	Number of defective products	
1	343	1	1	3	5	1.44%
2	444	1	2	1	4	0.89%
3	311	2	1	1	4	1.27%
4	541	1	2	2	5	0.92%
5	440	3	1	1	5	1.12%
6	456	2	1	2	5	1.08%
7	347	1	2	1	4	1.14%
8	387	2	1	2	5	1.28%
9	355	1	2	1	4	1.11%
10	440	1	2	1	4	0.90%
11	454	1	2	1	4	0.87%
12	460	2	2	1	5	1.08%
Amount	4,978	18	19	17	54	1.07%
% Total		0.36%	0.38%	0.34%	1.07%	

Based on Table 10, the total product defects produced are 1.07%. It can be concluded that the percentage of defects decreased by 65% from 3.84% (before improvement) to 1.07% (after improvement). Other studies that include defects in bakery products include dented, dirty, leaking contents, flat, and cut [23]. The contribution of this research includes the body of knowledge of design manufacturing engineering due to process improvements in the manufacture of bread and donut products, resulting in a reduction in product defects and producing new reference standards for quality improvement.

This research is included in the body of knowledge in industrial engineering in the work design and measurement section, because at the improvement stage experiments were carried out on dough, cooking temperature, and cleaning work equipment. this research has contributed to bread and donut SMEs, especially in increasing production quantities and reducing production defects, so that these SMEs can achieve sales targets every month.

5. CONCLUSION

This section discusses the conclusions that have been made in this study. This study found a cause for product defects in bread and donuts. The defects in the banquet products on bread and donuts are caused by material factors that have a changing dough composition. Bread and donut product defects are dirty because the equipment and work environment that is used are only cleaned once a day. Meanwhile, for the product defect, the donuts were burnt due to the stove temperature being too hot, causing the oil to dry quickly and the donuts to burn.

This research found the right solution to reduce product defects including the use of yeast of 10 grams and a bread improver of 15 grams, the temperature of the stove used should be 165~175°C, and the frequency of cleanliness of work equipment in making dough must be washed immediately once the dough is made. so keep the equipment clean. While the results of the DoE one shoot case study can be taken as a dough sample, the best is dough B with the addition of 10% beet juice with a score of 70% color aspect, 65% aroma aspect, 68.5% texture aspect, and 70% taste aspect.

This research resulted in a total product defect of 1.07%. It can be concluded that the percentage of defects decreased by 65% from 3.84% (before improvement) to 1.07% (after improvement). The theoretical implications of this research can add references for other researchers in their research on Bread and Donuts SMEs. While there are practical implications for SME products such as bread and donuts, the research results can be used as standards in the manufacture of bread and donuts, so that the production of bread and defects increases and reduces production defects. Subsequent research on improving the quality written by the author is still far from perfect and still has many shortcomings and weaknesses, therefore the researcher recommends conducting a sensory test to get results that are more appropriate to the community's liking. testing based on sensing processes, the science of using the human senses to measure the texture, appearance, aroma, and flavor of food products.

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REFERENCES

[1] S. Kumar, A. K. Dhingra, and B. Singh, "Process improvement through Lean-Kaizen using value stream map: a case study in India," *Int. J. Adv. Manuf. Technol.*, vol. 96, no. 5–8, pp. 2687–2698, 2018, doi: 10.1007/s00170-018-1684-8.

[2] J. Doshi and D. Desai, "Application of failure mode & effect analysis (FMEA) for continuous quality improvement - multiple case studies in automobile SMEs," *Int. J. Qual. Res.*, vol. 11, no. 2, pp. 345–360, 2017, doi: 10.18421/IJQR11.02-07.

[3] N. P. R. Yuliartini and K. D. Pramita, "Analisis SWOT dalam Menetukan Strategi Pemasaran Roti dan Donat di Lembaga Pemasyarakatan Kelas IIA Padang," *J. Komun. Hukum,Volume 7 Nomor 1 Februari 2021*, vol. 8, no. 1, pp. 469–480, 2022, [Online]. Available: https://ejournal.undiksha.ac.id/index.php/jkh/issue/view/863

[4] D. Chway, T. H. Jung, and C. S. Shin, "Dark matter filtering-out effect during a first-order phase transition," *Phys. Rev. D*, vol. 101, no. 9, p. 95019, 2020, doi: 10.1103/PhysRevD.101.095019.

[5] M. K. Nasoik, R. B. Jakaria, A. S. Cahyana, and B. I. Putra, "Talas Cripic Packaging Design Using Kansei Engineering And Analytical Hierarchy Process (Ahp) Method Desain," *Semin. Nas. Call Pap. Fak. Sains dan Teknol.*, vol. 4, no. June, pp. 1–13, 2023.

[6] N. Kadek and R. Sari, "Analisis Pengendalian Kualitas Proses Produksi Pie Susu Pada Perusahaan Pie Susu Barong di Kota Denpasar," *E-Jurnal Manaj. Unud*, vol. 7, no. 3, pp. 1566–1594, 2018, doi: 10.24843/EJMUNUD.2018.v7.i03.p016.

[7] D. Sjarifudin and H. Kurnia, "The PDCA Approach with Seven Quality Tools for Quality Improvement Men's Formal Jackets in Indonesia Garment Industry," *J. Sist. Tek. Ind.*, vol. 24, no. 2, pp. 159–176, 2022, doi: 10.32734/jsti.v24i2.7711.

[8] H. M. Asih, T. T. Suhariyanto, and M. C. Ramadhan, "Designing Standard Operation Procedure to Produce Environmentally Friendly Liquid Detergent," *Opsi*, vol. 15, no. 2, p. 317, 2022, doi: 10.31315/opsi.v15i2.6446.

[9] H. Kurnia, C. Jaqin, and H. Manurung, "Implementation of the DMAIC Approach for Quality Improvement at the Elastic Tape Industry," *J@ti Undip J. Tek. Ind.*, vol. 17, no. 1, pp. 40–51, 2022, doi: 10.14710/jati.17.1.40-51.

[10] Dias Irawati Sukma, I. Setiawan, H. Kurnia, W. Atikno, and H. H. Purba, "Quality Function Deployment in Healthcare: Systematic Literature Review," *J. Sist. Tek. Ind.*, vol. 24, no. 1, pp. 15–27, 2022, doi: 10.32734/jsti.v24i1.7297.

[11] F. F. Dieny, D. Y. Fitranti, B. Panunggal, and I. Safitri, "Pengaruh pemberian sari umbi bit (beta vulgaris) terhadap kadar hemoglobin dan performa atlet sepak bola," *J. Gizi Indones. (The Indones. J. Nutr.*, vol. 5, no. 2, pp. 119–126, 2017, doi: 10.14710/jgi.5.2.119-126.

[12] W. Solichah, D. Utomo, F. Pertanian, and U. Y. Pasuruan, "Pengaruh konsentrasi CMC (Carboxyl Methyl Cellulose) dan gula aren terhadap fisikokimia dan organoleptik selai umbi it (Beta vulgaris L .) ekstrak jahe merah," vol. 14, no. 36, pp. 118–131, 2023, doi: 10.35891/tp.v14i1.3784.

[13] M. S. Hidayatullah Elmas, "Pengendalian Kualitas Dengan Menggunakan Metode Statistical Quality Control (Sqc) Untuk Meminimumkan Produk Gagal Pada Toko Roti Barokah Bakery," *Wiga J. Penelit. Ilmu Ekon.*, vol. 7, no. 1, pp. 15–22, 2017, doi: 10.30741/wiga.v7i1.330.

[14] J. W Creswell, *Research-Design_Qualitative-Quantitative-and-Mixed-Methods-Approaches Forth Edition*, Fourth Edi. United Kingdom: Sage Publication Ltd, 2014.

[15] K. Barbeau, K. Boileau, F. Sarr, and K. Smith, "Path analysis in Mplus: A tutorial using a conceptual model of psychological and behavioral antecedents of bulimic symptoms in young adults," *Quant. Methods Psychol.*, vol. 15, no. 1, pp. 38–53, 2019, doi: 10.20982/tqmp.15.1.p038.

[16] S. Nasution and R. D. Sodikin, "Perbaikan Kualitas Proses Produksi Karton Box Dengan Menggunakan Metode DMAIC Dan Fuzzy FMEA," *J. Sist. Tek. Ind.*, 2018, doi: 10.32734/jsti.v20i2.488.

[17] A. Haslindah, A. Andrie, S. Aryani, and F. Nur Hidayat, "Penerapan Metode HAZOP Untuk Keselamatan Dan Kesehatan Kerja Pada Bagian Produksi Air Minum Dalam Kemasan Cup Pada PT. Tirta Sukses Perkasa (CLUB)," *J. Ind. Eng. Manag.*, vol. 1, no. 1, pp. 20–24, 2020, doi: 10.47398/just-me.v1i1.511.

[18] T. Aprianto, A. Nuryono, I. Setiawan, H. Kurnia, and H. H. Purba, "Waste Analysis in the Speaker Box Assy Process to Reduce Lead Time in the Electronic Musical Instrument Industry," *Qual. Innov. Prosper.*, vol. 26, no. 3, pp. 53–65, 2022, doi: 10.12776/qip.v26i3.1744.

[19] D. Sjarifudin, H. Kurnia, H. H. Purba, and C. Jaqin, "Implementation of the Six Sigma approach for increasing the quality of formal men ' s jackets in the garment industry," *J. Sist. dan Manaj. Ind.*, vol. 6, no. 1, pp. 33–44, 2022, doi: 10.30656/jsmi.v6i1.4359.

[20] H. Kurnia, C. Jaqin, H. H. Purba, and I. Setiawan, "Implementation of Six Sigma in the DMAIC Approach for Quality Improvement in the Knitting Socks Industry," *tekstilvemuhendis*, vol. 28, no. 124, pp. 269–278, 2021, doi: 10.7216/1300759920212812403.

[21] M. Mohan Prasad, J. M. Dhiyaneswari, J. Ridzwanul Jamaan, S. Mythreyan, and S. M. Sutharsan, "A framework for lean manufacturing implementation in Indian textile industry," *Mater. Today Proc.*, vol. 33, pp. 2986–2995, Jan. 2020, doi: 10.1016/J.MATPR.2020.02.979.

[22] S. Dewi, J. Alhilman, and F. T. D. Atmaji, "Evaluation of Effectiveness and Cost of Machine Losses using Overall Equipment Effectiveness (OEE) and Overall Equipment Cost Loss (OECL) Methods, a case study on Toshiba CNC Machine," *IOP Conf. Ser. Mater. Sci. Eng.*, vol. 847, no. 1, 2020, doi: 10.1088/1757-899X/847/1/012020.

[23] E. M. Ratri, E. B. G., and M. Singgih, "Peningkatan Kualitas Produk Roti Manis pada PT Indoroti Prima Cemerlang Jember Berdasarkan Metode Statistical Process Control (SPC) dan Failure Mode and Effect Analysis (FMEA)," *e-Journal Ekon. Bisnis dan Akunt.*, vol. 5, no. 1, p. 31, 2018, doi: 10.19184/ejeba.v5i1.7729.

[24] C. Jaqin, H. Kurnia, H. H. Purba, T. D. Molle, and S. Aisyah, "Lean Concept to Reduce Waste of Process Time in the Plastic Injection Industry in Indonesia," *Niger. J. Technol. Dev.*, vol. 20, no. 2, pp. 73–82, 2023, doi: 10.4314/njtd.v18i4.1396.

[25] S. Norawati and Zulher, "Analisis Pengendalian Mutu Produk Roti Manis Dengan Metode Statistical Process Control (SPC) Pada Kampar Bakery Bangkinang," *Menara Ekon.*, vol. V, no. 2, pp. 103–110, 2019.

[26] N. G. N. Desianti, "Analisis Pengendalian Kualitas Produk Dengan Menggunakan Statistic Processing Control (SPC) Pada CV. Pusaka Bali Persada (Kopi Banyuatis)," *J. Pendidik. Ekon. Undiksha*, vol. 10, no. 2, p. 637, 2019, doi: 10.23887/jjpe.v10i2.20151.

[27] R. Riyan and H. B. Ariyono, "Usulan Perbaikan Kualitas Proses Produksi Wafer Abon dengan Metode Six Sigma," *JIEMS (Journal Ind. Eng. Manag. Syst.*, 2017, doi: 10.30813/jiems.v10i1.38.

[28] A. Adyatama and N. U. Handayani, "Perbaikan Kualitas Menggunakan Prinsip Kaizen Dan 5 Why Analysis: Studi Kasus Pada Painting Shop Karawang Plant 1, Pt Toyota Motor Manufacturing Indonesia," *J@ti Undip J. Tek. Ind.*, vol. 13, no. 3, p. 169, 2018, doi: 10.14710/jati.13.3.169-176.

[29] T. N. Wiyatno and H. Kurnia, "Increasing Overall Equipment Effectiveness in the Computer Numerical Control Lathe Machines Using the Total Productive Maintenance Approach," *J. Optimasi Sist. Ind.*, vol. 15, no. 2, pp. 284–292, 2022, doi: 10.31315/opsi.v15i1.7284.

[30] A. P. Pradana, M. Chaeron, and M. S. A. Khanan, "Implementasi Konsep Lean Manufacturing Guna Mengurangi Pemborosan Di Lantai Produksi," *Opsi*, vol. 11, no. 1, p. 14, 2018, doi: 10.31315/opsi.v11i1.2196.

[31] B. T. Pramesti, R. Oktavera, and V. Y. Risonarta, "Pemilihan Keputusan Penggunaan Soda Api (NaOH) Sebagai Alternatif Pengganti Thinner Cairan Pembersih Cat pada Logam Dengan Menggunakan Metode Analityc Network Process (ANP)," *Opsi*, vol. 11, no. 2, p. 112, 2018, doi: 10.31315/opsi.v11i2.2551.

[32] H. Kurnia, C. Jaqin, and H. H. Purba, "Quality improvement with PDCA approach and design of experiment method in single socks industry in Indonesia," *Int. Conf. Informatics, Technol. Eng. 2021*, vol. 2470, no. 1, pp. 1–12, 2022, doi: 10.1063/5.0080179.

[33] F. Hanifan, A. Ruhana, and D. Yuni Nur, "Pengaruh Substitusi Sari Umbi Bit (Beta vulgaris L.) terhadap Kadar Kalium, Pigmen Betalain dan Mutu Organoleptik Permen Jeli," *Maj. Kesehat.*, vol. 3, no. 1, pp. 33–41, 2016, doi: 10.21776/ub.majalahkesehatan.003.01.5.