Indonesian Journal of Engineering, Science and Technology
IJENSET
Volume 02 - Issue 01, June 2025
e-ISSN: 3089-2392
Journal Link: https://jurnal.umla.ac.id/index.php/ijenset/index

APPLICATION OF STATISTIC QUALITY CONTROL METHOD AND KAIZEN APPROACH IN CONTROLLING THE QUALITY OF POTATO PRODUCTS

Sindy Nindia Maretha HarisTanti[1]*, Mala Rosa Apriliya[2], Mustika Ratnawati Faizah[1], Yoga Aulia Sulaiman[1]

[1.] Department Industrial Engineering; Faculty of Engineering; University of Trunojoyo Madura; Bangkalan (69162), Indonesia
[2] Department Information System; Faculty of Engineering; University of Trunojoyo Madura; Bangkalan (69162), Indonesia

* Corresponding Author Email: sindy.hanstanti@trunojoyo.ac.id

Article Information

Submitted	:	May 11, 2025
Revised	:	June 13, 2025
Accepted	:	June 16, 2025
Paper page	:	46-55
DOI	:	10.38040/ijenset.v2i1.1226Xxx

ABSTRACT

Quality control has the aim of reducing the number of defective or damaged products, maintaining products according to predetermined standards and avoiding the escape of defective products into the hands of consumers. Micro Enterprises play an important role in running a business to improve the economy by paying attention to product quality capital. One of the products that come from marine commodities is potato chips. This study aims to analyze the control of crab chips production whether the product is still within the control limits or not, as well as to find the cause of damage or defective products. To measure product damage that can be accepted by the company using the Statistical Quality Control (SQC) method which functions to manage and control the manufacturing process with statistical methods. The results of this study indicate that the control of the potato chips production process has been controlled because the points on the p map are still within the control limits, but there is still a need for improvement proposals to improve product quality by using the Kaizen 5W + 1H concept. Factors that cause damage are fishbone diagrams, materials, labor, methods and machines.

***Keywords*−** *Kaizen 5W + 1 H ; Statistical Quality Control*

Quality control has the aim of reducing the number of defective or damaged products, maintaining products according to predetermined standards and avoiding the escape of defective products into the hands of consumers (Ni Ketut Pande Sugiantari, n.d.). The existence of damage or defective products during the production process causes problems where the product does not comply with quality standards. By doing a statistical test through the Statistical Quality Control method, it is possible to find out the level of product damage by a company with a tolerance limit for the resulting product defects. Statistical Quality Control (SQC) or statistical quality control is a problem solving technique used to monitor, control, analyze, manage and improve products and processes using statistical methods. SQC is often referred to as statistical process control (SPC).

I. INTRODUCTION

Sumenep Regency, which has natural resources for marine potential with high quality and selling value, makes this city cultivate product innovations derived from marine commodities (Balili & Yuamita, 2022). One of the commodities comes from crab which is innovated into a crab chip product, where micro-enterprises here play an important role in running a business to improve the economy by paying attention to product quality capital. Determination of product quality affects the initial production process starting from raw materials to the final product in order to produce a positive impact on the product through quality control .(Siswanto et al., 2022)

This research is a novelty in the field of potato chips production at micro-enterprise, which has never been studied by anyone.Based on the predecessor carried out by (Faiz et al., 2022) ,states that the quality control process carried out in the banana chips production process can be carried out as follows:

1. Supervise during the production process
2. Carry out recording and measurement of defective products produced in order to reduce production costs
3. Make a more mature SOP (Standard Operational Procedure)
4. Perform regular machine maintenance and repairs

Based on the predecessor, the gaps taken are different types of chips and the method used by previous research is using the DMAIC method. DMAIC is a data-driven problem solving approach that helps make incremental improvements and optimizations to products, designs, and business processes (Gomaa, 2025). Meanwhile, what we studied was the Statistical Quality Control method, where this method is used to manage and control the manufacturing and service processes using statistical methods. Thus, this distinction is a research gap that becomes a new case in the home industry with the type of chips made from potato.

II. METHOD

This research was conducted in one of the home industries, micro enterprise, which is located in sub-district, Sumenep Regency, Madura. This study uses a quantitative method (Statistical Quality Control) which is one of the analytical methods that has a function to analyze the causes of defects that occur, both in terms of the quality of the production process and in terms of the quality of the final product. In the application of this kaizen using the concept of 5 W 1H (What, who, why, where, when and how). The concept of kaizen originating from Japan is a technique of thinking to promote and improve continuously in the work environment that functions to improve the quality of quality and output productivity (Reza & Santoso, 2022).

Research techniques for data collection, observation and recording is done by observation, interviews and documentation. This data collection technique is used to determine the implementation of the production process from the process of starting raw materials entering, to becoming the final product, how many products are damaged, and how many products do not meet standards (Attaqwa et al., 2021).

The data analysis technique of this research uses a check sheet, histogram, control chart by calculating the percentage of damage, calculating the upper control limit or Upper Control Limit (UCL), calculating the center line (CL), calculating the lower control limit or Lower Control Limit (LCL) and cause-and-effect diagrams.

$$CL = p = \sum \frac{np}{p} \quad \text{.................................(1)}$$

$\sum np$ = Total number of damaged
$\sum p$ = Total quantity produced/inspected

$$LCL = \bar{p} - 3\,\frac{\sqrt{\bar{p}\,(1-\bar{p})}}{n} \quad \text{......................(2)}$$

$$UCL = \bar{p} + 3\,\frac{\sqrt{\bar{p}\,(1-\bar{p})}}{n} \quad \text{......................(3)}$$

III. RESULTS AND DISCUSSION

Check Sheet

Check sheet is used to produce a simple document that serves to collect data on defective products in real time and at the location where the data appears. The following is data on the number of productions and the number of defective products for the period January - December 2024 at Sumenep Regency.

Table 1. Type of Damage and Total Production, Defective Products of Diana's Micro Business for January-December 2024.

Month	number of product (kg)	size is not suitable (kg)	scorched (kg)	not crunchy (kg)	Broken Amount (kg)
January	537	10	4	3	17
February	549	15	7	5	27
March	585	25	10	7	42
April	539	17	5	2	24
May	547	22	6	4	32
June	595	17	13	8	38
July	540	19	8	5	32
August	536	13	7	3	23
September	557	21	11	7	39
October	545	18	5	4	27
November	550	17	9	5	31
December	560	19	6	7	32
Total	**6590**	**213**	**91**	**60**	**364**
Average	**549**	**18**	**8**	**5**	**30**

Source: Primary Data

Histogram

After using the Check Sheet, the next step is to create a histogram. The histogram is used to see the type of damage that occurs the most. The following histogram is made based on the table 1.

Based on Figure 1, the results obtained from the data on types of defective products are the types of sizes that are not suitable at 213 kg. The amount for the type of burnt damage is 91 kg, and the amount for the type of damage to crab chips that are not crispy is 60 kg from January to December 2024.

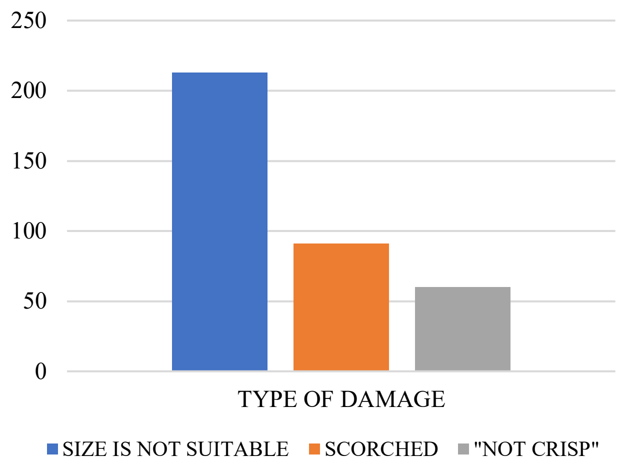

Figure 1. Histogram of the Number of Types of Defective Products.

Chart control chart (p)

After obtaining the histogram results, the next step is to determine the control chart that functions to determine changes in quality from time to time and predict whether the control of the production process at Micro Enterprises has been controlled or not. Following

a) Calculating the Central Line (CL)

The central line is a line that symbolizes the absence of deviation and is usually located between the upper control limit (UCL) and the lower control limit (LCL) (Isaac E .O., *et al,* 2018). This CL line represents the average number of defects produced. To calculate LCL the following formula is used

From the formula above, the result is:

n = 537

$$UCL = 0{,}018535 + 3\frac{\sqrt{0{,}018535\,(1-0{,}018535)}}{537}$$

Calculate the Lower Control Limit (LCL) formula and Upper Control Limit (UCL)

$\bar{p}$ = average product damage

n = total groups / samples

from the above formula the following results are obtained:

$\bar{p} = 0{,}03597$

n = 537

$1 - \bar{p} = 0{,}96637$

$$LCL = 0{,}03363 - 3\frac{\sqrt{0{,}03363\,(1-0{,}03363)}}{537} = 0{,}010293$$

$\bar{p} = 0{,}03097$

n = 549

$$UCL = 0{,}03097 + 3\frac{\sqrt{0{,}03097\,(1-0{,}03097)}}{537} = 0{,}0571$$

Based on the results of the calculation of the Central line (CL), Upper Control Limit (UCL), and Lower Control Limit (LCL) above, a P chart map is obtained using Microsoft Excel Windows 10, to see whether the product is still within control limits or not as shown below this. Variable Control Chart is used to control processes with variable data such as component leg length, soldering temperature, power supply voltage, component dimensions and other variable data. These types of control charts include Xbar - R Chart, Xbar - s Chart and I - MR Chart. An important component contained in a control chart is the control limits consisting of Upper Control Limit (UCL), Central Limit (CL), and Lower Control Limit (LCL) (Prambudi & Giyanti, 2021). np-Chart is a control chart that serves to measure the number of defective (failure / defect) in production. np-Chart is used when the number of samples (sample size) collected is constant or fixed. The sample size should be more than 30 (n>30) and should be constant (fixed) over time while the ideal number of sample sets is around 20 - 25 sample sets, as shown below in Figure 2 and table 2 P chart Control Map Chart.

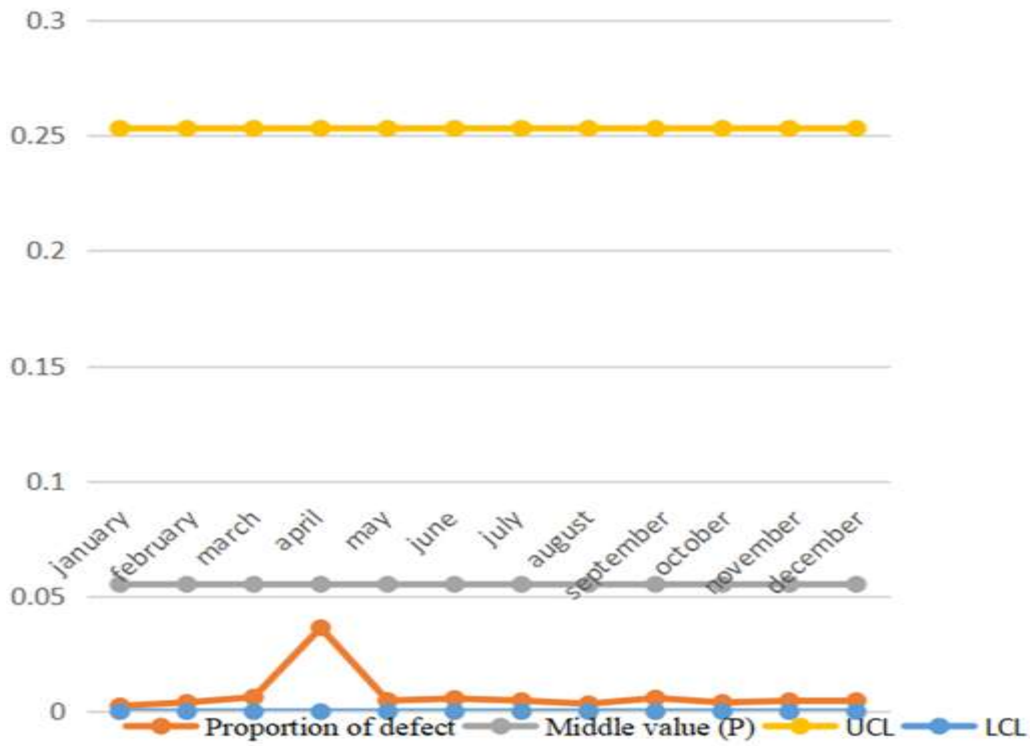

Figure 2. P Chart of Damage Product

From the graphic image above P chart (proportion chart) is one type of control chart used in Statistical Process Control (SPC) to monitor the proportion of defective units in a production process over time. The following table P control map chart.

Based on the picture and table above, it shows that the points from January to December are still within the control limits, this is indicated by the graph that does not exceed or deviate from the LCL or UCL limits, so that the product can be said to have good quality by reducing the number of defects. However, it is still necessary to propose improvements to avoid types of products that are still defective with the Kaizen approach and find the causes of the damage factors using a fishbone diagram. The percentage of damage that occurred in the period from January to December 2024 has an average of 5%. This indicates that there is a development in the quality Potato chips as evidenced by the reduced number of defective products (level of product damage) compared to the history of damage in the previous year which still produced a high percentage of 7%. Meanwhile, the production manager at Diana Micro Enterprises sets a standard tolerance limit with a defect rate of 3-4%, so that Potato chips products from year to year produce high quality by reducing the amount of damage to Potato chips.

Fishbone Diagram

The factors that cause defective or damaged products can be illustrated through the fishbone diagram on Figure 3.

Table 2. P Chart Control Map Chart

Month	Number of product (kg)	Proportion	CL	UCL	LCL
January	537	0,03597	0,03599	0,0571	0,01029
February	549	0,03097	0,03363	0,05671	0,01055
March	585	0,04615	0,03363	0,05599	0,01127
April	539	0,03525	0,03363	0,05693	0,01034
May	547	0,04388	0,03363	0,05676	0,01051
June	595	0,03248	0,03363	0,05599	0,01127
July	540	0,03818	0,03363	0,05669	0,01057
August	536	0,00733	0,03363	0,05678	0,01049
September	557	0,04056	0,03363	0,05635	0,01092
October	545	0,03604	0,03363	0,05659	0,01067
November	550	0,03393	0,03363	0,05649	0,01078
December	560	0,03684	0,03363	0,05629	0,01098
Total	6590				
Average	549				

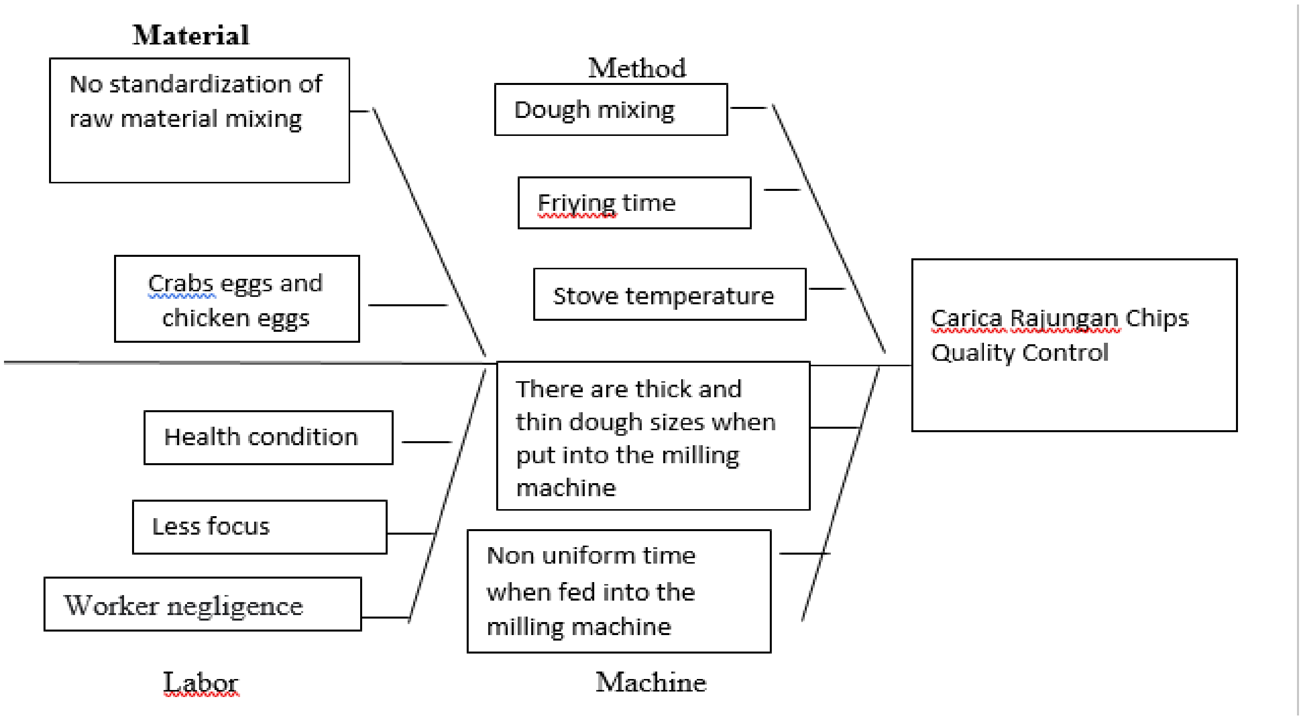

Figure 3. Fishbone Diagram Cause of Defective Products

Burnt Product

From the results of the calculation of the chipped product that has burned, it is known that 91 kg of the total production of 6590 kg. This defective or potato product was observed through interviews and surveys in the Diana Business field, Sumenep. The factors that cause charred are labor, machinery, raw materials, and work methods. One of the factors that have a big influence is the stove fire that is too big and the length of the frying process, then on the labor factor there is a lack of thoroughness and focus in the frying process (Fatkhurrohman, 2016)

Product Size Doesn't Fit

Through the results of the calculation of the chip product that has an inappropriate size, it is known that it is 213 kg of the total production of 6590 kg. Potato chips products whose size did not fit were observed through interviews and surveys in the Micro Business field in Kertasada Sumenep. The factors that cause the size to be inappropriate are labor, machinery, raw materials and work methods (Pamungkas et al., 2023). One of the factors that have a big influence is the machine factor and the dough method where the entry of dough into the milling machine is uneven so that the size is different or not as expected.

Product Not Crispy

Through the results of the calculation of the product of chips that are not crunchy, it is known that 60 kg of the total production of 6590 kg. The crispy potato product produced was observed through interviews and surveys in Micro Business field in Sumenep. The factors causing the occurrence of a taste that is not crispy are caused by labor, machinery, raw materials, and work methods. A very influential factor here is the raw material where there is no standardization when mixing the ingredients between crab eggs, flour, and eggs. Each of these raw materials must have a determination or standardization on the amount of concentration so as to obtain a crispier product. Mixing the dough that is not in the right proportions can cause the potato chip product to not be crispy.

Kaizen Approach

The kaizen approach originated in Japan and means “continous improvement” . It is widely used in management, especially is in industry and manufacturing, but is also relevant in many other fields such as education, service, and personal development. Function of the Kaizen Approach Improve Process Efficiency , Kaizen help identify and eliminate waste in work processes. It focuses on improving workflow, cycle time, and productivity. In addition, Improve product or service quality with incremental and continous immprovement, product or service quality can be consistently improved. Benefits of the Kaizen Approach is Productiviy increased simplified and more efficient processes increase output. Better quality problems are identified early and corrected quickly (Elly Kristiani Purwendah & Daniel Joko Wahyono, 2022) . By using the kaizen approach, the proposed improvement can be carried out continuously, the following table 3 is suggested for improvement with 5 W + 1 H.

Table 3. Proposed Repair with 5W + 1H

No	Factor	what	Why	Where	When	Who	How
1	There is no automatic packaging machine facility	provides facilities in the form of automatic packaging machines	so that workers save their energy and don't experience fatigue	in the packaging process area	to make work lighter during the production process	Workers who put chips into the packaging in the packaging process area	can make time efficient because it has the ability to pack products at high speed and is equipped with a control panel facility as a regulator in running automatic packaging machines
2	There is no standard time during the frying process	provides operational standards related to frying time	to reduce burnt products during the frying process	At central kitchen during production	done after making the carica crab flour dough	the worker in charge of frying the carica chips	provide briefing and motivation to all workers to be more consistent and responsible for their work
3	There is no standard setting for dough mixing	provide counseling on operational standards regarding dough to meet specifications	so that the level of crispness of the product can produce high quality	Central chicken where to make dough process	done before the raw materials are mixed into one dough	the worker in charge of mixing the raw materials so that it becomes a dough that has a high level of crispness	make operational standards regarding the standard of mixing between raw materials, each of which must have a determination of the concentration and composition of the raw materials and conduct briefings, counseling workers regarding the operational standards applied.

This improvement proposal was carried out through direct observation to the location where the carica crab chips production process was made at the Diana Kertasada Micro Enterprise, Sumenep. The proposed improvements from the raw material process to the packaging are to provide warnings related to operational standards regarding the mixing standards between each raw material must have the right concentration in mixing the dough, provide briefings and motivate workers related to operational standards so that workers are more consistent. in determining how long the frying time will produce a product that does not burn and has a high quality of color chips (Firdaus & Wahyudin, 2023)

In addition, it provides facilities in the form of automatic packaging machines so that the quality of the packaging produced is neater and makes the workforce more efficient.

Furthermore, it is necessary to provide guidance and motivation to workers so that they better understand and comply with SOPs, including in determining the duration of frying. Thus, it is expected that the quality of the chips produced will be more stable, not burnt, and have an optimal taste. In addition, the procurement of facilities in the form of an automatic packaging machine is also part of the proposed improvements (Triandini et al., 2019). The use of this machine is expected to increase the efficiency of the packaging process, reduce human error, and extend product shelf life through more hygienic and precise packaging.

Automatic packaging machines for MSME (Micro, Small, and Medium Enterprises) products should be tailored to the production capacity, product type, and business budget (Jufrijal & Fitriadi, 2022). Here are some important points to consider as well as recommendations for the type of packaging machine suitable for MSMEs, Criteria for Automatic Packaging Machines Suitable for MSMEs: a) Affordable and Economical Semi-automatic machines are often more affordable than fully automatic. It is important that the machine fits the scale of production and does not burden business capital. b) Easy to Operate and Maintain, The machine should be user-friendly so that it can be operated by workers without high technical skills. c) Daily maintenance and cleaning of the machine should be easy to do. d) Compact Size, MSMEs usually have limited production space, so the size of the machine should not be too large. e) Local Technical Support, Ensure that after-sales service, spare parts, and training are available from local manufacturers. f) Flexible Packaging Types, The machine should be able to handle various forms of packaging such as plastic, sachets, or standing pouches, according to product needs. g) Capacity as Needed, No need for large capacity like in large industries. Packaging speed of 10-30 products/minute is usually sufficient for MSMEs. (Allo & Bhaskara, 2022).

IV.CONCLUSION

From the results of this research, it was found that the percentage of damage was 5% with the largest level of defects in the type of defect of inappropriate size, which amounted to 213 kg. Based on the results of the fishbone diagram, it is known that the factors causing product damage in the production process come from production machine factors, worker factors, work methods, and materials / raw materials, so it is necessary to propose improvements by providing facilities in the form of automatic packaging machines, providing operational standards related to frying time, providing counseling on operational standards regarding dough to match specifications and providing direction and motivation to all workers to be more consistent and responsible for their work. Provide control and supervision before the production process is carried out and provide additional time to rest for all workers.

From the above statement it can be concluded that:

a. Based on the results of the processing of the data above, we can conclude that the results of the P chart control chart of the production process are still within the control limits, this is indicated by the absence of points that deviate from the LCL and UCL charts. So it can be said that the Carica crab chips are still in good quality. The percentage level of the damage tolerance limit set by the company is 3-4%, while the percentage of damage to Carica crab chips products in the period from January to December 2021 is 5%. It is still necessary to improve the production process of Carica crab chips by providing training to all workers and setting standard operating procedures in each manufacturing process for Carica crab chips so that this product can reduce the number of defects by not exceeding the tolerance limit set by the company and of course more preferred by consumers.
b. Based on the results of the histogram, it can be concluded that the most damaged products were the inappropriate size of 213 kg, the second highest level of damage was charred products of 91 kg, and the lowest level of damage to non-crispy products was 60 kg. The total number of product defects was 364 kg from 6590 kg of the total production.
c. Based on the results of the fishbone diagram, it is known that the factors causing product damage in the production process are derived from the production machine, worker factors, work methods, and materials/raw materials.
d. Based on observations, there are suggestions for improvements that must be implemented by Diana Micro Enterprises, which are as follows: Providing facilities in the form of automatic packaging machines, provided operational standards related to frying time, Provide counseling on operational standards regarding dough to meet specifications and Provide briefing and motivation to all workers to be more consistent and responsible for their work.

There is control and supervision before the production process is implemented and provided additional time to rest for all workers.

e. Based on observations, there are suggestions for improvements that must be implemented by Diana Micro Enterprises, which are as follows: Providing facilities in the form of automatic packaging machines, Provide operational standards related to frying time, Provide counseling on operational standards regarding dough to meet specifications and Provide briefing and motivation to all workers to be more consistent and responsible for their work. There is control and supervision before the production process is implemented and Provide additional time to rest for all workers.

Based on the results of observations, analyzes and discussions that have been carried out at DIANA Micro Enterprises, the authors have suggestions as a reference for conducting ongoing evaluations to improve the quality of the company and its products. Suggestions that can be useful for the company are:

1. Implementing the proposed improvement
2. Create and establish standard operating procedures (SOPs) during the production process
3. Conduct training and motivation for all workers related to standard operating procedures (SOP) so as to minimize factors that cause product damage.
4. The company controls and supervises the applicable Standard Operating Procedures (SOP).

ACKNOWLEDGEMENT

The author would like to express sincere gratitude to Usaha Mikro Diana Kertasada, Sumenep, for providing the opportunity and access to observe the production process of keripik kepiting carica. Special thanks to Mrs. Diana and her team for their cooperation and valuable insights during the research. Lastly, appreciation is extended to all colleagues who provided helpful feedback and encouragement throughout the preparation of this paper.

REFERENCES

Abdullatif, Y., Dasipah, E. and Natalingsih, N. (2024) ‘peran strategi pemasaran dan kualitas produk terhadap keberhasilan usaha tani papaya california (Carica Papaya L.) (Suatu Kasus Terhadap Petani Papaya California di Kecamatan Cibeber, Cianjur, Jawa Barat)’, *OrchidAgri*, 4(1), pp. 1–10. https://doi.org/10.35138/orchidagri.v4i1.728.

Allo, R.I.G., Bhaskara, A., 2022. Waste Material Analisys With he Implementation of Lean Construction. jurnal teknik sipil 18, 343–355. https://doi.org/10.28932/jts.v18i2.4494

Attaqwa, Y., Hamidiyah, A., Ekoanindyo, F.A., 2021. Product Quality Control Analysis with Statistical Process Control (SPC) Method in Weaving Section (Case Study PT.I). International Journal of Computer and Information System 2, 86–92. https://doi.org/10.29040/ijcis.v2i3.43

Cagnetti, C., Gallo, T., Silvestri, C., Ruggieri, A., 2021. Lean production and Industry 4.0: Strategy/management or technique/implementation? A systematic literature review. Procedia Computer Science 180, 404–413. https://doi.org/10.1016/j.procs.2021.01.256

Elly Kristiani Purwendah, Daniel Joko Wahyono, 2022. Waste Bank as an Alternative to community-based waste management. Jurnal Komunikasi Hukum. 8, 10–17. https://doi.org/10.23887/jkh.v8i2.47084

Faiz, M.A., Winarno, W., Suseno, A., 2022. Analisis Pengendalian Kualitas Produk Celana pada UMKM KMStoreid

Menggunakan Metode Statistical Process Control. Journal Serambi Engineering 7. https://doi.org/10.32672/jse.v7i4.4915

Firdaus, R.Z. and Wahyudin, W. (2023) ‘Penerapan Konsep Lean Manufacturing untuk Meminimasi Waste pada PT Anugerah Damai Mandiri (ADM)’, Journal of Integrated System, 6(1), pp. 21–31. Available at: https://doi.org/10.28932/jis.v6i1.5632.G omaa, A.H. (2025) ‘Achieving Project Management Excellence through Lean Six Sigma’, Middle East Research Journal of Engineering and Technology, 5(02), pp. 18–32. https://doi.org/10.36348/merjet.2025.v0 5i02.001.

Jufrijal, J. and Fitriadi, F. (2022) ‘Identifikasi Waste Crude Palm Oil dengan Menggunakan Waste Assessment Model’, Jurnal INTECH Teknik Industri Universitas Serang Raya, 8(1), pp. 43–53. https://doi.org/10.30656/intech.v8i1.438 7

Pamungkas, S., Suhendar, E. and Usman, R. (2023) ‘Implementasi Metode Lean Six Sigma dan Fault Tree Analysis Untuk Peningkatan Kualitas Produk Kulit Kebab Labanese di PT Bangaji Citrarasa Lestari’, Performa: Media Ilmiah Teknik Industri, 22(2), p. 98. https://doi.org/10.20961/performa.22.2. 80462.

Prambudi, W.R. and Giyanti, I. (2021) ‘Lean Analysis Framework for Waste Management: A Case of Indonesian Textile Company’, Jurnal Optimasi Sistem Industri, 20(1), pp. 11–21. https://doi.org/10.25077/josi.v20.n1.p11 -21.2021.

Reza, R. R., & Santoso, A. (2022). Penerapan Lean Manufacturing di Sebuah Perusahaan Keramik. Jurnal Teknik Industri: Jurnal Hasil Penelitian dan Karya Ilmiah dalam Bidang Teknik Industri, 8(2), 140. https://doi.org/10.24014/jti.v8i2.19954

Siswanto, D.J. et al. (2022) The Effect of Production Planning and Quality Control on The Final Product, Journal of Social Science, 3(6), pp. 2128–2136. https://doi.org/10.46799/jss.v3i6.485.