

Analyzing Product Defects in the Tempeh Production Process Using FTA and FMEA Methods in CV. Aderina

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Abstract: CV. Aderina is a Home Industry that produces tempeh and has a product quality problem that still causes defective products. The types of product defects that often occur are foreign object entry, blackish color, and maturity level. A very effective method to overcome these problems is the FTA (Fault Tree Analysis) and FMEA (Failure Mode and Effects Analysis) methods. The purpose of this research is to identify the types of defects and factors that cause the highest defects in tempeh products and provide recommendations for improvement to improve the quality of Tempe products. Foreign body entry is the highest type of tempeh product defect in October 2021 based on the Pareto diagram with the number of defective products, namely 356 pcs and a defect percentage of 47.72%. In the Fault Tree of Foreign Object Entry, the causes of defects that occur are caused by tools, human error, and the environment. Based on the FMEA method, the highest RPN value is obtained, namely the cause of defects in a less clean room with an RPN value of 189, and becomes a priority for improvement. By using the 5W + 1H approach, the proposed improvement that can be given is to carry out cleaning in all production rooms regularly by making a cleaning picket schedule.

Abstrak: CV. Aderina adalah Home Industry yang memproduksi tempe memiliki masalah kualitas produk yaitu masih ditemukan produk yang cacat. Adapun jenis cacat produk yang sering terjadi yaitu kemasukan benda asing, berwarna kehitaman, dan tingkat kematangan. Metode yang sangat efektif untuk mengatasi permasalahan tersebut adalah metode FTA (Fault Tree Analysis) dan FMEA (Failure Mode and Effects Analysis). Tujuan dilakukannya penelitian ini ialah untuk mengidentifikasi jenis kecacatan dan faktor penyebab kecacatan paling tinggi pada produk tempe serta memberikan rekomendasi perbaikan untuk meningkatkan kualitas produk Tempe. Kemasukan benda asing merupakan jenis kecacatan produk tempe yang tertinggi pada bulan Oktober 2021 berdasarkan diagram Pareto dengan jumlah produk yang cacat yakni 356 pcs dan persentase cacat sebesar 47,72 %. Pada Fault Tree kemasukan benda asing, penyebab kecacatan yang terjadi adalah disebabkan oleh tools, human error, dan lingkungan. Berdasarkan metode FMEA, didapatkan nilai RPN paling tinggi yaitu pada penyebab kecacatan ruangan kurang bersih dengan nilai RPN sebesar 189 dan menjadi prioritas perbaikan. Dengan menggunakan pendekatan 5W + 1H, usulan perbaikan yang dapat diberikan adalah melakukan pembersihan di semua ruang produksi secara rutin dengan membuat jadwal piket kebersihan.



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INTRODUCTION

Competition between companies is increasing along with the development of the industrial world, and companies try to win the competition by prioritizing customer satisfaction (Sari et al., 2018). To

survive and thrive in tight competition, all companies must prioritize the quality of their products (D'Ettore, 2014). Product quality with customers is very closely related because customer satisfaction with quality products makes customer trust in the company increase (Mukminin & Dahda, 2022). If the product quality is very good and the price is affordable in the market, therefore, customers will be interested in the goods and can compete in the manufacturing industry market. The manufacturing industry is an industry that focuses on processing raw materials, materials, or other components into finished products that have added value and are done with machines or not with machines (Pratama & Suhartini, 2019).

Quality is an element contained in an item or result that can achieve the purpose of the item or result (Utami & Hariastuti, 2016). From the customer's point of view, quality is something that has its dimension, in contrast to quality from the manufacturer's point of view, when a product that has been known for its actual quality is brought to the market (Alma, 2011) (Indriati et al., 2019). (Indriati et al., 2019) In general, *waste* is likely to occur in the production process. Waste is the work of wasting resources that do not provide added value, for example, expenses or extra time for the work (Musfita & Mahbubah, 2021). *Defective Design* is one of the wastes that occur in the production process, which refers to the non-conformity of product design with established standards and consumer views. The appearance of defects in products is an example of waste in the production process. This can affect product quality, also result in waste of production costs, and make the company's business performance decrease (Hendra & Effendi, 2018). Intensive monitoring is required in the production process to minimize defects in the product, including monitoring the raw materials used because the quality of raw materials will have a major impact on the quality of the finished product (Ulum, 2017).

To ensure product quality, *comprehensive quality control* is carried out starting from the main ingredients and production processes to become finished products (Darmawan et al., 2022). Quality control is an engineering and management activity in which measuring the quality attributes of goods or services, then the measurement results are compared with the expected details and appropriate improvements if there are differences between actual performance and standards (Bakhtiar et al., 2013). Tempeh is a food with soybean ingredients which is one of the traditional foods in Indonesia. According to research, each stage of tempeh production does not pay much attention to quality control because the process is still carried out manually (Idris & Aditya Sari, 2016).

CV. Aderina is one of the *tempeh production Home Industries* that has been operating for 25 years. Therefore, for the business to run smoothly, CV. Aderina must continue to produce tempeh with guaranteed quality. CV. Aderina has some problems with product quality i.e. still found damaged or defective products. From the results of data obtained through direct interviews with business owners and direct observation of the field, it is known that the types of defects commonly found in tempeh products are: foreign body entry, blackish color, and maturity level.

Based on these problems, FTA (*Fault Tree Analysis*) and FMEA (*Failure Mode and Effects Analysis*) methods are very effective methods to reduce the risk of product failure and maximize quality according to the characteristics of each product. The FTA method is a strategy to identify risks or find

the root cause of failure by conducting a *Fault Tree analysis* (Ardiansyah & Wahyuni, 2018). Meanwhile, the FMEA Method is a systematic method to prioritize and avoid *failure mode* as much as possible (Irawan July et al., 2017). The creation of FMEA aims to identify and evaluate all risks associated with potential failures (Iswanto et al., 2013). The purpose of this study is to identify the dominant factors and types of defects in tempeh products and provide suggestions for improvements to improve the quality of tempeh products.

METHODS

This research was conducted on the tempeh production process at CV. Aderina. Data was collected from tempeh production in October 2021. Interviews with company owners and direct observation of the field are carried out for data collection activities, where the data is in the form of historical data on the number of products produced and product defects found.

The procedure for this research is problem identification carried out through field studies and literature studies, problem formulation, data collection, data processing, results & discussion, and conclusions & suggestions. This research method is illustrated in the following flowchart.

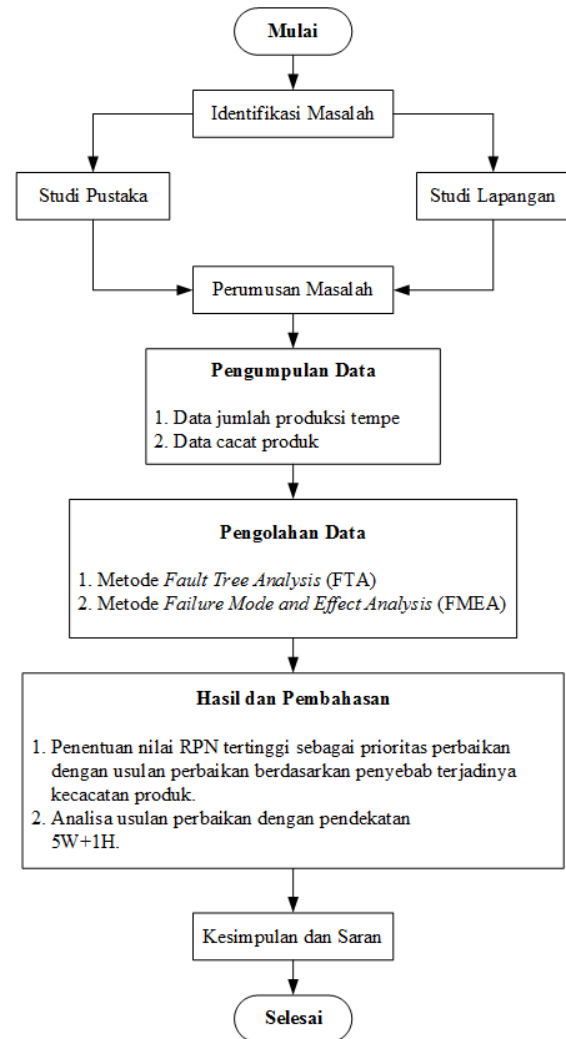


Figure 1 Research method flowchart

RESULTS AND DISCUSSION

Here is the data on the amount of tempeh production and the number of defective tempeh products in CV. Aderina in October 2021.

Table 1 Data on the amount of tempeh production and the number of defective products in CV. Aderina in October 2021

Sunday	Total output (pcs)	Types of defects (pcs)			Total defect (pcs)	percentage defect
		Entry of foreign objects	Blackish in color	Maturity level		
1	7.410	86	35	67	188	2,53 %
2	5.985	75	28	40	143	2,38 %
3	7.790	100	32	78	210	2,69 %
4	7.600	95	40	70	205	2,69 %
Total	28.785	356	135	255	746	

Sumber : Data CV. Aderina, Oktober 2021

Based on data obtained from the production department, there are 3 types of imperfections known in the process of making tempeh products, namely the entry of foreign objects, blackish color, and

maturity level. In determining the highest or dominant type of disability in October 2021, data processing is carried out using a Pareto diagram.

Table 6 Number of Defects Data

Types of defects	Number of Defects	Persentase	Cumulative
Entry of foreign objects	356	47,72 %	47,72 %
Blackish in color	135	18,09 %	65,81 %
Maturity level	255	34,18 %	100 %
Total	746	100 %	

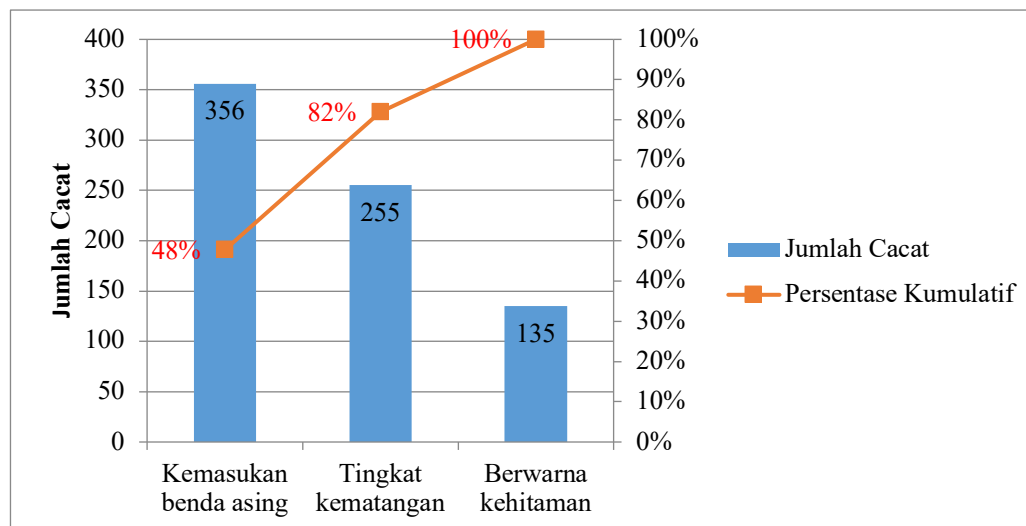
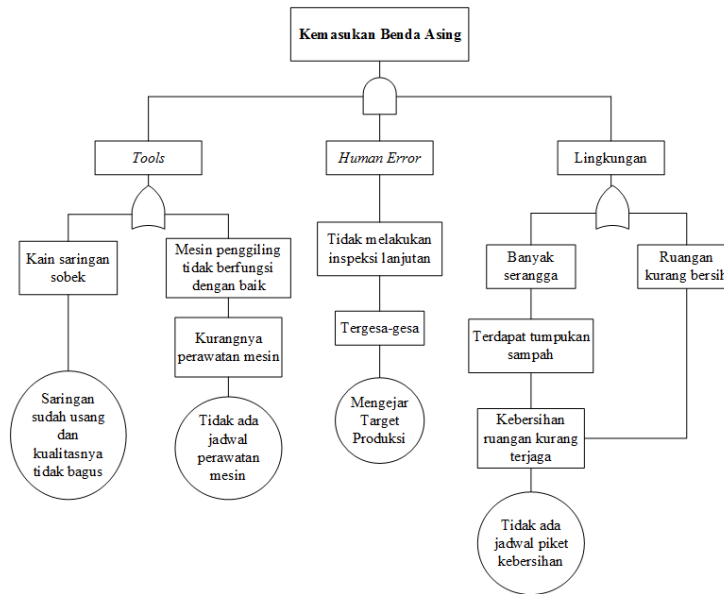


Figure 2 Pareto diagram of types of tempeh product defects in CV. Aderina in October 2021

In the Pareto diagram above, the highest type of defect is the type of defect in foreign body entry, so it is the main focus of repair. So, further analysis is needed to find out the root cause of disability and the consequences caused, so that it can be minimized earlier.

Analysis by FTA Method

This FTA method aims to determine the most basic causes of defects in the tempeh production process. *The fault Tree* of foreign body ingress defect type is as follows.



Gambar 3 Fault Tree jenis kecacatan kemasan benda asing

In the *Fault Tree* above, it is known that defects in foreign object entry are caused by *tools*, human error, and the environment. The absence of a machine maintenance schedule causes the grinding machine to not function properly and the filter that is worn out with poor quality causes the filter cloth to tear easily. Workers who are in a hurry because they are chasing production targets cause *human error*. The absence of a hygiene picket schedule leads to unsanitary working environment conditions and many insects.

Analysis by FMEA Method

The FMEA method is applied to determine, recognize, and eliminate

problems and failures in the tempemaking process in CV. Aderina. The results of the *Fault Tree Analysis* (FTA) conducted previously, are entered into the FMEA calculation table and will be given a weighting of *Severity, Occurrence, and Detection values* by 6 respondents, namely the owner and 5 CV employees. Aderina from the questionnaire that has been given. The *Risk Priority Number* (RPN) value is generated from the multiplication of the SOD value.

$$RPN = S \times O \times D$$

Table 2 Calculation of FMAE types of foreign body entry defects

No.	Types of Disability	Causes of Disability	Process Control	S	O	D	RPN
1.		Torn sieve fabric	Replace it with a new and best-quality filter.	7	5	4	140
2.	Entry of foreign objects	The grinding machine is not working properly	Perform inspection or maintenance of grinding machines.	7	4	5	175
3.		Did not conduct follow-up inspections	Inspect soybeans in every process.	7	6	4	168

4.	Lots of insects	Maintain the cleanliness of the work environment, and sterilize the workspace.	7	7	3	147
5.	The room is not clean	Clean the room before and after the production process.	7	9	3	189

Based on the calculation of the RPN value, then sorted the RPN value from the highest to the lowest and identifies proposed improvements that can be made based on

the causes of defects from foreign object entry.

Table 3 Proposed improvements

No.	Causes of Disability	RPN	Proposed Improvements
1.	Rungan is less clean	189	Cleaning the workspace regularly every day.
2.	The grinding machine is not working properly	175	Perform <i>maintenance</i> on grinding machines used in the production process regularly.
3.	Did not conduct follow-up inspections	168	Inspect soybeans in every tempeh-making process.
4.	Lots of insects	147	Sterilize the workspace during the production process and maintain the cleanliness of the work environment.
5.	Torn sieve fabric	140	Replacing an obsolete filter with a new, good-quality filter.

Based on Table 7, it can be seen that the cause of defects in foreign object entry in tempeh products that are a priority for repair is a less clean room with the highest RPN value of 189 and the proposed improvement.

Based on the highest RPN value and the proposed improvements made, further analysis of the proposed improvements is carried out using the approach 5W+1H (*What, Why, Who, Where, When, How*) (Krisnaningsih et al., 2021).

Table 8 Analysis of 5W+1H proposed improvements to foreign body entry

Causes of Disability	5W + 1H					
	What (apa rencana perbaikan)	Why (mengapa perlu perbaikan)	Who (siapa yang melakukan)	Where (dimana tempat perbaikannya)	When (kapan perbaikan dilaksanakan)	How (bagaimana langkah perbaikan)
The room is not clean	Cleaning the production room regularly every working day.	To maintain the cleanliness of the production room so that soybeans are not easily contaminated	All employee's CVs. Aderina.	Semua ruangan produksi.	Sebelum dan sesudah proses produksi.	Membuat jadwal piket kebersihan ruangan produksi.

with foreign objects.

The result of the analysis of the 5W + 1H approach for the cause of defects in foreign object entry, namely less clean rooms, is to clean all production rooms regularly on every working day by making a picket schedule for the cleanliness of the production room for all CV employees. Aderina to maintain the cleanliness of the production room so that soybeans are not easily contaminated by foreign objects.

CONCLUSION

The author provides several conclusions from the results of the above research, namely. First, in the tempeh production process at CV. There are 3 types of product defects, namely foreign body entry, blackish color, and maturity level. The highest type of defect in tempeh products is foreign body entry. Second, the *Fault Tree Analysis* (FTA) method produces defects in foreign body entry caused by *tools, human error*, and the environment which are input factors that cause defects. Second, the Failure Mode and Effect Analysis (*FMEA*) method produces the cause of foreign object entry defects that have the highest RPN value, namely less clean rooms that have an RPN value of 189 and are a priority for repair. Third, the 5W + 1H approach resulted in an improvement proposal given, namely cleaning all production rooms regularly on every working day by making a picket schedule for the cleanliness of the production room for all CV employees. Aderina to maintain the cleanliness of the production room so that soybeans are not easily contaminated by foreign objects.

The author advises CV. Aderina to immediately make improvements to the causes of tempeh product defects with the highest RPN value, so that tempeh products can be sent to customers without product

defects and the company will not lose money. It is expected in future studies to use other methods in controlling the quality of tempeh products so that CV. Aderina is growing and there are more and more enthusiasts.

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