

REGULAR ARTICLE

ANALYSIS OF LEAKAGE PRIMARY PACKAGING SAMPLE OF CRACKER PRODUCT AT PT XYZ*Visca Rasheesa Hestia Prasetyo^{*1}, Muhammad Rosyid Wardianto¹, Luqman Agung Wicaksono¹***Address:**¹Universitas Pembangunan Nasional "Veteran" Jawa Timur, Faculty of Engineering and Sains, Department of Food Technology, Jl Rungkut Madya, Gunung Anyar, Surabaya 60294, Indonesia, (031) 8706369.*Corresponding author: 23033010072@student.upnjatim.ac.id**ABSTRACT**

One of the important factors in maintaining the quality and shelf life of crackers products is packaging. Packaging leaks often occur, especially in primary packaging, allowing air and moisture to enter the packaging. This study was conducted to analyze the leakage of primary packaging samples in one of PT XYZ's crackers products. This analysis was conducted during the internship period using observation and interview methods. The method used to detect this leakage was a vacuum test. The analysis results showed fluctuations in the number of leaking packaging samples during the observation period. The main factors causing this problem lie in the sealing temperature and operator performance. Efforts that can be made include training packaging operators, selecting permanent operators for each packaging machine, and conducting regular monitoring to reduce the frequency of leaks and improve product quality.

Keywords: crackers, packaging leakage, primary packaging, sealing, vacuum test**INTRODUCTION**

Crackers are a wheat flour-based food product widely consumed by the public, consisting of a series of steps, from mixing the ingredients, forming the dough, fermenting or resting, molding, and baking. They are made using wheat flour because its gluten content plays a crucial role in forming a stable and elastic dough structure. These steps aim to produce a product with a dry, crunchy texture and a relatively long shelf life (**Tri Oktarini et al., 2022**). Crackers have a crunchy texture and a low water content. The final water content of the product, the volume of expansion during baking, and the pore structure formed in the dough after heating significantly influence this level of crunchiness. High water content usually results in a tougher product, less crispy, and a shorter shelf life. Conversely, crackers with a low water content have a more brittle, lighter texture, and a crunchy sensation when consumed. Therefore, the water content in crackers must be maintained at a low level to maintain stability during storage and maintain the same textural quality for a longer period (**Br Sidabutar et al., 2025**).

If the moisture content is low and the water activity value is controlled, crackers will be more resistant to microbial growth and other quality degradation. The use of airtight packaging is crucial to prevent the absorption of moisture from the environment, which can cause the product to lose its crispiness. Therefore, a proper packaging system is crucial to maintain the quality of crackers throughout the entire process, from distribution to marketing and storage by the end customer (**Maisont et al., 2021**). Throughout the product's storage process until it reaches the consumer, packaging plays a crucial role in protecting the product. Beyond protection, packaging also serves as an information medium and a marketing tool to attract consumer interest. Today, packaging is no longer simply seen as a wrapper; it also provides added value that can enhance a product's competitiveness in the market (**Zuliyawati et al., 2024**).

Primary packaging is packaging that comes into direct contact with food and serves to protect it from external factors such as air, water vapor, light, and other contaminants that can degrade product quality (**Robertson, 2016**). Primary packaging is crucial for crackers to maintain their crispy texture during storage. The types of packaging used in crackers are oriented polypropylene (OPP) and polypropylene (PP). These two materials were chosen because they are lightweight, flexible, and have good water and air barriers. According to **Bamps et al. (2023)**, flexible packaging materials must have good sealing capabilities so that the sealing process can produce tight, leak-proof packaging. To maintain optimal seal quality, the packaging material must also be able to withstand high temperatures during the heat sealing process.

OPP is a material with good barrier properties, but its oxygen barrier is still moderate. OPP is typically oriented to enhance the packaging's protection against food products. OPP is also often combined with other materials to enhance its protective properties. The hydrophobic nature of oriented polypropylene allows it to retain water vapor well, according to (**Kumari & Boora, 2024**). However, compared to materials like EVOH

and PET, its oxygen barrier properties are lower. OPP and PP are heat-resistant materials, making them widely used as base materials for food packaging. PP's melting point is relatively stable during sealing, resulting in strong, leak-proof packaging. According to (Ilhan et al., 2023), polypropylene's sealing properties make it ideal for flexible food storage because it can maintain seal strength at specific sealing temperatures. This heat resistance is crucial to prevent seal failure caused by incorrect temperature settings in storage equipment. Based on these conditions, an analysis of primary packaging leaks in cracker products at PT XYZ is necessary. This study aims to analyze the occurrence of primary packaging leaks, identify the factors that cause leaks, and determine corrective measures that can be taken to minimize packaging leaks and maintain the quality of cracker products during storage and distribution. Therefore, the objective of this study was to analyze the occurrence of primary packaging leakage in cracker products at PT XYZ, identify the factors causing leakage, and determine improvement efforts to minimize packaging leakage and maintain product quality.

MATERIAL AND METHODS

Research Time and Location

This research was conducted during the Field Work Practice (PKL) at PT XYZ in East Java, a food industry company, in January 2026

Material and Tools

The materials used in this study were primary cracker packaging samples obtained from PT XYZ's production line. The tools used included a vacuum tester, observation sheets, and stationery.



Figure 1 Vacuum test used for leakage detection of primary packaging sample

Research Methode

This study employed a descriptive method with an observational approach. Data collection was conducted through direct observation of the packaging process, interviews with operators and quality control (QC) personnel, and documentation during the Field Work Practice. Packaging leak testing was conducted using a vacuum test method. Two primary cracker packaging samples were randomly taken from the production line. The samples were then placed in a vacuum tester filled with water and subjected to vacuum pressure in accordance with the company's standard operating procedures (SOP). Leakage was determined if air bubbles continuously appeared during the testing process. Leakage test data were then recorded and analyzed descriptively to determine the incidence of primary packaging leaks, identify contributing factors, and determine corrective measures to minimize leaks in primary cracker packaging.

RESULTS AND DISCUSSION

Primary Packaging Leakage Rate

The testing method used to determine packaging leaks at PT XYZ was a vacuum test on packaging samples taken from the production line. Test results during January 2026 showed that the percentage of primary packaging leaks fluctuated between each observation date, with values ranging from 0% to 100% (**Figure 2 and Table 1**). This fluctuating percentage of packaging leakage indicates inconsistent sealing of the primary packaging. This inconsistent seal is influenced by several factors. This leakage can cause several impacts, such as the loss of the product's crispy texture and a decrease in quality in the hands of consumers.

The high percentage of leakage indicates that the packaging sealing process is still affected by process changes during production. This condition indicates that the packaging process's ability to produce a uniform seal quality is not optimal. The percentage of leakage should be low and not change significantly between observations if the sealing process is running consistently. The high percentage of leaks found in several samples indicates that seal failures are still common during the production process. Leaks in the primary packaging can allow air and water vapor to enter the packaging, reducing the effectiveness of the

packaging barrier. This condition can lead to decreased crispness, increased moisture content, and accelerated quality deterioration during storage.

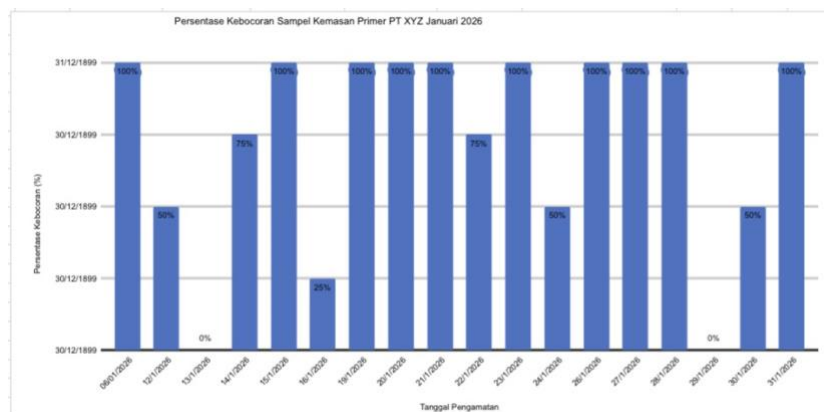


Figure 2 Percentage of primary packaging sample leakage during the observation period

Based on Table 1 and Figure 2, the percentage of sample primary packaging leakage fluctuated during the observation period, ranging from 0% to 100%. These fluctuations indicate that the sealing process was not carried out consistently during production. On several observation dates, all tested packages experienced leakage, while on other dates no leakage was detected. This condition suggests that the quality of the sealing process was influenced by changes in processing conditions and operator handling during packaging production. Leakage in primary packaging can reduce the effectiveness of the packaging barrier against oxygen and water vapor. Consequently, cracker products may lose their crispness more rapidly, experience an increase in moisture content, and undergo faster quality deterioration during storage and distribution.

Table 1 Observation results of primary packaging sample leakage in cracker products at PT XYZ

No	Date	Number of Samples	Leaking Samples	Non-Leaking Samples	Leakage Percentage (%)
1	06/01/2026	1	1	0	100%
2	12/01/2026	2	1	1	50%
3	13/01/2026	4	0	4	0%
4	14/01/2026	4	3	1	75%
5	15/01/2026	4	4	0	100%
6	16/01/2026	4	1	3	25%
7	19/01/2026	2	2	0	100%
8	20/01/2026	4	4	0	100%
9	21/01/2026	4	4	0	100%
10	22/01/2026	4	3	1	75%
11	23/01/2026	4	4	0	100%
12	24/01/2026	2	1	1	50%
13	26/01/2026	2	2	0	100%
14	27/01/2026	4	4	0	100%
15	28/01/2026	4	4	0	100%
16	29/01/2026	2	0	2	0%
17	30/01/2026	4	2	2	50%
18	31/01/2026	2	2	0	100%

Factors Causing Primary Packaging Leaks

Based on observations and interviews during the Field Work Practice, the most dominant factors causing primary packaging leaks in crackers at PT XYZ are sealing temperature and operator factors. One important factor in the seal formation process in flexible packaging is the sealing temperature. Incorrect temperature settings can cause the packaging layers to fuse incompletely, resulting in a weak seal that is prone to leaks. Conversely, setting the temperature too high can damage the packaging layers and reduce the strength of the seal. **Yamada et al. (2017)** stated that polypropylene (PP) typically has a sealing temperature range between 140 and 170 degrees Celsius, while BOPP ranges between 130 and 160 degrees Celsius, depending on the material type and film thickness.

Therefore, the temperature must be maintained stable throughout the packaging process to maintain good seal quality. Furthermore, **Ilhan et al. (2023)** explained that PP material in food packaging can require

sealing temperatures of up to 170–200°C, depending on the material structure and packaging process conditions. Based on observations, the sealing temperature on the machine can fluctuate within a range of approximately 100–200°C depending on production conditions and packaging sealing performance. These temperature changes are made by the operator to maintain optimal packaging adhesive quality throughout the packaging process. The temperature can fluctuate depending on the results checked by quality control. If leaks occur, the operator can raise or lower the temperature. If no leaks occur, the temperature is maintained until the production process is complete.

In addition to sealing temperature, operator factors also influence primary packaging leaks. Findings indicate that operators change workstations frequently on packaging machines, resulting in inconsistent skill levels and understanding of machine operation. Operator failure to set machine parameters, monitor sealing results, and address issues during the production process can impact seal quality. To ensure that changes in seal quality are quickly identified, operators must be meticulous in checking the sealing results. In addition to setting machine parameters, operators must also ensure the package remains stable as it passes through the horizontal sealing machine to ensure even heat and pressure distribution across the seal area. Failure by operators to check the seal results can increase the likelihood of leaks.

Sadeghi et al. (2025) stated that to maintain the quality of the seal on flexible packaging throughout the production process, routine monitoring of the sealing process is required. Furthermore, frequent operator changes result in limited operator knowledge of the unique features of packaging machines. Each machine's operating conditions and response to changes in process parameters vary. Operators who lack a thorough understanding of the machine's characteristics tend to take longer to identify and resolve errors during the packaging process. As a result, products with poor-quality seals may continue to be produced before repairs are made. Frequent operator rotation may also reduce the consistency of machine parameter adjustments because each operator has different levels of experience and understanding of the packaging machine. As a result, the response to leakage problems may vary between operators, leading to inconsistent sealing quality throughout the production process.

Corrective and Preventive Measurement

Research results indicate that improvements that can be made to reduce primary packaging leaks primarily focus on controlling sealing temperatures and improving operator skills. Temperature can be controlled by regularly monitoring and checking machine parameters to ensure they remain within a predetermined range, which will result in a more consistent seal. To ensure that temperatures do not fluctuate throughout the production process, the condition of the packaging machine must also be regularly checked. According to **Ilhan et al. (2021)** consistently controlling heat sealing parameters can help improve seal integrity in flexible packaging and reduce the risk of microleaks in the seal area.

For operators, companies should provide regular training on how to operate the wrapping machine, set wrapping parameters, and inspect the wrapping results. Furthermore, operators should be permanently stationed at each wrapping machine to better understand the features of the machine they operate and to detect changes in seal quality more quickly and accurately. Operator skills can help identify and address problems with packaging machines more quickly and accurately. **Robertson (2016)** states that operator skills in monitoring the packaging process affect the consistency of food packaging quality.

CONCLUSION

Analysis of primary packaging leaks in crackers at PT XYZ showed that the percentage of leaks fluctuated throughout the observation period, ranging from 0% to 100%. This fluctuation indicates that the sealing process is not consistent, resulting in variations in seal quality and packaging leaks. The dominant factors causing primary packaging leaks are suboptimal sealing temperatures and operator factors. Recommended improvements to reduce packaging leaks include regular monitoring and control of sealing temperatures and improving operator competency through training and the placement of permanent operators at each packaging machine. Implementing these improvements is expected to improve seal quality consistency and minimize packaging leaks in crackers. Further studies are recommended to evaluate the optimization of sealing parameters and machine performance to further reduce the occurrence of primary packaging leakage.

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