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Product Planning for Soda Can Lid Using the Quality Function Deployment (QFD) Method

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Abstract

The carbonated beverage industry continues to grow in line with the increasing practical lifestyle of modern society. One of the main challenges in the packaging of soda products is the inability of the lid of the cans to maintain carbonation pressure after opening, which leads to a decrease in taste quality and consumer experience. This research aims to design an innovative soda can lid that preserves carbonation using the Quality Function Deployment (QFD) method. Data was collected through questionnaires distributed to 10 consumers to identify primary needs. House of Quality analysis revealed that product precision, ease of use, and material safety were the top priorities. The proposed design incorporates food grade HDPE, ergonomic form, and a seal system to prevent leakage. The concept also emphasizes one handed usability and aesthetic integration with packaging. The QFD approach effectively translates consumer needs into actionable technical specifications, and the final design is expected to enhance consumer satisfaction and loyalty.

Keywords: Carbonation, House of Quality, Packaging design, QFD, Soda can lid

INTRODUCTION

The beverage industry in Indonesia has experienced significant growth, particularly in the carbonated beverage segment. According to data from Statistics Indonesia (BPS, 2026), the average household expenditure on prepared food and beverages monthly average reached IDR 294,118, representing the highest expenditure among all food categories. This indicates that s beverages, including canned carbonated drinks, have become an integral part of modern lifestyles, especially among younger generations and urban communities that prioritize convenience. In addition to convenience, packaging innovation has become a key factor influencing product competitiveness within the beverage industry (Rundh, 2016).

Despite these developments, the design of conventional soda can lid continues to present several technical and ergonomic limitations. Once the can is opened, the beverage gradually loses its carbonation due to the release of carbon dioxide gas into the surrounding environment. This process leads to a decline in the product's sensory quality, including its taste and freshness, thereby affecting consumers' overall consumption experience. Furthermore, the absence of a resealable mechanism increases the risk of spillage and contamination while reducing user convenience, particularly when the beverage is not consumed in a single serving. These limitations may negatively affect the overall user experience, customer satisfaction, and consumers' intention to repurchase the product. In line with this, Silayoi & Speece (2007) emphasized that functional packaging attributes, including ease of use, safety, and convenience, have a significant influence on consumers' purchasing decisions. Therefore, there is a need to develop a can lid design that not only provides aesthetic value but also enhances functionality and preserves product quality after the package has been opened.

Previous studies have demonstrated a strong relationship between packaging design and consumers' perceptions of product quality. Ariyanti & Chan (2020) found that ergonomics, simplicity of form, and visual appeal significantly influence perceived product quality and consumers' purchase intentions. Similarly, Pinthanon et al., (2025) developed a 330 mL beverage package by integrating accessibility, ergonomic considerations, clear typography, and minimalist visual elements, resulting in improved user convenience and enhanced product attractiveness. Nevertheless, studies specifically focusing on soda can lid design with respect to carbonation retention, resealable functionality, and hygienic performance remain limited. This research gap is particularly important because innovations in packaging elements have been shown to enhance consumers' perceptions of product quality and shape their preferences, thereby providing significant added value to the product (Celhay & Trinquecoste, 2015).

To address these challenges, this study proposes the development of an improved soda can lid design using the Quality Function Deployment (QFD) approach. QFD was selected because it systematically translates the voice

of the customer into technical product specifications, enabling each design attribute to be developed based on consumers' prioritized needs and expectations. According to Akao (1990), QFD is an effective product development methodology that enhances product quality from the early design stage by minimizing the gap between customer requirements and technical specifications. Furthermore, the application of QFD has been shown to improve the effectiveness of product development, accelerate the design process, and increase customer satisfaction (de Sales et al., 2022). Accordingly, the implementation of QFD in this study is expected to produce a soda can lid design that is more functional, ergonomic, and responsive to consumer needs while maintaining beverage quality after the package has been opened.

METHODS

Quality Function Deployment (QFD) is a structured methodology utilized to translate customer requirements (CR) into technical specifications (TS) throughout the product development process. This approach enables designers to integrate the voice of the customer into every design phase, ensuring the resulting product aligns more closely with market demands (Karsak, 2004). Furthermore, QFD aids in mitigating design modifications during the late stages of product development through the early identification of customer requirements at the conceptual phase (Carnevalli & Miguel, 2008). The principal instrument within QFD is the House of Quality (HoQ), a matrix employed to systematically map the correlations between customer requirements and the technical characteristics of a product (Marson & Sartor, 2019). According to Akao (1990), the HoQ constitutes the core of QFD implementation due to its capacity to bridge customer requirements with controllable technical parameters during the design process.

The application of QFD has also been proven to enhance product development efficacy via the objective prioritization of customer attributes and technical characteristics (Chan & Wu, 2002). This research was conducted using a quantitative descriptive approach. Primary data were collected through questionnaires distributed to 10 respondents who were active consumers of soda drinks. The sampling technique used was purposive sampling, with criteria including experience in consuming soda products in canned packaging.

The questionnaire consisted of nine indicators of consumer needs for soda can lid. Each indicator was assessed using a Likert scale of 1–5 to measure importance. The results were analyzed to generate CR priorities, which were then linked to TS in the House of Quality matrix.

The main steps in implementing QFD refer to Saeful Nurochim et al., (2021):

1. Identify customer needs (quality needs).
2. Describe measurable quality characteristics.
3. Determine relationships between quality requirements and technical characteristics.
4. Assign numerical weights to technical characteristics.
5. Integrate those characteristics into product design.
6. Carry out design, production, and quality control processes.

Applying these steps, the resulting soda can lid design is expected to be precise, safe to use, ergonomic, and capable of maintaining carbonation quality post opening.

RESULT AND DISCUSSION

The initial process of this research began with collecting customer needs data through questionnaires to 10 active consumers of canned soda drinks. Based on the questionnaire results, nine main needs were identified as the basis for the House of Quality (HoQ). Each need was weighted based on importance assessed by respondents using the Likert scale, shown in Table 1. Questionnaire Results.

Table 1. Questionnaire Results

No	Statement	Degree of importance
1	Can prevent leakage when cans are tightly closed	4.88
2	Maintaining the carbonation level of the drink in the can	4.63
3	Easy to open and close without aids	4.75
4	Visually appealing and in keeping with the design of the can	4.00
5	Material made of eco friendly materials	4.25
6	Not easily damaged or broken during use	4.13
7	Easy to clean after use	4.25
8	Affordable prices	4.13
9	The product is safe to use	4.38

These results show that functional aspects such as preventing leaks, maintaining carbonation, and ease of use are top priorities for consumers. Next, consumer needs were translated into five technical specifications formulated based on QFD principles, as described in Table 2. Technical Target.

Table 2. Technical Target

No	Technical Specifications	Technical Target
1	Precision Products	Using Seal
2	Easy to use and clean.	Simple design has a smooth surface
3	Ergonomic and comfortable design.	5.8 cm Mouth Hole & Easy Lid Opening
4	Safe material.	HDPE plastic, BPA free, Food grade
5	Durable and strong.	Product thickness 2 mm

Based on the QFD analysis, the findings indicate that the most critical technical specifications for soda can lid identified through the five main criteria will be further developed to address consumer requirements through the House of Quality (HOQ). This process is also illustrated in the accompanying figure below.

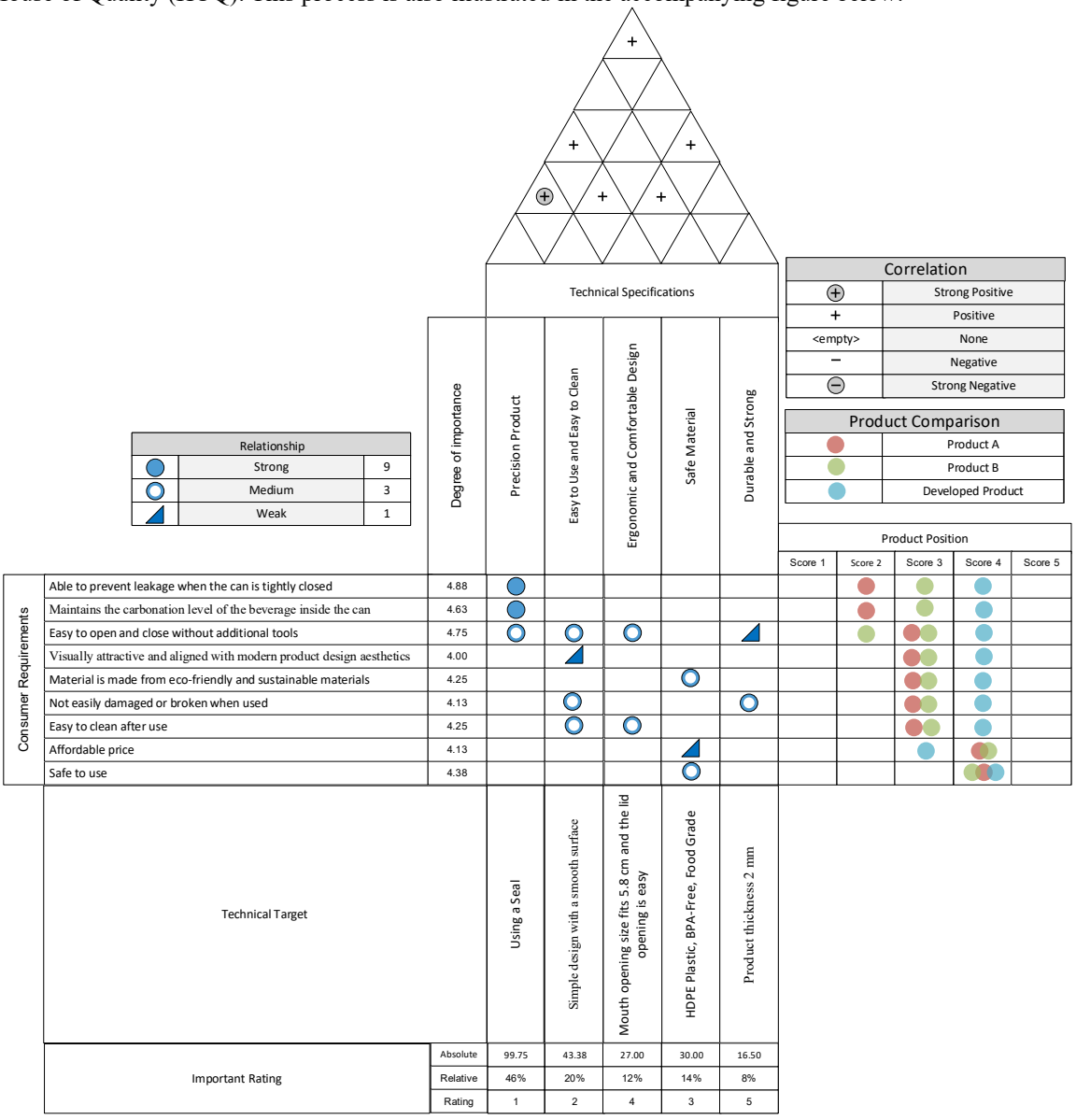

Figure 1 House *Of Quality Results*

From Figure 2 the results of the House Of Quality are explained as follows:

1. Based on the calculation results of the Importance Rating in the House of Quality (HOQ) matrix, the technical specification with the highest level of importance is the use of seals, with an absolute value of

99.75 and a relative value of 46%. These findings indicate that product precision and airtightness have the most significant influence on fulfilling consumer needs, especially in preventing leaks, maintaining beverage carbonation stability, and ensuring ease of use. Therefore, the development of soda can lid designs should focus on improving the effectiveness of the sealing system as the main component that determines the overall performance of the product.

2. The second priority is the application of a simple design with a smooth surface, which has a relative value of 20%. This aspect reflects consumers' preference for convenience and ease when opening and closing cans. An ergonomic shape and smooth surface not only enhance user safety but also strengthen the product's visual appeal and modern appearance.
3. The use of BPA free and food grade HDPE plastic materials ranks third, with a relative value of 14%. Although it is positioned below aspects related to ease of use, this factor still plays an important role because it is directly associated with the safety of products that come into contact with beverages. The selection of safe, non toxic, and environmentally friendly materials adds value that supports the concept of sustainable (eco friendly) packaging.
4. The parameters of the drinking hole fit approximately ±5.8 cm in diameter and the easy open close system have a relative value of 12%, placing them in the fourth priority. Although their contribution is not as significant as the main aspects, they serve important functions in ensuring compatibility between lid and cans while improving product practicality for consumers.
5. Finally, products with a thickness of 2 mm have the lowest relative value at 8%, ranking fifth. These results show that although structural strength and physical durability are still required, they are not top priorities compared to airtightness, ease of use, and material safety. Nonetheless, the product thickness must still be maintained within a safe range to ensure it does not crack or become damaged during use.

After completing the analysis, the next step is to translate each characteristic into the product design. The resulting soda can lid design can be seen in the image presented below

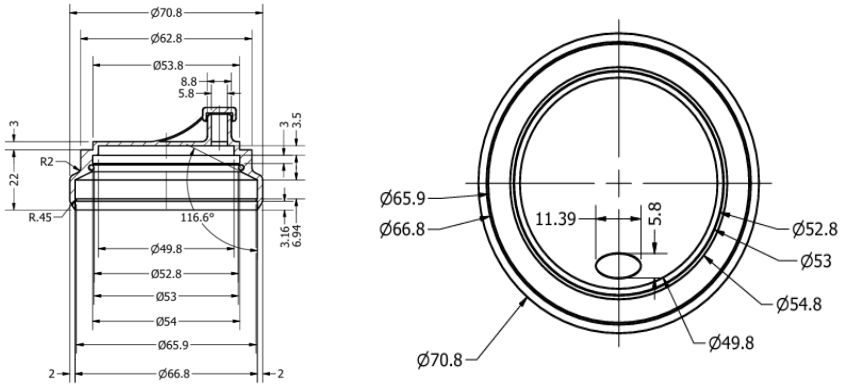

Figure 2. Product Dimensions

The initial stage involves measuring the diameter of the soda can, followed by adjusting the product design so that the resulting can lid achieve a level of precision that aligns with the technical targets established in the House of Quality .

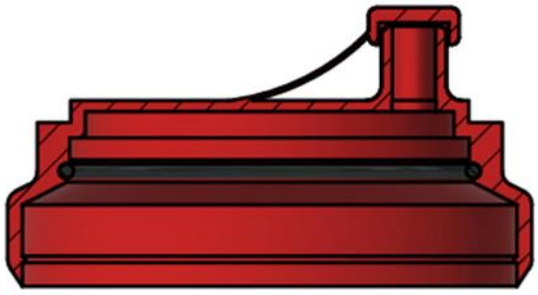

Figure 3. Product Design

The next stage is the implementation of the soda can lid design, as shown in Figure 4. This design represents a product development concept created to ensure an optimal level of precision, enabling it to prevent leaks, maintain the beverage's carbonation, and provide ease of use. The simple lid design allows consumers to open the

can with just one hand, making the product well positioned to meet user needs and expectations. An illustration of the product's usage can be seen in the image below.

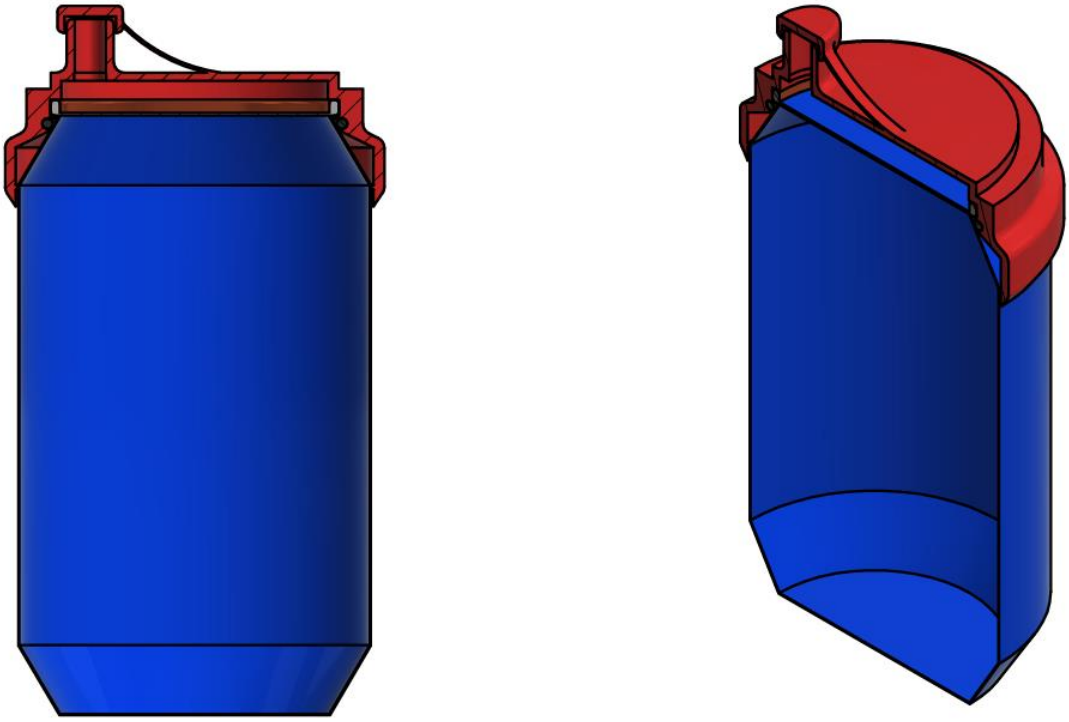

Figure 5. Product Application Illustration

CONCLUSION

This research aimed to design soda can lid products addressing key consumer needs: leak prevention, carbonation preservation, and ease of use. Using the QFD approach, customer voices were translated into five technical specifications guiding the product design.

The House of Quality analysis revealed that sealing precision is the most critical aspect, followed by usability and material safety. The resulting product features a precise sealing system, food grade HDPE material, and an ergonomic design suitable for one handed operation. This design balances functionality, sustainability, and user convenience.

Future research should test the prototype on a broader scale and assess durability and long term usability in real world scenarios.

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