

Using Quality Function Deployment Approach to Design Ready to Drink Beverage Bottles

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ABSTRACT

Due to its role and usefulness in enhancing the product's consistency of beverage product, ready to drink (RTD) packaging is essential and has the appeal. In the beverage industry, competition in packaging is very intense. The practicality requirements promote new beverage packaging bottles that meet customer needs using the Quality Function Deployment (QFD) method. Ready to drink (RTD) category bottle is the design of beverage bottles produced. The choice of methods for the QFD approach is based on consumers' participation in the product design sequence as early as possible to ensure that the product will please customers. Research started with the dissemination of the initial questionnaire, the preparation of the customer's speech, the dissemination of the second questionnaire, the determination of the customer's needs, the decision on technical characteristics, the formation of the house of quality (HOQ), and the production of a visualized design. Round, pet (Polyethylene Terephthalate), bottle height 175 mm, bottle base diameter 61.65 mm, bottle body diameter 59.95 on the bloated body is the resulting RTD beverage bottle shape. In comparison, the diameter of the shrinking body in the middle is 53.24 mm, the height of the neck-to-hole is 15.63 mm, the diameter of the hole is 24.38 mm, the diameter of the cap is 30.63 mm, the weight of the light bottle is 20 grams, the width of the label is 40 mm, the length of the label is 100 mm and the color of the blue and green label with flip and slide versions. The innovation in the design of this RTD beverage bottle is that by separating the two sides vertically, it can accommodate two types of drinks in one bottle (2 in 1 bottle), each side can accommodate 250 ml, and the suggested types of drinks are mineral water and tea from the survey results.

Key Words: Product Design, Packaging, Ready to Drink (RTD), Quality Function Deployment (QFD), House of Quality (HOQ).

1. INTRODUCTION

The company must please its consumers to win the market by offering better goods than its competitors. Companies that have long dominated the market for packaged drinks, as in Figure 1, different types of beverage goods. Bottled water as RTD (Ready to Drink) called in the beverage industry. This RTD drink comprises a wide variety of drinks that can generally be classified as RTD Water (mineral water), RTD Tea, RTD Carbonates. RTD Water has the highest percentage in the first order of 85.1 percent, and the second place is RTD Tea 8.7 percent, the third-place RTD Carbonates 3.0 percent, and the other fourth-place RTD 3.2 percent, based on 2014 Soft Drinks Industry Association (ASRIM) results. Other types of soft drinks, such as coffee, juice, energy drinks, and fitness, are other RTDs.



Figure 1 Examples of Manufacturers of Packaged Beverages with Various Product Variants

Source: cocacola.co.id, sinarsosro.co.id

As shown in the data above, this RTD beverage industry shows the potential to continue to expand. This potential can also be motivated by the immediate changes in young people's lifestyles who like to gather and work outdoors[1]. Consumer rivalry, both locally and multi-nationally, often offers the business more product variations and creates more value or excellence for the product. The packaging is one of the five keys to the successful marketing of food products, and the other is price, product, place, and promotion[2]. Packaging also creates a difference in helping customers decide to pick one of the same works[3], [4].

A product development concept based on customer demand is product creation with the QFD method[5], [6]. The QFD approach has many benefits that companies can obtain, such as being able to schedule quality levels, benchmarking with other companies to understand knowledge about competitors so that they can design and manufacture different products and have superior quality, can minimize design changes resulting from less maximum design, minimize production time and costs, and can broaden the market according to customers wishes, QFD is expected to deliver a revolutionary beverage packaging bottle design.

The characteristics of customer needs for RTD bottle packaging can be known through this research and how the design of beverage packaging bottles is focused on consumer feedback. The aim of deciding characteristics is to understand the consumer's taste for the product. This can be achieved by means of a process (Quality Function Deployment), i.e., by converting the preferences of the user into customer needs attributes corresponding to technical characteristics[7], [8]. QFD is a systematic matrix that illustrates the approach taken to quality product design.

2. METHODOLOGY

The type of data used in this study is quantitative data, which is data in the form of numbers in the form of information required by the consumer. In the context of data from the questionnaire, the primary data source used is the data source, while the secondary data used in this analysis is derived from other literature. Non-probability sampling with unintended sampling is the sampling approach this study uses. Using the Bernoulli sample approximation or proportion method to assess the number of samples in this analysis, the size or number of the total population is unknown[9], [10]. The formula calculates the number of proportional sample methods as follows:

$$n = \frac{(Z_{\alpha/2})^2 \cdot p \cdot q}{e^2} \dots\dots\dots (1)$$

Where:

- n = Minimum sample count
- Z = Normal distribution value (viewed on normal distribution table)
- α = Level of significance (95%)
- p = Proportion of population (70%)
- q = 1-p
- e = Error tolerance (10%)

The results of the estimation using the Bernoulli method on the number of test samples are as follows:

$$\begin{aligned}
 n &= \frac{(Z_{\alpha/2})^2 \cdot p \cdot q}{e^2} \\
 &= \frac{(1,96)^2 \cdot 0,7 \cdot 0,3}{(0,1)^2} \\
 &= \frac{0,806736}{0,01} \\
 &= 80.7 \sim 81 \text{ samples}
 \end{aligned}$$

So the minimum number of samples is as many as 81 samples or 81 respondents. In this study, 85 respondents were taken. The questionnaire that has been disseminated and collected next is tested its validity and reliability[11]. In testing the validity and reliability of data, researchers used tools in the form of computer software.

3. RESULT AND DISCUSSION

Consumer perception (voice of customer) regarding RTD beverage bottles' packaging obtained eight perceptions from the preliminary research results through a questionnaire, namely the lid, shape, label, dimensions, capacity, label design, color, and label detail. Benchmarks of some scientific literature related to beverage packaging have been focused on that understanding. So, 15 characteristics of customer needs were obtained. Packaging dimensions, packaging color, packaging style, packaging shape, non-perishable packaging, safe packaging for health, easy to hold and carry packaging, recyclable packaging, beverage type version, packaging capacity and volume of beverages, and packaging can protect beverage products, packaging weight, easy to open and close lids, easy to leak cap, packaging labels to protect beverage products, packaging weight, easy to open and close lids,

Then, in the questionnaire on consumer needs, 15 attributes of consumer needs were evaluated to obtain the interests of the characteristics of the consumer needs found. From the consumer needs questionnaire answered by 88 respondents, 15 consumer needs, each respondent answered statements. Five response options are given for each report; namely, VNI= Very Not Important, NI= Not Important, IE= Important Enough, I= Important, VI= Very Important.

The next step after obtaining answers from respondents is to assess the data's validity and reliability. One invalid attribute of 15 attributes in the second attribute, namely the color of the packaging, from the test results of the customer requires. This questionnaire relied on reliability test results when approached via the Cronbach Alpha statistical test.

The number of customer needs characteristics is reduced to 14 facts from the test results of validity and reliability data due to invalid need attributes. The indicated points are valid and reliable as follows: packaging measurements, packaging design, packaging shape, non-perishable packaging, health-safe packaging, packaging that is easy to hold and carry, recyclable packaging, beverage type model, packaging capacity and volume of beverage, packaging that can protect beverage products, packaging weight, easy to open and close lids, easy to leak cap, packaging laboratory length, packaging that can protect beverage products, packaging weight,

After the customer needs attribute is calculated, the importance of the interests of each stage of the needs of the consumer is calculated. To measure the amount of interest is to multiply each respondent's response by the weight of each solution. VNI response weight (Very Not Important) 1, NI weight (Not Important) 2, IE weight (Important Enough) 3, I (Important) 4 weight, and VI (Very Important) weight 5.

The results of VNI=1, NI=10, IE=38, I=28, and VI=11 were obtained from the packaging dimension attribute of the respondent's response in Table 1. The value of the packaging dimension = ((1x1)+(2x10)+(3x38)+(4x28)+(5x11)) is divided by 88 (number of respondents), which results in an interest value of 3.43 for the packaging attribute, as shown in Table 2.

Table 1 Customer Need Questionnaire Results

| No | Attributes of Customer Needs | VNI | NI | IE | I | VI | Sample Count |
|----|---------------------------------|-----|----|----|----|----|--------------|
| 1 | Packaging dimensions | 1 | 10 | 38 | 28 | 11 | 88 |
| 2 | Packaging color | 13 | 35 | 28 | 10 | 2 | 88 |
| 3 | Packaging design | 3 | 17 | 24 | 30 | 14 | 88 |
| 4 | Packaging form | 3 | 13 | 22 | 32 | 18 | 88 |
| 5 | Packaging is not easily damaged | 2 | 14 | 19 | 32 | 21 | 88 |

| | | | | | | | |
|----|--|---|----|----|----|----|----|
| 6 | Safe packaging for health | 0 | 11 | 19 | 28 | 30 | 88 |
| 7 | The packaging is easy to hold and carry | 3 | 10 | 35 | 26 | 14 | 88 |
| 8 | Recyclable packaging | 0 | 10 | 9 | 31 | 38 | 88 |
| 9 | Beverage type variants | 3 | 6 | 22 | 38 | 19 | 88 |
| 10 | Packaging capacity and beverage volume | 2 | 9 | 35 | 28 | 14 | 88 |
| 11 | Packaging can protect beverage products | 2 | 17 | 24 | 31 | 14 | 88 |
| 12 | Packaging weight | 1 | 13 | 14 | 40 | 20 | 88 |
| 13 | Bottlecap easy to open and close | 2 | 12 | 16 | 26 | 32 | 88 |
| 14 | The bottle cap is not easy to leak | 2 | 7 | 15 | 24 | 40 | 88 |
| 15 | Packaging labels can provide information | 2 | 13 | 24 | 35 | 14 | 88 |

Source: Processed Primary Data, 2020

For the relative weight value of the attribute of the packaging dimension, obtained from 3.43 divided by 14 (the total number of customers requires characteristics), the relative weight value of the packaging dimension is 6.7% (Table 2).

Those customers' needs with technological characteristics capable of realizing the quality of packaging or bottles of RTD beverages should be addressed after the next customer has been identified. Through the analysis of relevant literature, as many as 24 technical characteristics were obtained from technical aspects to respond to the customer needs characteristics. The technical features of RTD beverage packaging or bottles are the height of the bottle, the base diameter of the bottle, bottle body diameter, neck to hole height, hole diameter, cap diameter, mineral water, and tea marker relief and motif on bottle body, bottle partition to separate drinks, round with middle slightly shrinking. The plastic bottle is quite thick, plastic material, ergonomic hand shape, recyclable plastic bottle, mineral water and tea, total capacity, resistant to cold temperature, lightweight, bottle cap working, bottle cap design, bottle cap material, bottle cap mold result, label width, label length, and last label color.

Like consumer requirements, by sorting the importance of technical attributes from the largest to the smallest quantity, technical characteristics can also be recognized as a priority. In Table 4, the emphasis of the overall technological features can be seen.

Table 2 Value of Interests of Each Attribute of Consumer Needs

| No | Customer Need | Weight Importance | Relative Weight |
|----|--|-------------------|-----------------|
| 1 | Packaging dimensions | 3,43 | 6,7 |
| 2 | Packaging design | 3,40 | 6,6 |
| 3 | Packaging form | 3,56 | 6,9 |
| 4 | The packaging is not easily damaged | 3,64 | 7,1 |
| 5 | Safe packaging for health | 3,88 | 7,6 |
| 6 | The packaging is easy to hold and carry | 3,43 | 6,7 |
| 7 | Recyclable packaging | 4,10 | 8,0 |
| 8 | Beverage type variants | 3,73 | 7,3 |
| 9 | Packaging capacity and beverage volume | 3,49 | 6,8 |
| 10 | Packaging can protect beverage products | 3,43 | 6,7 |
| 11 | Packaging weight | 3,74 | 7,3 |
| 12 | Bottlecap easy to open and close | 3,84 | 7,5 |
| 13 | The bottle cap is not easy to leak | 4,06 | 7,9 |
| 14 | Packaging labels can provide information | 3,52 | 6,9 |

Source: Processed Primary Data, 2020

The way the bottle cap works is the most critical priority in carrying out the design, based on the priority of technical characteristics in Table 4. On the other hand, the most recent value is the relief of mineral water and tea markers and motifs on the body of the container.

Table 3 Customer Needs Priorities

| No | Customer Need | Weight Importance | Priority |
|----|--|-------------------|----------|
| 1 | Recyclable packaging | 4.10 | 1 |
| 2 | The bottle cap is not easy to leak | 4.06 | 2 |
| 3 | Safe packaging for health | 3.88 | 3 |
| 4 | Bottlecap easy to open and close | 3.84 | 4 |
| 5 | Packaging weight | 3.74 | 5 |
| 6 | Beverage type variants | 3.73 | 6 |
| 7 | The packaging is not easily damaged | 3.64 | 7 |
| 8 | Packaging form | 3.56 | 8 |
| 9 | Packaging labels can provide information | 3.52 | 9 |
| 10 | Packaging capacity and beverage volume | 3.49 | 10 |
| 11 | Packaging dimensions | 3.43 | 11 |
| 12 | The packaging is easy to hold and carry | 3.43 | 12 |
| 13 | Packaging can protect beverage products | 3.43 | 13 |
| 14 | Packaging design | 3.40 | 14 |

Source: Processed Primary Data, 2020

Determining customer needs and technological characteristics is the next step. This relationship aims to understand the strength of the relationship between technical features and customer requirements. There are three types of these relationships: stable relationships, moderate relationships, and poor relations. The three types of partnerships were weighted between customer desires and RTD beverages' packaging's technical characteristics. For stable relationships, the weight of the relationship between technical characteristics and customer needs is 9, 3 for medium relationships, and 1 for poor relationships. The relation is shown in Figure 1. in the house of quality (HOQ).

Title: House of Quality
 Author: Didi Junaedi, ST., MT
 Date: 10/9/2020
 Notes:

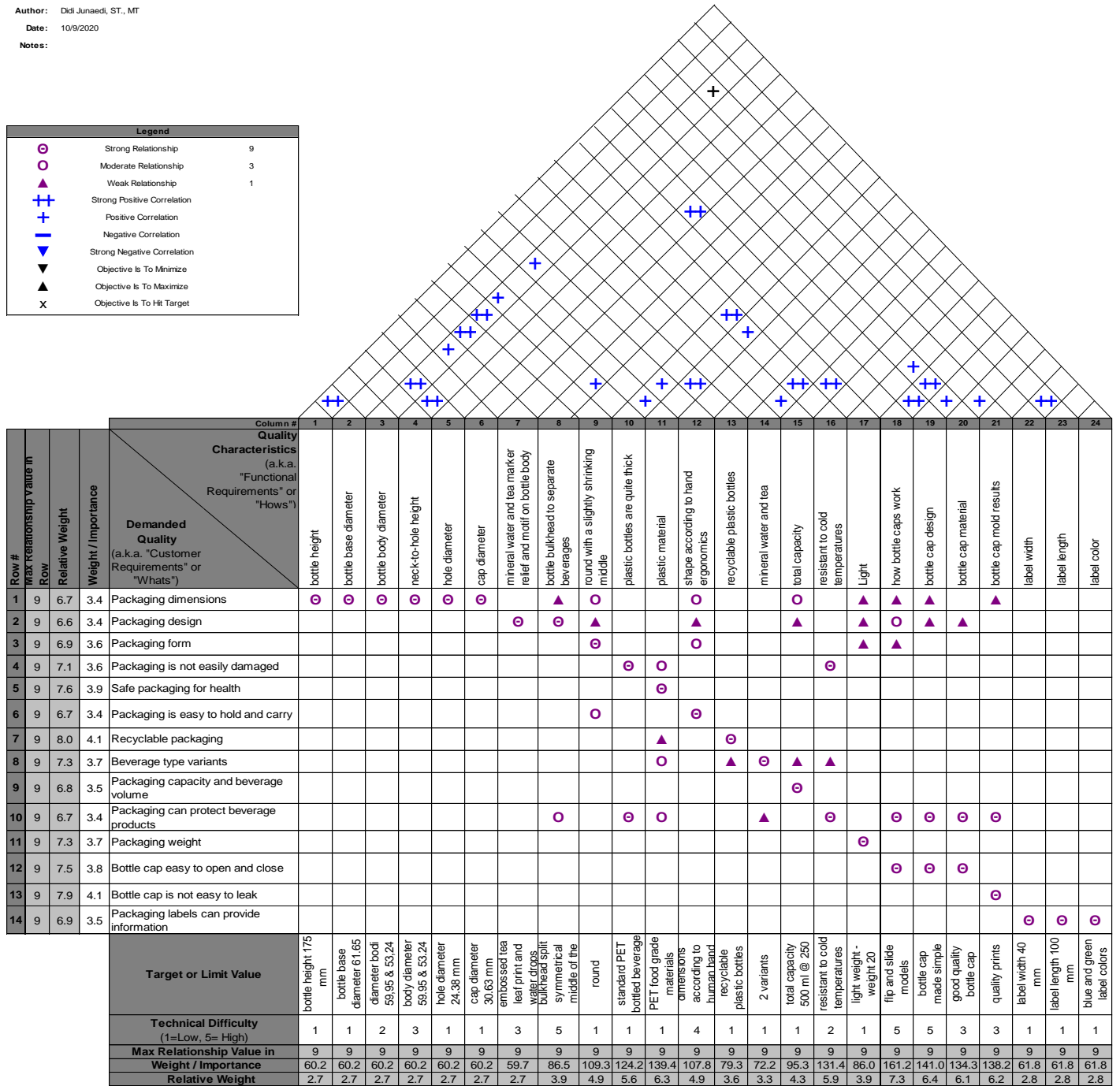


Figure 1 House of Quality RTD Bottle Packaging
 Source: Processed Primary Data, 2020

Next is to set the goal of each technical function attributes. This goal is to monitor each technical function to shape a design that meets consumers' needs. In deciding the objectives of this report, literature reviews and reviews are carried out via the packaging manufacturers' website and discussions with design experts, shown in Table 5, the effectively formulated label.

Table 4 Priority Technical Characteristics of RTD Beverage Packaging

| No | Technical Characteristics | Value of Interest | Priority |
|----|---------------------------|-------------------|----------|
| 1 | How Bottle Caps Work | 161.2 | 1 |
| 2 | Bottle Cap Design | 141 | 2 |
| 3 | Plastic Material | 139.4 | 3 |
| 4 | Bottle Cap Mould Results | 138.2 | 4 |

| | | | |
|----|--|-------|----|
| 5 | Bottle Cap Material | 134.3 | 5 |
| 6 | Resistant to Cold Temperatures | 131.4 | 6 |
| 7 | Plastic Bottles are Quite Thick | 124.2 | 7 |
| 8 | Round With A Slightly Shrinking Middle | 109.3 | 8 |
| 9 | Shape According to Hand Ergonomics | 107.8 | 9 |
| 10 | Total Capacity | 95.3 | 10 |
| 11 | Bottle Bulkhead to Separate Beverages | 86.5 | 11 |
| 12 | Light | 86 | 12 |
| 13 | Recyclable Plastic Bottles | 79.3 | 13 |
| 14 | Mineral Water and Tea | 72.2 | 14 |
| 15 | Label Width | 61.8 | 15 |
| 16 | Label Length | 61.8 | 16 |
| 17 | Label Color | 61.8 | 17 |
| 18 | Cap Diameter | 60.3 | 18 |
| 19 | Bottle Height | 60.2 | 19 |
| 20 | Bottle Base Diameter | 60.2 | 20 |
| 21 | Bottle Body Diameter | 60.2 | 21 |
| 22 | Neck-To-Hole Height | 60.2 | 22 |
| 23 | Hole Diameter | 60.2 | 23 |
| 24 | Mineral Water And Tea Marker Relief And Motif on The Bottle Body | 59.7 | 24 |

Source: Processed Primary Data, 2020

The RTD bottled water packaging breakthrough is on the inside of the bottle and the bottle cap. Two symmetrical sections are divided into the bottle; the object of these two parts or two spaces is to accommodate two types of beverages. Mineral water and tea-flavored water are part of the idea of creating RTD drink bottles. The findings of 9 respondents from 27 samples were collected from two forms of beverages from the distribution of questionnaires at the time of preliminary testing (Figures 2a and 2b), so it was agreed to bottle this RTD beverage kit for mineral water and tea-type drinks.

Table 5 Objectives of Each Distinctive Technical Characteristics

| No | Technical Characteristics | Objective |
|----|--|--|
| 1 | Bottle height | bottle height 175 mm |
| 2 | Bottle base diameter | bottle base diameter 61.65 mm |
| 3 | Bottle body diameter | bottle body diameter 59.95 and 53.24 mm |
| 4 | Meck-to-hole height | neck-to-hole height 15.63 mm |
| 5 | Mole diameter | hole diameter 24.38 mm |
| 6 | Cap diameter | cap diameter 30.63 mm |
| 7 | Mineral water and tea marker relief and motif on the bottle body | embossed print of leaf motifs and water drops |
| 8 | Bottle bulkhead to separate beverages | an asymmetrical split of the middle of the bottle |
| 9 | Round with a slightly shrinking middle | Round |
| 10 | Plastic bottles are quite thick | standard thick beverage bottle PET (<i>Polyethylene Terephthalate</i>) |
| 11 | Plastic material | PET material (<i>Polyethylene Terephthalate</i>) food grade |
| 12 | Shape according to hand ergonomics | dimensions according to human hand ergonomics |
| 13 | Recyclable plastic bottles | recyclable plastic bottles |
| 14 | Mineral water and tea | Two variants |
| 15 | Total capacity | the total capacity of 500 ml @250 ml |
| 16 | Resistant to cold temperatures | resistant to cold temperatures |
| 17 | Light | lightweight - weighing 20 grams |
| 18 | How bottle caps work | flip and slide models |
| 19 | Bottlecap design | the lid is made simple |

| | | |
|----|------------------------|-----------------------------|
| 20 | Bottlecap material | quality bottle cap material |
| 21 | Bottlecap mold results | quality prints |
| 22 | Label width | Label width 40 mm |
| 23 | Label length | Label length of 100 mm |
| 24 | Label color | Blue and green label colors |

Source: Processed Primary Data, 2020

Furthermore, the bottle cap is the other invention besides the notion of 2 drinks in 1 bottle. Since it requires two types of beverages, a good lid must be designed to not leak or clash between the two drinks. The expectation is that it can be easily opened and closed (Figure 2b), the concept-designed bottle cap flips, and slides.



(2a)

Figure 2a Design 3 Dimensional Bottle Packaging RTD



(2b)

Figure 2b Design 3 Dimensional Bottle Cap Packaging RTD

4. CONCLUSION

Characteristics of the consumer's need for beverage packaging bottles ready to drink are as follows: Packaging measurements, Packaging style, Packaging form, Non-perishable packaging, Health-safe packaging, Simple to hold and carry packaging, Recyclable packaging, Beverage type variants, Packaging capacity and volume of beverage, packaging can protect beverage goods, Packaging weight, The lid is simple, Bottle height 175 mm, bottle base diameter 61.65 mm, bottle body diameter 59.95 and 53.24 mm, neck height to hole 15.63 mm, hole diameter 24.38 mm, cap diameter 30.63 mm, bottle base diameter 61.65 mm, bottle body diameter 59.95 and 53.24 mm, neck height to hole 15.63 mm, tea box diameter 24.38 mm, cap diameter 30.63 mm, printed leaf motif and water drops near the bottleneck (tea box) are the following technical features or specifications.

ACKNOWLEDGMENT

Thank you to the Mercu Buana University Research Centre, which has sponsored this research.

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