Affective visual prototyping of ready-to-drink (RTD) spiced beverage packaging

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Abstract. This research aims to develop an affective visual prototype for ready-to-drink (RTD) spice beverage packaging. The study focuses on *wedang uwuh* RTD as an traditional Indonesian spice beverage. Consumer needs were identified through Kansei words collected from Twitter, analyzed using a word cloud and data extraction tools. Kansei words refer to affective adjectives and verbs representing consumers' perceptions of products in the form of measurable parameter. These words were organized into phrases via Semantic Differential I (SD1) questionnaires and selected through factor analysis. Then, the kansei words were translated into design elements, including technical attributes and packaging parameters. Visual concepts were optimized using an orthogonal array. The visual prototype was tested with SD II questionnaires and analyzed using Quantification Theory Type I (QT1). The final prototype, featuring PET material, a screw-on lid, a 6 cm diameter, 250 ml volume, and a curved, round text design, effectively met three of seven Kansei phrases: "Protect the Product," "Easy to Store," and "Simple Design". These features enhance durability, convenience, and aesthetic appeal, aligning with consumer preferences for secure, space-efficient, and visually clear packaging. Future improvements could focus on enhancing grip, reducing size for portability, and improving label visibility to maximize user satisfaction and market appeal.

1 Introduction

Indonesia is a country which has significant historical background related to spice cosmopolis. This country has enormous opportunities and potential for developing industries based on processed spice products [1]. The natural advantages possessed currently are the large number of workers, abundant raw materials, and local spices with unique characteristics, which are lacking in other countries. To remain competitive in the same industry during the liberalization era, Indonesia needs to increase the share of spice exports by developing unique advantages compared to competitors [1].

Wedang uwuh is one of spiced beverage in Yogyakarta which was traditionally produced from a mixture of ginger, clove leaves, cloves, cinnamon, cardamom, shavings of sappan bark, and rock sugar [2]. This beverage has several unique features, with the first being the name which implies "garbage drink" particularly referring to the use of twigs and leaves as

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the basic ingredients looks like garbage swimming in water. Second, the earliest preparation occurred during Sultan Agung's meditation, where ingredients such as leaves and clove flowers were accidentally mixed into the beverage served, creating a fresh and warming taste. Third, *wedang uwuh* is part of Yogyakarta culture and tradional cullinary [3]. Fourth, it has the product features of antioxidant, fenol, aroma, colour and tatste [4]. The previous research also show that the body weight and blood glucose levels has a potential to be controlled by *wedang uwuh* formulation [5]. Based on the numerous benefits and uniqueness, *wedang uwuh* has a high potential to be developed both in terms of product and packaging design.

Packaging affects product image and purchasing decisions [6] due to increasing the interest of consumers through satisfaction. Consumers are often attracted to visually attractive packaging, such as colors, logos, illustrations, text, and appropriate layouts [7]. Packaging design is essential due to the direct impact on purchasing decisions [8], and it plays a crucial role in communicating product attributes to consumers, which shapes awareness and perception. This perception is the initial stage in the purchasing decision-making process, but a positive perception of a product does not necessarily lead to a purchasing decision considering the influence of various other factors [9].

Despite the growing influence of Millennial and Gen Z consumers in the market, existing packaging designs often fail to meet their evolving preferences, particularly in the context of revitalizing traditional spice beverages, which are predominantly produced by micro, small, and medium enterprises (MSMEs). These consumers prioritize sustainability, convenience, and digital integration, yet many current packaging solutions remain outdated, overly complex, or environmentally unsustainable. Effective packaging design is crucial in attracting and engaging these consumers, with affective design playing a key role in addressing their emotional needs. To bridge this gap, it is essential to integrate consumer preferences into packaging design through a combination of physical, virtual, and visual elements, ensuring a more appealing and functional product presentation.

Consumer needs (feelings and first impressions about products) are often transformed into design elements during the development process through a technology known as *Kansei* engineering [10]. According to Ushada et al. [11], the target of *Kansei* is measurable through verbal and nonverbal parameters for the application in agroindustry. In this study, verbal parameters were used in the form of written words known as *Kansei* words, which included adjectives used by consumers to describe perceptions of a particular product.

The collected *Kansei* words were used to describe the perceptions of consumers and potential consumers towards the packing of *wedang uwuh* Ready-to-Drink (RTD) spiced beverage product. Consumer needs expressed in the form of *Kansei* words were translated into design elements which served as the basis for developing 2-dimensional (2D) packaging design for *wedang uwuh*, thereby determining product specifications.

2 Method

Figure 1 indicated the research methodology. The design of *wedang uwuh* RTD spiced beverage packaging was focused on 2-dimensional aspects and product evaluation was conducted using a questionnaire in Google Forms. For micro, small, and medium enterprises (MSMEs) to easily determine design corresponding to the preferences of consumers and potential consumers, Google Forms was used as a medium to distribute the questionnaire received by respondents located outside Yogyakarta and the surroundings. Additionally, 2D designs were developed using the infinite design application and GNU Image Manipulation Program. The choice of Infinite Design and GNU Image Manipulation Program (GIMP) for 2D design was based on their functionality, accessibility, and suitability for packaging design. Infinite Design, a vector-based drawing application, allows for precise shape manipulation,

scalable graphics, and intuitive sketching, making it ideal for creating flexible and refined packaging concepts. GIMP, an open-source raster graphics editor, was selected for its advanced image editing capabilities, including layering, color correction, and text integration, which are essential for enhancing visual elements and refining label designs. The combination of these tools provided a cost-effective yet powerful solution for developing high-quality packaging visuals while ensuring ease of modification and adaptability.

On the other hand, the determination of Kansei words in this study involved collecting data from the social media platform X (formerly Twitter) using Tweet-Harvest, a command-line tool that enables data extraction based on predefined keywords related to packaging preferences. Once collected, the raw data underwent a cleaning process, which included removing duplicates, filtering out irrelevant content, and eliminating spam or promotional tweets [12]. The refined dataset was then analyzed using a word cloud visualization, which helped identify the most frequently occurring words associated with consumer emotions and perceptions. These high-frequency words were subsequently reviewed and selected as Kansei words, representing key emotional attributes that influence packaging preferences.

X (formerly Twitter) is a potential platform to gather consumer perceptions of Indonesian spice drinks as the Millennials and Gen Z consumers [13]. These generations frequently use X to share opinions, preferences, and experiences with brands, making it a relevant source for understanding their perceptions of packaging design. Additionally, X's text-based format allows for natural expressions of consumer sentiment, enabling sentiment analysis and trend identification.

However, The platform's user demographics may not fully represent the broader target consumer group [13]. Additionally, opinions shared on X may be influenced by social trends, virality, and algorithmic visibility, which could introduce bias into the findings. Furthermore, tweets are often brief and may lack the depth needed to understand the full spectrum of consumer preferences and motivations.

To address these limitations and enhance data reliability, Twitter analysis can be supplemented with other methods such as surveys and in-depth interviews. Surveys would allow for a more structured collection of consumer preferences across a diverse demographic, ensuring broader representation. In-depth interviews, on the other hand, would provide deeper insights into the emotional and psychological factors influencing consumer behavior, which may not be fully captured in social media posts. By integrating multiple data sources, the study can achieve a more comprehensive and balanced understanding of consumer needs and packaging preferences.

2.1 Determining the Number of Samples

To determine the adequacy of sample numbers required with an unknown population, the following formula was used [14].

$$n=\left(\frac{Z_{\alpha/2\sigma}}{e}\right)^2 \quad (1)$$

Where:
n = Number of samples
$Z_{\alpha/2}$ = Value of Table $Z_{0.05}$
σ = Population standard deviation
e = Error rate (5%)

$$n = \left(\frac{(1.96)x(0.25)}{0.05}\right)^2 = 96.04 \approx 100 \text{ respondents}$$

The minimum sample size was 100 respondents, with a confidence interval level of 95% and an accuracy level of 90%. Before data collection, a questionnaire test was first performed

with a minimum of 30 respondents to determine the validity and reliability [15]. In the case of *Kansei* word pairs that appeared invalid and reliable, appropriate changes were carried out.

The sampling method in this study was designed to ensure that the selected respondents accurately represent the target demographic of Millennials and Gen Z consumers, who are key drivers of modern purchasing trends. A purposive sampling approach was used, focusing on individuals who actively engage with packaging-related discussions on social media, particularly on X. This platform was chosen due to its high user engagement and the ability to extract real-time consumer opinions. To enhance representativeness, additional criteria such as age, frequency of purchasing packaged beverages, and interest in product design were considered. Where necessary, survey questionnaires or online screening methods were employed to validate the eligibility of respondents. By targeting digitally active consumers with direct purchasing influence, this method ensures that the insights derived from the study align with the preferences and expectations of the intended market.

2.2 Validity and Reliability Test

$$r = \frac{N\sum XY - \sum(X)\sum(Y)}{\sqrt{\{N\sum X^2 - (\sum X^2)\}\{N\sum Y^2 - (\sum Y^2)\}}} \quad (2)$$

Where:
N = Number of data
X = Variable score
Y = Total variable score

The realiability of the questionnaire was tested using the Cronbach Alpha method, where the coefficient was stated to be greater than 0.70 [16].

$$r_{11} = \left[\frac{k}{k-1}\right]\left[1 - \frac{\sum \sigma_b^2}{\sigma^2 t}\right] \quad (3)$$

Where:
N = Number of respondents
$\sum x_I$ = Sum of question item score
$\sum y_I$ = Total score
$x_I y_I$ = Question item score multiplied by total score
r_{II} = Instrument reliability
k = Number of question items
$\sum \sigma_b^2$ = Sum of item variances
$\sigma^2 t$ = Total variance

2.3 Factors Analysis

A factor analysis was conducted following the collection of data from Semantic Differential I (SD 1) questionnaire. This aimed to simplify the data consisting of *Kansei* words associated with the packaging design of *wedang uwuh* RTD spiced beverage through grouping into several related factors. The factor analysis stage comprised Kaiser Meyer Olkin (KMO) and Barlett test as well as a test related to Measure of Sampling Adequacy (MSA) value. KMO value determination and Barlett test were both used to evaluate data adequacy, while MSA was a statistical indicator that measured variable diversity. MSA $\geq$ 0.5 signified a predictable variable worthy of further analysis, but the variable with MSA $\leq$ 0.5 was considered unpredictable and unsuitable for further analysis. The value of 0.5 was used as a cut-off point to remove inappropriate variables [17].

2.4 Determination of Technical Attributes

Determination of technical attributes included discussions with developers and spice experts as well as literature reviews. These technical attributes were the basis for designing the packaging of *wedang uwuh* RTD spiced beverage.

2.5 Orthogonal Design

The preparation of product packaging design was conducted based on the technical attributes and levels of attributes previously collected. At this stage, a product packaging design was produced for subsequent assessment by respondents in Semantic Differential 2 (SD 2) questionnaire. To facilitate assessment, the number of product packaging design produced could be reduced by applying orthogonal design.

2.6 Quantification Theory Type I

Quantification Theory Type I analysis was conducted to evaluate the relationship between *Kansei* word parameters obtained with the packaging design elements of *wedang uwuh* RTD spiced beverage. From this analysis, the correlation value between each technical attribute and *Kansei* word parameters was found. This correlation value would be used as a consideration in determining the best prototype for packaging design development.

2.7 Study Flow Chart

The Figure 1 illustrates the research process for Kansei-based packaging design, beginning with preliminary observations, problem identification, literature study, and objective setting (Stage A). In Stage B, data is collected through Twitter crawling, word cloud generation, Kansei word identification via online questionnaires, and expert judgment, followed by validity and reliability testing. Stage C involves determining technical attributes, developing 2D design alternatives, categorizing items, and compiling the results. Finally, Stage D consists of QT1 analysis, prototype determination, and concluding the study, ensuring the most suitable packaging design is selected based on Kansei evaluation.

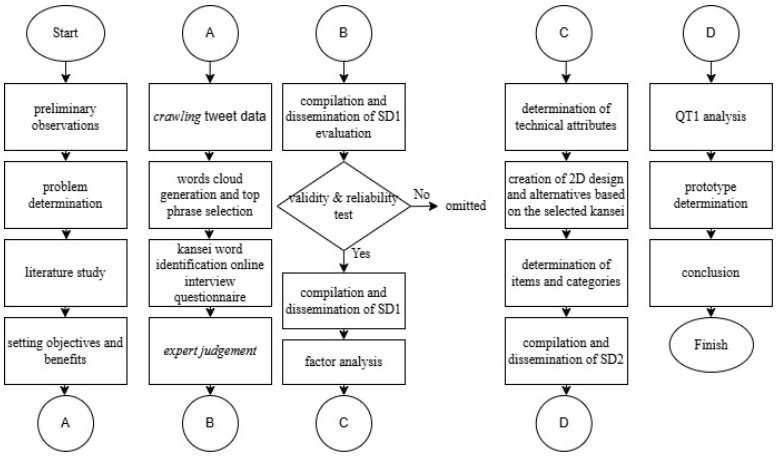


Fig. 1. Research methodology

3 Result and Discussion

Kansei words were determined in this study by crawling data on X using tweet-harvest, a command-line tool containing a certain programming language. The data generated through crawl process were reprocessed with the word cloud to identify the most frequently appearing words. In this context, Twitter/X was selected because it has proven to be capable of capturing *Kansei* words and validating consumer perceptions of spiced beverage as agroindustry products [13]. The keywords used in crawling process were related to *wedang uwuh* RTD spiced beverage, including packaging, RTD, spiced drinks, and *wedang uwuh*. Furthermore, the raw data collected were processed by selecting only the tweets to be used as input for preparing the word cloud through exclusion of *"di", "ke", "dari", "dia",* and other words in Bahasa Indonesia which were prepositions or pronouns (Figure 2).

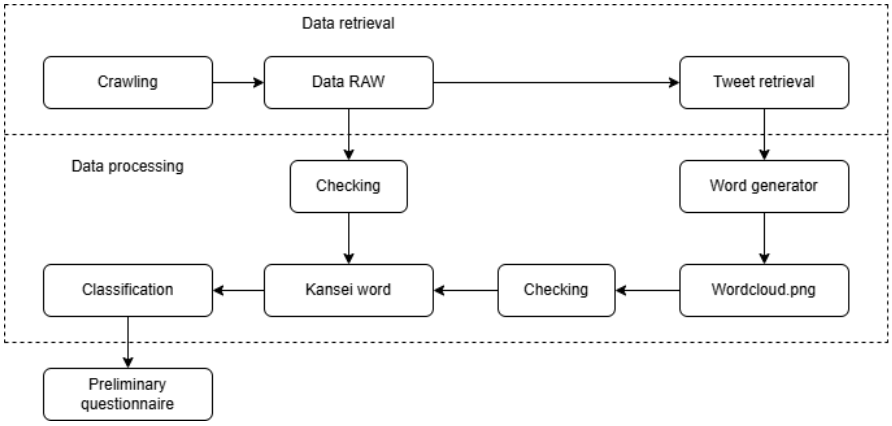


Fig. 2. Initial data collection flow

The results of a word cloud prepared using the website generator are presented in Figure 3. By using the word cloud, the size of each word is specifically proportional based on its frequency of occurrence in the given text [13]. Hence, the more frequently a word appears in the text, the larger it appears in the word cloud. Otherwise, less common words were displayed in a smaller font size. This word cloud can gain quick insights into a large amount of text data from tweets, providing a visual summary of the main topics or themes present in the text and allowing users to grasp the overall content at a glance.

Fig. 3. Word cloud creation results

A total of 47 *Kansei* words collected were classified into 4 closed-ended questions consisting of words describing packaging shape/material, size, and visual design, as well as those relating to typography. *Kansei* word identification questionnaire was distributed to reduce the collected words to be more specific for subsequent pairing with bipolar words. The reduced *Kansei* words paired with bipolar words were tested to obtain views and assessments from experts in related fields. In this study, 5 experts in different fields were used. The validity test of the instrument content was performed using Aiken's V method to assess the relevance of an item to a group of experts [18]. Instruments that have been declared valid were compiled in SD 1 evaluation questionnaire to conduct validity and reliability tests, with Table 1 presenting the validity test results.

Table 1. Validity test results

No	*Kansei* Word Pairs		1^{st} R_{Count} (*Pearson Correlation*)	R_{Table}	Validity	2^{nd} R_{count}	Validity	3^{rd} R_{count}	Validity
1	Complex design	Simple design	0.419	0.312	Valid	0.409	Valid	0.379	Valid
2	Unique nuance	Classic feel	0.337	0.312	Valid	0.305	**Invalid**	-	**Invalid**
3	No images	There are images	0.528	0.312	Valid	0.496	Valid	0.514	Valid
4	Visuals are not too important	Attractive visuals	0.513	0.312	Valid	0.517	Valid	0.547	Valid
5	Modern design	Traditional design	0.228	0.312	**Invalid**	-	**Invalid**	-	**Invalid**
6	Free packaging material	Packaging material according to SNI (Indonesian National Standard)	0.525	0.312	Valid	0.517	Valid	0.552	Valid
7	Easily broken/damaged	Protects the product	0.777	0.312	Valid	0.813	Valid	0.846	Valid
8	Disposable	Reusable	0.707	0.312	Valid	0.731	Valid	0.746	Valid
9	Pollutes the environment	Environmentally friendly	0.592	0.312	Valid	0.616	Valid	0.632	Valid
10	Dark packaging material	Clear packaging material	0.464	0.312	Valid	0.463	Valid	0.431	Valid
11	Single open	Easy to open and close	0.551	0.312	Valid	0.580	Valid	0.610	Valid
12	Complex shape	Practical shape	0.578	0.312	Valid	0.583	Valid	0.592	Valid
13	Difficult to store	Easy to store	0.649	0.312	Valid	0.678	Valid	0.690	Valid
14	Difficult to hold	Easy to hold	0.518	0.312	Valid	0.500	Valid	0.505	Valid
15	Large size	Small size	0.425	0.312	Valid	0.452	Valid	0.409	Valid
16	No need for halal label	Needs halal label	0.742	0.312	Valid	0.778	Valid	0.795	Valid
17	No expiration date information	Include expiration date information	0.803	0.312	Valid	0.834	Valid	0.862	Valid
18	No product benefit information	Include product benefit information	0.551	0.312	Valid	0.549	Valid	0.534	Valid
19	No need for nutritional content information	Includes nutritional content information	0.724	0.312	Valid	0.762	Valid	0.791	Valid

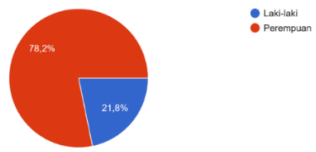
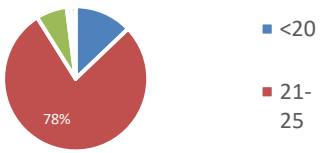
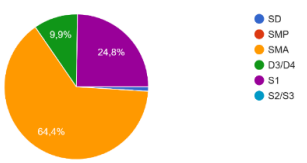
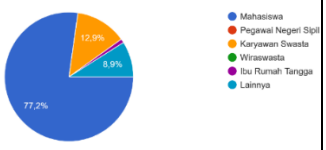
The validity evaluation results showed that 2 pairs of *kansei* words, namely "unique nuance - classic nuance" and "modern design - traditional design", were declared invalid because the calculated *R* correlation value was smaller than the table *R* correlation value. The

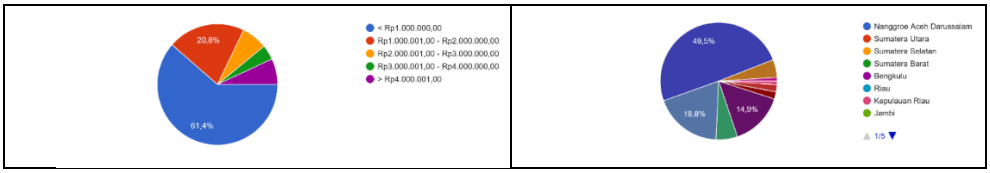
two invalid words cannot be used. Thus, these pairs were not included in the next analysis stage, while *kansei* words declared valid were tested for reliability using Cronbach Alpha. The test generated a Cronbach Alpha of 0.871, where a value greater than 0.7 was considered to have quite high reliability and was recommended [19], hence, the 17 pairs of words used in this study were reliable. *Kansei* words declared valid and reliable included "Complex design – Simple design", "No images– There are images", "Visuals are not too important – Attractive visuals", "Free packaging materials – Packaging materials according to SNI", "Easily broken/damaged – Protects the product", "Disposable – Reusable", "Pollutes the environment – Environmentally friendly", and "Dark packaging materials – Clear packaging materials". Others were "Single-open – Easy to open and close", "Complex shape – Practical shape", "Difficult to store – Easy to store", "Difficult to hold – Easy to hold", "Large size – Small size", "No need for the halal label – Needs halal label", "No expiration date information – Include expiration date", "No need to include product benefits – Include product benefits", and "No need to include nutritional content – Include nutritional content". The word pairs that have been declared valid and reliable were used to compile and distribute SD 1 questionnaire.

3.1 Respondent Characteristics

In the Table 2 reveals that the most of respondents are female (78.2%) within the age range of 20–25 years (78%). In terms of education, most respondents (64%) have completed high school as their highest level of education. The majority are students (77.2%) with a monthly income of less than Rp1,000,000.00 (61.4%). Regarding their place of residence, most respondents are from the Special Region of Yogyakarta (49.5%), followed by Central Java (18.8%) and Jakarta (14.9%). These findings indicate that the most of respondents are young females with a high school education, primarily students, and earning less than Rp1,000,000.00 per month.

Table 2. Respondent Characteristics

Gender	**Age**
	
Educational background	Job
	
Average income	Domicile



3.2 Factor Analysis

SD 1 questionnaire was distributed to 105 respondents aged 18-41 years, including those who have or have not consumed RTD beverage. The data obtained were processed using SPSS version 25 to conduct factor analysis and reduce data complexity by generating a new set of variables (factors) for the replacement of several specific variables. The first step in factor analysis was to conduct a feasibility test on the variables using KMO method and Barlett test.

3.3 KMO and Barlett Tests

The determination of data factorization was based on both KMO value, which was greater than 0.5 (0.908), and the significance of Barlett test value (p <0.05). The results showed that the data used met the requirements for factor analysis, as it benchmarked to other research result [19]. Meanwhile, from Barlett sphericity test with Chi-Square 1.243 and df 136, the significance value obtained was <0.001. These suggested that the correlation matrix was not an identity matrix, thereby enabling further analysis, with Table 3 presenting the results of KMO and Barlett test.

Table 3. KMO and Barlett Tests

KMO and Barlett Tests		
Kaiser Meyer Olkin Measure of Sampling Adequacy		0.908
Barlett Test of Sphericity Approx. Chi-Square		1.243
	Df	136
	Sig	<0.001

3.4 Anti-Image Matrices

Anti-image matrix in factor analysis is a diagonal matrix containing the individual reliability coefficients of each variable and it assesses how each variable can represent the factors analyzed. Additionally, anti-image correlation section has a correlation number with the sign "a" on each variable. This sign denotes MSA value, where the value of 0.5 is used as a cut-off point to remove inappropriate variables [17], and anti-image correlation results are shown in Table 4. From the 17 variables, no MSA values <0.5 were found, therefore, all variables were qualified for further analysis.

Table 4. MSA Values of Kansei Word Pairs

No	**Variables (*Kansei* Word Pairs)**		**MSA Values**
1	Complex design	Simple design	0.706
2	No images	There are Image	0.882
3	Visuals are not very important	Attractive visuals	0.910

No	Variables (*Kansei* Word Pairs)		MSA Values
4	Free packaging material	Packaging materials according to SNI	0.959
5	Easily broken/damaged	Protects the product	0.912
6	Disposable	Re-usable	0.88
7	Pollutes the environment	Environmentally friendly	0.91
8	Dark packaging material	Clear packaging materials	0.698
9	Single open	Easy to open and close	0.864
10	Complex shape	Practical shape	0.936
11	Difficult to store	Easy to store	0.898
12	Difficult to hold	Easy to hold	0.929
13	Large size	Small in size	0.618
14	No need for halal label	Needs a halal label	0.919
15	No expiration date information	Expiration date information	0.934
16	No product benefit information	Product benefit information	0.918
17	No need for nutritional content information	Nutritional content information	0.929

3.5 Total Variance Explained

Total variance explained describes the extent to which the factors identified in the factor analysis explain the variance in the data, with Table 5 presenting the number of factors formed.

Table 5. Eigenvalues and Factors Formed

Component	*Extraction* Sums of Squared Loadings		
	Total	% of Variance	Cumulative %
1	8.574	50.437	50.437
2	1.460	8.588	59.025
3	1.084	6.378	65.403

Based on the presented information, when using 1 out of the identified factors, the eigenvalue value reached 8.574. The use of 2 factors led to the dropping of eigenvalue to 1.460, and with 3 factors there was a decline to 1.084. However, when examined with 4 factors, the eigenvalue value reduced to 0.933 which was less than 1, suggesting only 3 factors to be optimally significant for consideration.

3.6 Rotated Component Matrix

The rotated component matrix originates from the rotation of the component matrix in factor analysis which is conducted to simplify the interpretation of factors. In this study, orthogonal rotation was used with the varimax method which has jointly proven effective in estimating statistics on certain latent variable models during application with spectral-based matrix pruning techniques to reduce dimensions [20]. *Kansei* word pairs with loading factor values of less than 0.7 show that the rotation coefficient between the variables and factors after the rotation process is below the threshold value generally considered significant. This suggests

that the variable has a lower contribution to the factors in the rotated component matrix, leading to an insignificant influence on the analysis. Based on the results of processing the rotated component matrix for 17 *Kansei* word pairs, only 12 pairs met the criteria with loading factor values greater than 0.7, as presented in Table 6.

Table 6. Selected Kansei Word Pairs

No	Factor	*Kansei* Word Pairs		*Loading Factor*
1	1	No expiration date information	Expiry date information	0.898
2		Easily broken/damaged	Protects the product	0.891
3		Difficult to store	Easy to store	0.887
4		No nutritional information needed	Nutritional content information	0.851
5		Free packaging material	Packaging material according to SNI	0.822
6		Difficult to hold	Easy to hold	0.794
7		Complex shape	Practical shape	0.764
8		No halal label needed	Needs halal label	0.761
9		No product benefit information	Product benefit information	0.737
10		Pollutes the environment	Environmentally friendly	0.715
11	2	Complex design	Simple design	0.832
12	3	Large size	Small size	0.886

The factor analysis results reveal three key dimensions that influence consumer emotional needs in packaging design:

a) Product Information (Factor 1) – This factor represents the importance of clear and accessible product details. Consumers value packaging that provides transparent information about ingredients, nutritional content, origin, and sustainability [21]. High loadings on elements such as labels, QR codes, and transparent materials suggest that consumers seek trust and authenticity in their purchasing decisions. Millennials and Gen Z, in particular, prioritize brands that communicate openly and provide verifiable claims, reinforcing their confidence in product quality.

b) Simple Design (Factor 2) – This factor highlights consumer preference for minimalist and uncluttered packaging. A high correlation with clean typography, neutral color schemes, and straightforward branding suggests that consumers appreciate designs that are easy to understand and aesthetically pleasing [22]. Simple designs help reduce cognitive overload, enhance product recognition, and create a sense of sophistication and modernity, making the product more appealing on shelves.

c) Small Size (Factor 3) – This factor reflects consumer demand for compact and portable packaging. Consumers, particularly younger demographics with on-the-go lifestyles, prefer smaller packaging formats that offer convenience and portion control. High loadings on lightweight materials, resealable features, and ergonomic shapes indicate that portability is a key driver of purchasing decisions, particularly for beverages and single-use products.

3.7 Translation of Consumer Needs into Technical Attributes

Selected *kansei* words were used in this study as consumer needs for the packaging design of *wedang uwuh* RTD spiced beverage product due to the potential positive connotation possessed. Furthermore, words with the same meaning can be combined into one unit to form one technical attribute such as an information label representing consumer needs related to expiration date information, nutritional content information, halal labels, and product benefit information. The technical attributes determination is based on data obtained through literature studies, which are subjected to expert testing again to assess whether the technical attributes to be developed are relevant to the selected *Kansei* words. In *Kansei* engineering, technical attributes are often classified into intrinsic and extrinsic categories (Table 7). Intrinsic technical attributes are directly related to the characteristics or functionality of product, while extrinsic are closely related to external factors affecting user perceptions of product developed. These technical attributes will be described on several levels, leading to the conduction of a combination process to identify the most optimal design.

Table 7. Intrinsic and Extrinsic Technical Attributes and Factor Levels

No	Technical Attributes		Factor
1	Intrinsic	Packaging material	*Glass*
			PET
			Tetrapak
		Middle diameter	6 cm
			8 cm
		Packaging shape	*Curve* or *Sharp-corner*
			Tapering or *Regular*
2	Extrinsic	Bottle cap mechanism	*Screw Cap*
			Flip-top Cap or Cork Closure
		Content capacity	250 ml
			330 ml
		Logo	*Image*
			Text
		Label	*Round*
			Angular

3.8 Compilation of Design Samples Using Orthogonal Design SPSS

In determining design samples, intrinsic and extrinsic technical attributes are combined. Supposing all factors of intrinsic and extrinsic technical attributes are combined in this study, a large number of results will be formed, namely 192 (3×2^6) combinations. This complicates the assessment of the entire design samples by respondents, leading to the need to reduce the number of samples using orthogonal design. The results of determining packaging design combinations using orthogonal design are presented in the Table 8.

Table 8. Combination Results with Orthogonal Design

Design	Packaging Material	Bottle cap mechanism	Middle Diameter	Center Capacity	Packaging Shape	Product Logo	Information Label
1	PET	Flip-top	6 cm	250 ml	Curve	Text	Round
2	PET	Flip-top	6 cm	330 ml	Tapering	Image	Round
3	Glass	Cork Closure	8 cm	250 ml	Curve	Image	Round
4	Glass	Screw	6 cm	330 ml	Curve	Image	Angular

Design	Packaging Material	Bottle cap mechanism	Middle Diameter	Center Capacity	Packaging Shape	Product Logo	Information Label
5	Glass	Screw	6 cm	250 ml	Tapering	Text	Angular
6	Tetrapak	Flip-top	6 cm	330 ml	Sharp-corner	Text	Angular
7	Tetrapak	Screw	8 cm	330 ml	Regular	Image	Round
8	Glass	Cork Closure	8 cm	330 ml	Curve	Image	Angular
9	Glass	Cork Closure	8 cm	330 ml	Tapering	Text	Round
10	Glass	Screw	6 cm	250 ml	Curve	Image	Round
11	Glass	Screw	6 cm	330 ml	Tapering	Text	Round
12	PET	Screw	8 cm	250 ml	Tapering	Image	Angular
13	PET	Screw	8 cm	330 ml	Curve	Text	Angular
14	Tetrapak	Flip-top	6 cm	250 ml	Regular	Image	Angular
15	Tetrapak	Screw	8 cm	250 ml	Sharp-corner	Text	Round
16	Glass	Cork Closure	8 cm	250 ml	Tapering	Text	Angular

3.9 Design Results

Based on the specifications determined with orthogonal design, the samples were developed using the infinite design application and GNU Image Manipulation Program software. Subsequently, packaging design was obtained from the entire results generated, as shown in Table 9.

Table 9. Results of Prototype Design Preparation

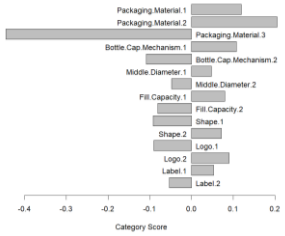
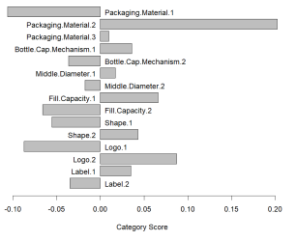
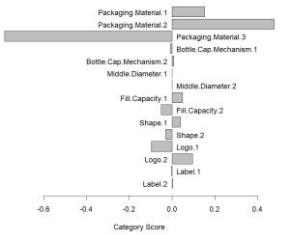
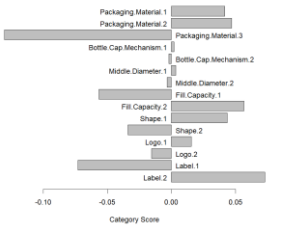
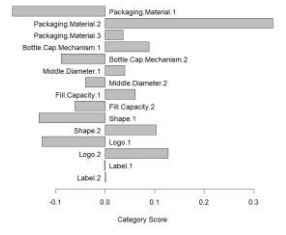
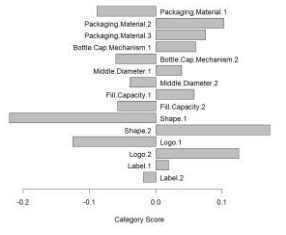
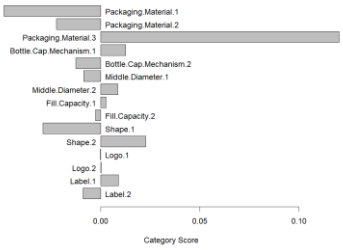
		
Front view design	Rear view design	Side view design

3.10 Quantification Theory Type I (QT1) Analysis Results

A total of 16 packaging design prototypes developed were distributed through SD 2 questionnaire. The following are QT1 analysis results in plot form, as shown in Table 10. The

diagram on the right side shows positive values, indicating the specifications that best represent the Kansei phrases, while the diagram on the left side shows negative values, indicating the least representative specifications.

Table 10. Plot Results

Plot Results		
 Protect the product	 Easy to store	 Easy to hold
 Small size	 Practical shape	 Simple design
Description: From left to right in order “Protects the product”, “Easy to store”, “Easy to hold”, “Small size”, “Practical shape”, “Simple design”, and “Information label”	 Label	

The category score determines the strength of category influence or factor level on *Kansei* words, while the score sign describes the nature of the factor level influence on *Kansei* words. Additionally, the polarity determines the influence characteristics, and a greater category score value leads to a more significant influence on consumer psychological perception [23]. The most optimal prototype, which represents three out of the seven selected Kansei phrase images—*"Protects the Product," "Easy to Store,"* and *"Simple Design"*— is the prototype with the following specifications: PET, Screw Cap, 6 cm diameter, 250 ml volume, Curved Shape, Text Logo, and Round Label. These three Kansei phrase images were determined to be the most optimal because they share common specifications, meaning minimal adjustments are required. The selection of specifications aligns with the designer's needs

based on the chosen Kansei phrases. The design specifications corresponding to all seven Kansei phrases was indicated by Table 11.

Table 11. Packaging design based on 7 selected kansei words

Protects the product	Easy to store	Easy to hold
		
Small size	Practical shape	Simple design
		
Description: From left to right in order “Protects the product”, “Easy to store”, “Easy to hold”, “Small size”, “Practical shape”, “Simple design”, and “Information label”	Information label 	

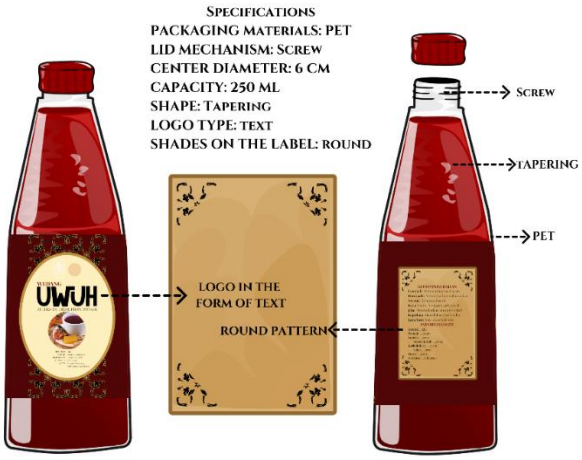


Fig. 4. The best prototype based on consumer preferences

The final prototype design was developed to align with consumer emotional needs while ensuring commercial viability. One of the key design features is the emphasis on product information, which enhances trust and transparency. The prototype incorporates clear and concise labeling that highlights key product benefits, ingredients, and sustainability claims. The prototype also adopts a minimalist and modern aesthetic to enhance cognitive ease and visual appeal. A clean, uncluttered design with a neutral color scheme and modern typography creates a premium perception and improves product recognition on store shelves [22]. By reducing excessive design elements, the packaging offers a more intuitive shopping experience, reinforcing consumer confidence and brand credibility.

Furthermore, the compact and portable packaging size addresses consumer demand for convenience and flexibility. The smaller, lightweight design makes the product easy to carry and store, while the resealable screw cap prevents spills and maintains freshness [24]. This feature is particularly beneficial for on-the-go consumers who value practicality in their daily routines.

Overall, the final prototype design successfully integrates emotional and functional needs, creating a packaging solution that is not only attractive and engaging but also practical for large-scale production. By addressing key consumer expectations and maintaining commercial feasibility, the design enhances brand appeal and market potential, ultimately contributing to long-term business success.

4 Conclusion

This study explored consumer emotional needs in packaging design by applying kansei engineering to identify key preference factors. The results revealed seven Kansei word pairs that represent consumer perceptions, including "Easily broken/damaged – Protects the product," "Difficult to store – Easy to store," "Difficult to hold – Easy to hold," "Large size – Small size," "Complex shape – Practical shape," "Complex design – Simple design," and "Without information label – Information label." The final prototype, designed based on these findings, successfully incorporated three of the most influential factors: "Protects the product," "Easy to store," and "Simple design." The selected prototype featured PET material, a screw cap, a middle diameter of 6 cm, a volume of 250 ml, a curved shape, a text-based logo, and a round label—elements that align with consumer preferences for functionality, convenience, and aesthetic appeal.

Beyond identifying preferred packaging attributes, the study demonstrates the value of kansei engineering in translating consumer emotions into tangible design features. The findings provide practical implications for businesses, particularly micro, small, and medium enterprises (MSMEs), seeking to develop packaging that enhances user experience and brand perception. By integrating emotional design elements, companies can create packaging that not only appeals visually but also improves usability and functionality.

However, there were some limitations in this study. The reliance on Twitter as a data source may not fully represent the broader consumer demographic, as opinions on social media can be skewed by digital trends and platform-specific user behavior. Additionally, while factor analysis provided valuable insights, further validation through surveys, in-depth interviews, or real-world product testing could strengthen the findings. Future research could explore cross-cultural differences in packaging preferences or examine the long-term impact of emotionally driven packaging on consumer loyalty and brand perception.

In conclusion, this study highlights the critical role of emotional and functional considerations in packaging design. By aligning design elements with consumer expectations, brands can develop more effective, engaging, and commercially viable packaging solutions, ultimately enhancing their market competitiveness and customer satisfaction.

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