Implementation of kansei engineering in the design of packaging design elements: study case for Food MSME

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ABSTRACT

The current packaging of products in the market is criticized for its simplicity and lack of adequate safety features, which compromises both product safety and visual appeal. To address this, a research initiative was undertaken to enhance the design and functionality of packaging. The study employed Kansei engineering to discern consumer preferences regarding packaging. The findings incorporated 46 packaging samples and identified 44 Kansei words. Utilizing Principal Component Analysis (PCA), two design concepts emerged: "Standard-simple" and "informative-efficient." The "standard-simple" concept, with the highest R-Square value of 0.9615 through QTT-1 results, was selected for further development. The design elements derived from consumer preferences include a square shape, kraft cardboard material, window feature, typography design, minimalist style, surface sticker, grey colour, and header card/topper cover shape. The packaging design, based on these elements, was translated into 3D mockups. Survey results indicated a preference for the Reusable concept mockups (PC2). Sample evaluation, conducted using fuzzy logic on the PC1 sample, yielded a value of 4.0, affirming the positive reception of the redesigned packaging concept. This research contributes to elevating the visual appeal and functionality of packaging, aligning it more closely with consumer preferences.

1. Introduction

Rangi cake, a traditional Indonesian dish known for its sweet and savoury taste and soft texture, is considered an integral part of our culinary heritage (Teviningrum, 2016). Made from simple ingredients such as rice flour, brown sugar, and coconut milk, this cake has become a favourite of many for its distinctive deliciousness. However, lack of attention to packaging and hygiene often causes Rangi cake to be less desirable in the market and reduces its competitiveness. Traditional packaging of Rangi cake often uses clear plastic material which is less attractive and ineffective in preventing contamination. In fact, some sellers choose to use used paper, such as newsprint, as an alternative to wrapping. Although considered cheap, the use of newsprint has its own risks that are often not realized, especially when it comes to ink that contains harmful compounds such as lead. The use of newsprint to wrap cakes can result in the accumulation of harmful substances, potentially jeopardizing the health of consumers with the risk of nervous system disorders and an increased chance of cancer (Indraswati Denok, 2017).

Awareness of the importance of product quality and appearance in competing in the market is still low among Micro, Small and Medium Enterprises (MSMEs), especially related to packaging aspects

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(Suherlan, 2018; Parid & Hasibuan, 2020). The quality of Rangi cake's packaging is not only related to product safety aspects, but also an effort to create an appeal that is able to compete in the midst of increasingly competitive market competition. More than just ensuring product safety, improvements to packaging also play an important role in building an attractive image for consumers Packaging plays an important role in attracting consumer attention to Rangi cake, with attractive and informative designs being key in influencing purchasing choice (Sari et al., 2020). This is in line with the view that packaging is not only a container for the product, but also a description of the contents of the product itself. In addition to influencing purchasing decisions, packaging also plays a role in shaping the impression or image of a product in the minds of consumers. In designing packaging for Rangi cake, it is important to consider the traditional sweet-savoury taste inherent in the cake, with design aspects such as colour, image, and packaging shape having a significant role in creating an attractive appeal to consumers (Prameswari et al., 2018).

Rangi cake's packaging development process involves the Kansei Engineering method as an active approach in product development, playing a key role in translating consumers' impressions, emotions, and desires of a product or concept into design adjustments and design factors (Guo et al., 2020). This method deeply understands Kansei words to obtain a more detailed picture of the appearance of the packaging desired by consumers (Mashadi & Munawar, 2021). By taking into account the highest ranking and most desired categories by consumers, this approach enables the development of packaging that is not only visually appealing but also more in line with consumer desires and expectations. In the research process, the Kansei Engineering method was used to gain a deeper understanding of consumer preferences and desires for Rangi cake packaging. Furthermore, the Principal Component Analysis (PCA) method was applied to find a more suitable new design concept through morphological identification and R-Square values (Granato, 2018). Complementing this approach, PCA is also used to process complex data of consumer preferences for Kansei words, resulting in design concepts that are more focused and in line with consumer perceptions (Suzianti & Aldianto, 2020). Following this, an evaluation was conducted by applying the Fuzzy Inference System (FIS) method, a method in fuzzy logic used for decision-making and control.The integration of the FIS method as an evaluation stage is relevant to ensure the suitability of Rangi cake's packaging design to the expectations and preferences of consumers holistically.

In determining the design elements of Rangi cake's packaging, the Quantification Theory Type-1 (QTT-1) method was applied to identify design elements based on consumer preferences. The selected design elements, resulting from the QTT-1 method, will be the basis in designing the new packaging for Rangi cake. A 3D mockup will be created as a visual representation of the resulting packaging design. The main objective of this research is to apply the Kansei Engineering approach in the development of packaging design concepts and elements, focusing not only on product safety aspects but also creating an attractive appeal to consumers. Through the improvement of Rangi cake's packaging in accordance with the desires and emotions of consumers, it is expected to increase its competitiveness in the market, make a positive contribution to consumer acceptance, and strengthen the product's position in the increasingly fierce market competition.

2. Methods

This research uses data obtained from semantic differential questionnaires and processed using the PCA method to produce design concepts. The design concepts obtained were evaluated using a Likert questionnaire and analyzed using morphological analysis and processed using the QTT-1 method. This method can convert the category type of the independent variable (design element) into a quantitative type in Kansei Engineering. The following is the flow of research stages that can be seen in Fig. 1.

Collecting Packaging Samples

The collection of packaging samples aims to provide information in the form of design concepts, shapes, and materials contained in product packaging. Packaging samples can be packaging already on the market or packaging with similar products, which have the same product characteristics. The minimum number of samples used is 20 to 25, which includes various properties and types of packaging (Sari, 2019). The packaging samples are then selected and identified in terms of packaging shape, design concept, packaging material and functionality.

Collecting Kansei Words

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The process of collecting Kansei words was carried out by means of questionnaires to respondents and direct interviews in an open manner. Video stimulus was used to facilitate the collection of Kansei words to provide detailed information on product packaging to the product. Implementation depends on the purpose, the recommended number of this kind of consumer research is about 30-50 words, from a reference number of 30 respondents (Sari, 2019).

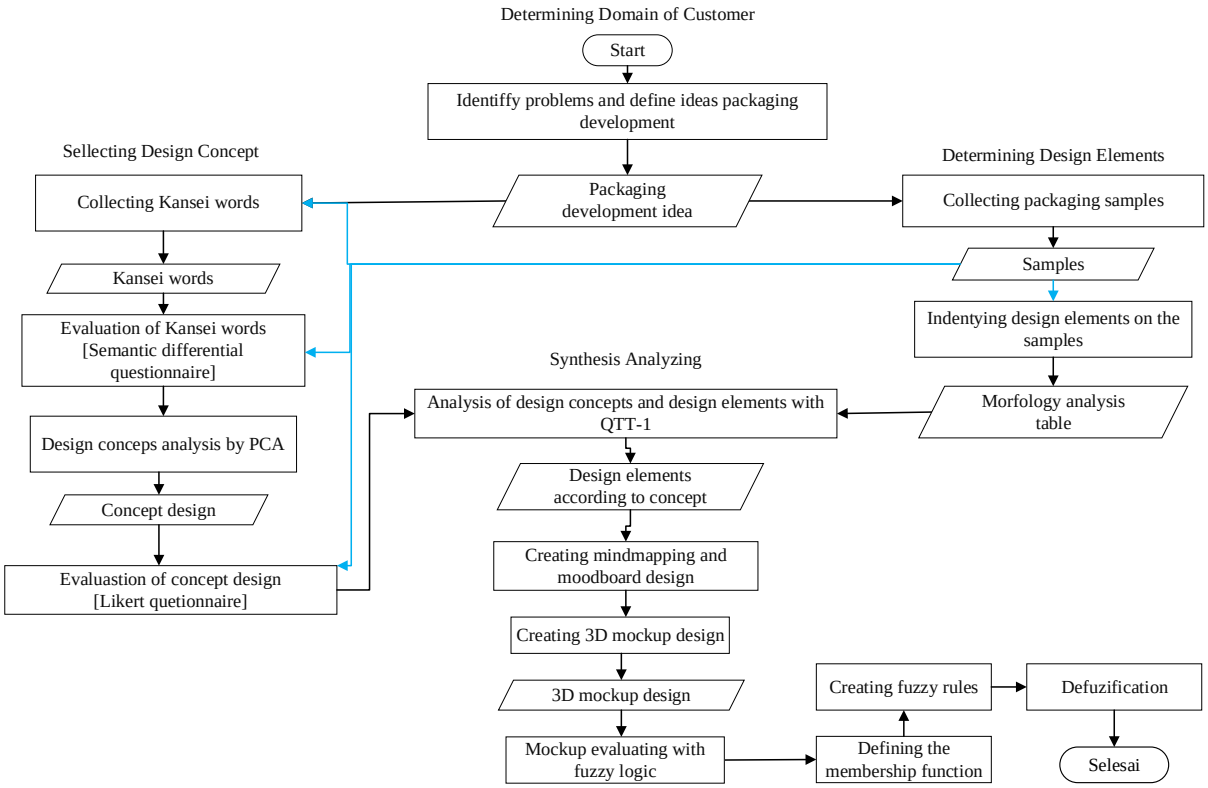

Fig. 1. Research process flow.

Determining Concept with PCA

In determining the design concept, a survey was conducted to respondents using the Semantic Differential questionnaire. The Semantic Differential questionnaire uses a 7-point measurement scale that has a semantic meaning bounded by 2 opposing adjective attributes (Sari, 2019). The data obtained from the semantic differential questionnaire is processed using R software, resulting in a Principal Cumulative (PC) value. The selected PC is the one that has a cumulative proportion value above 80%, with the value of the principal component variation and standard deviation > 1 must be maintained (Coghlan, 2014).

Concept Evaluation

The selected PC are concepts that have positive and negative values, then the PC are made antonyms and evaluated with the selected packaging samples. Concept evaluation is done using a Likert questionnaire with 7 rating scales. The rating scale will make it easier for consumers to assess the selected packaging samples with existing concepts, according to consumer views.

Morphology Analysis

Morphological analysis is an approach used to extract product elements from existing product samples. This process involves interviews with experts (Sari, 2020). The selected packaging samples are identified physically, aesthetically, and functionally by creating codes and types in the morphology table.

Element Analysis with QTT-1

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The data obtained from the Likert questionnaire were calculated as min, max, mean and standard deviation values for each packaging sample (Adrianty & Sari, 2023). Each selected packaging sample was identified according to the design elements according to the morphology table. The results obtained from morphological grouping, mean, and standard deviation are processed using QTT-1 analysis with R software. QTT1 is one of the multiple linear regression analysis tools to measure the relationship between design elements and design concepts. The results obtained are design elements and types that are selected based on morphological grouping (Peng Lu, 2021). The QTT-1 method uses a multiple linear regression model formula with the following equation (Yuliara, 2016):

$$Y = a + b_1X_1 + b_2X_2 + \cdots + b_nX_n \quad (1)$$

Notes:
Y : the independent variable (the value of the variable to be predicted)
a : constant
$b_1, b_2, \ldots, b_n$: coefficient value
$X_1, X_2, \ldots, X_3$: independent variable

Creating Mockups

The design elements obtained were made into rough sketches based on the results of the QTT-1 data analysis on PC1 and PC2, to be selected by packaging experts. The selected sketches were made into surface designs based on the mind mapping and mood board that had been made. Packaging design is done using adobe illustrator software to create a 2-dimensional design and blender software to create a 3D mockup. Design concepts that have been obtained in the PCA process and design elements from the QTT1 process, mockups are made based on selected concepts and elements, then a survey is conducted using Google Form, to find out the selected packaging design that is suitable based on consumer preferences.

Mockups evaluation with Fuzzy

Fuzzy logic is used to provide tolerance for data uncertainty (Munawaroh ., 2019). The following are the stages in making the Fuzzy Logic model:

a. Defining input and output variables
The priority of the design concept applied to the design is determined by looking at the largest R Square value. The design concept with the largest PCC value in the QTT1 data, which will be applied in the packaging development design. The mean value will be input and will produce output in the form of value and DoS.

b. Defining the membership function
Fuzzification refers to the process of transforming the values of input variables into the form of fuzzy sets or membership degrees. The shape of fuzzy numbers can vary, but triangular or trapezoidal shapes provide an adequate representation of expert knowledge and significantly simplify the computational process.
According to (Fitrie & Arnah Ritonga, 2022), a triangular Fuzzy number is a fuzzy value that has a point Ã = ($a1$, $a2$, $a3$) as for the membership function as follows:

$$\begin{cases} 0, x < a1 \\ \frac{x-a1}{b-a}, a1 \le x \le a2 \\ \frac{a3-x}{a3-a2}, a2 \le x \le a3 \\ 0, x > a3 \end{cases} \quad (2)$$

c. Creating fuzzy rules (based rule)
Fuzzy rules are determined based on input variables (Hartanto, 2017). According to Munawaroh (2019), the use of fuzzy rules is written as follows:

IF X_1 is A_1 AND X_2 is A_2...AND X_n is A_n THEN Y is B

Making fuzzy rules using the selected packaging sample will be multiplied by 2, because the membership degree has two possible linguistic variables

d. Defuzzification and Fuzzy rule test
Defuzzification is needed because the result of the fuzzy inference system is still a fuzzy value that shows the level of membership in a particular fuzzy set (Madin, 2024). Fuzzy rule testing will

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be carried out using packaging samples that have been selected, and the testing process will be carried out on these packaging samples. Sample testing is carried out using MATLAB software on the Fuzzy Inference System Tools (Puspitasari, 2017).

3. Results and Discussion

The packaging of in circulation today is very important to carry out the development process to have a selling appeal from consumers to buy products. Therefore, in this research, packaging is used as the object of research using Kansei engineering method. This method goes through several stages to get a new packaging design based on the data we obtained.

Collecting Packaging Samples

Sample packaging references were obtained through a survey of the market and searching through virtual media by looking for examples of packaging and products that have similar packaging techniques in a total of 50 samples which were then reduced by 4 samples because they had similar shapes, colours and uses. Based on the survey results, 46 samples were selected with different characteristics so that they can be a reference form in the process of developing this packaging. The list of selected packaging samples can be seen in Fig. 2.

Fig. 2. Packaging samples

Collecting Kansei Words

Kansei words were obtained by conducting surveys and direct interviews with respondents. The respondents used at this stage were 30 respondents, with characteristics of being loyal consumers of the product or often consuming kue ranggi products or at least having consumed the product so that they have an idea of the packaging problems on the product. On average, respondents live in the city of Depok or Jakarta and are around 15-35 years old, both female and male. This process is supported

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by a stimulus video containing details of the current Rangi cake product packaging with the aim of obtaining objective consumer responses regarding the product packaging. The questionnaire was given to consumers who have frequent intensity in consuming Rangi cake products with the hope that respondent representatives will provide objective impressions and desires for better Rangi cake packaging in the future. Based on the survey results, 352 Kansei words were obtained which were then grouped based on similarity of meaning so that there were 46 pairs of Kansei words. The list of Kansei words is in Table 1.

Table 1 Kansei words

No	Kansei Word	Antonym
1	White	Black
2	Food grade	Non-food grade
3	Design interprets savory taste	Design does not interpret savory taste
4	Design interprets the aroma of coconut	Design does not interpret coconut taste
5	Design interprets sweetness	Design does not interpret sweetness
…	…	…
…	…	…
42	Thick	Thin
43	Design interprets soft texture	Design does not interpret soft texture
44	Safety hole	Without safety hole
45	Easy to use	Difficult to use
46	Easy to store	difficult to store

Each formula is given an occurrence number on the right side using Arabic numerals accompanied by a description. To give a formula an occurrence number press the tab key once to the right of the formula.

Design Concept with PCA

The Kansei obtained from the previous process is then evaluated by comparing 46 packaging samples. This process was carried out by distributing questionnaires using 7 scales to 30 respondents with the aim of respondents assessing the suitability of kansei words with packaging samples. The results of the questionnaire were then used as PCA data input which resulted in the design concept. In this process, the processing carried out by R software will produce a distribution of kansei words formed between 4 quadrants. At this stage, the design concept can be determined by looking at the distribution of kansei words on the positive and negative axes. After conducting discussions with expert panellists, it can be concluded that obtaining 2 PCs with PC1 has the concept of "Standard-Simple" and PC2 "Informative - Efficient". The Kansei word distribution map can be seen in Fig. 3.

The concept of standard is interpreted by kansei words including without handling and without safety holes while for the word simple it is interpreted by the kansei word white. PC 2 informative concept is interpreted by kansei word design interpreting savoury taste while for the word efficient is interpreted by kansei word among others: Functional, unique, and easy to hold.

Design Concept Evaluation

The design concepts were evaluated through the Kansei Word extraction process using the PCA method) resulting in two pairs of packaging design concepts to be developed. The first design concept is Standard and Simple while the second design concept is Informative and Efficient. Furthermore, the concepts are processed using a 7-scale Likert questionnaire to calculate the Min, Max, Mean and standard deviation values of each sample which will be used as data input for the QTT1 method.

Analysing Packaging Morphology

In the QTT method, 1 design element is obtained by consulting through expert panellists with the aim of getting the number of factors that must be used in packaging. The results obtained are 8 categories of elements which include shape (X1), material (X2), features (X3), design elements (X4), design style (X5), design surface (X6), design colour (X7), and cover shape (X8). Morphological analysis can be seen in Table 2.

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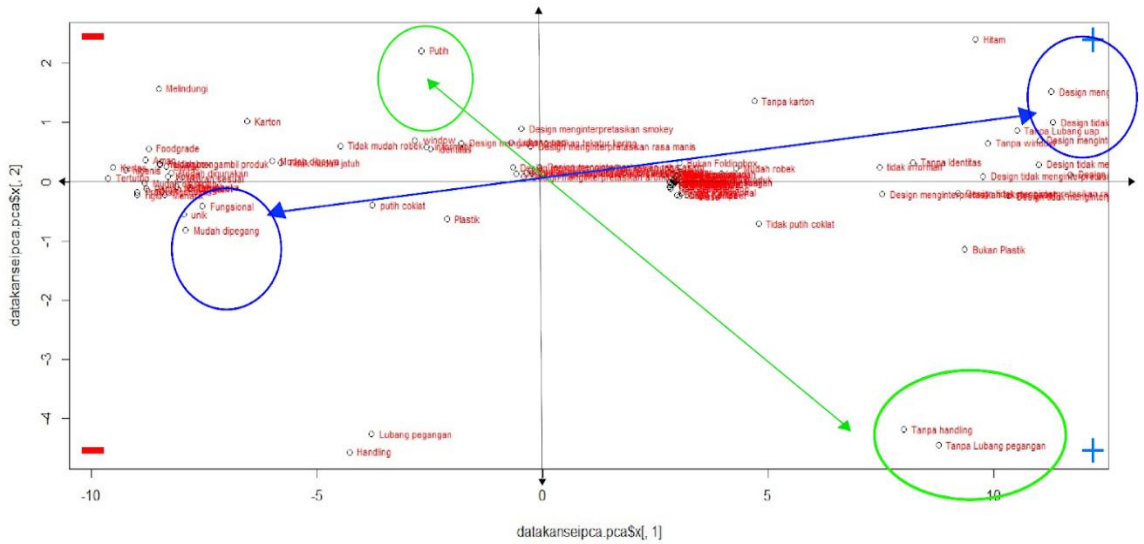
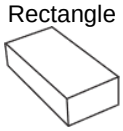
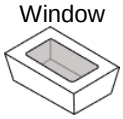
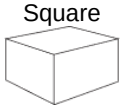
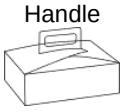
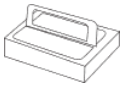
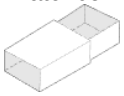
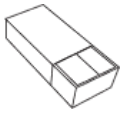
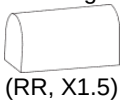


Fig. 3 Kansei words distribution map.

Table 2 Morphology analysis

	Shape (X1)	**Material (X2)**	**Features (X3)**	**Design Element (X4)**	**Design Style (X5)**	**Surface Design (X6)**	**Colour design (X7)**	**Shape Cover (X8)**
TYPE 1	Rectangle  (R, X1.1)	Ivory (I, X2.1)	Window  (W, X3.1)	Illustration (IL. X4.1)	Simple (S, X5.1)	Direct (D, X6.1)	Black white (BW, X7.1)	Tuck ends  (TE, X8.1)
TYPE 2	Square  (S, X1.2)	Kraft Carton (KC, X2.2)	Handle  (H, X3.2)	Product image & illustration (PII, X4.2)	Minimalist (M, X5.2)	Label (L, X6.2)	Orange (O, X7.2)	**Rol end tuck top**  **(RE, X8.2)**
TYPE 3	Triangle Prism  (TP, X1.3)	Art Carton (AC, X2.3)	Window & handle  (WH, X3.3)	Without Illustration (WI, X4.3)	Elegant (E, X5.3)	Sticker (S, X6.3)	Colourful (C, X7.3)	Matchbox  (M, X8.3)
TYPE 4	Trapezoid  (T, X1.4)	Paper & mica (PM, X2.4)	Slide  (S, X3.4)	Typography (TY, X4.4)	Plain (P, X5.4)	Without Design (WD, X6.4)	White (W, X7.4)	Gable box  (GB, X8.4)
TYPE 5	Rounded Rectangle  (RR, X1.5)		Rope Handle  (B, X3.5)				Without colour (WC, X7.5)	Bag 

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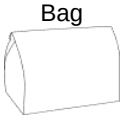
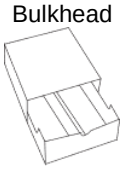
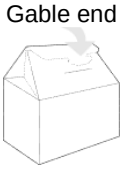
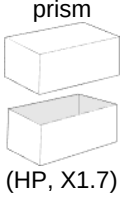
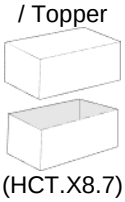
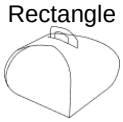
	Shape (X1)	Material (X2)	Features (X3)	Design Element (X4)	Design Style (X5)	Surface Design (X6)	Colour design (X7)	Shape Cover (X8)
								(B, X8.5)
TYPE 6	Bag  (B, X1,6)		Bulkhead  (SKT, X3.6) Without Features (WF, X3.7)				Black (B, X7.6)	Gable end  (GE, X8.6)
TYPE 7	Hexagon prism  (HP, X1.7)						Grey (G, X7.7)	Header Card / Topper  (HCT.X8.7)
TYPE 8	Rounded Rectangle  (RoR, X1.8)						Black Brown (BB, X7.8)	
TYPE 9							Brown white (BW, X7.9)	

Determine the relationship between design concept and packaging design elements

The packaging concept obtained is then analysed regarding its relationship with each Purposive Judgment Sampling. Purposive Judgment Sampling aims to determine the identity of respondents who match the research objectives (Lenaini, 2021). The input data obtained through the questionnaire is processed using the Quantification Theory Type 1 (QTT-1) method in R software. The data processed using the QTT-1 method can be seen in Table 3.

Table 3 Data input QTT-1

Sampel Code	X1	X2	X3	X4	X5	X6	X7	X8	Standar - Simpel			
									Mean	Min	Max	Std. Dev
A	7	3	7	3	4	4	4	2	3.6	1.0	7.0	2.4
B	4	3	7	3	4	4	4	2	2.9	1.0	7.0	2.1
C	1	4	4	4	1	1	1	3	4.4	1.0	7.0	2.4
D	1	1	1	4	1	1	3	7	4.5	1.0	7.0	2.4
E	4	4	1	3	4	4	5	2	4.2	1.0	7.0	2.3
F	1	1	7	3	2	4	4	1	3.1	1.0	7.0	2.0
…	…	…	…	…	…	…	…	…	…	…	…	…
…	…	…	…	…	…	…	…	…	…	…	…	…
AS	4	3	1	3	4	4	6	2	4.9	1.0	7.0	2.2
AT	1	2	2	3	4	4	5	6	3.8	1.0	7.0	2.1
AU	1	2	2	4	1	1	1	4	4.4	1.0	7.0	2.0
AV	1	3	3	3	4	4	4	2	4.7	1.0	7.0	2.0
AW	1	2	4	3	4	4	5	3	3.8	1.0	7.0	2.1
AX	6	4	1	1	2	1	8	5	4.2	1.0	7.0	2.1

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This processes the results of calculations using software in the form of a histogram. Through the histogram, the longest stem length in each category is the type that influences consumer desire preferences (Sari, 2020). The results of the QTT1 process can be seen in the Fig. 4 below.

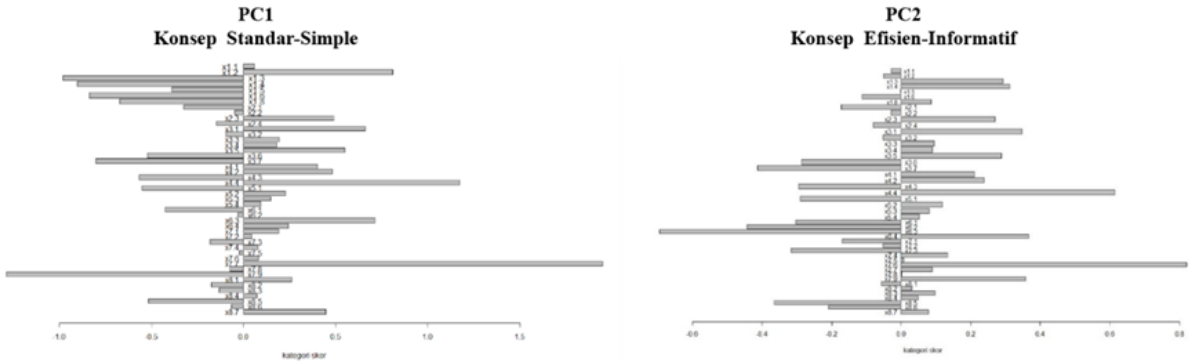

Fig. 4 Concept element of Principal Component 1 (PC1) and Principal Component 2 (PC2) PC 1 & PC 2.

In the next stage, for each concept, a graph/bar with a positive value was selected. The selected design element has the longest histogram so it can be concluded that this category is the type that influences consumer desire preferences (Sari, 2020). The simple concept obtained an R Squared value of 0.9615 and the Informative concept obtained an R Squared value of 0.9515, so it can be concluded that the simple concept is the selected concept because it has the largest R squared value of 0.9615. Selected design elements of each concept can be seen in Table 4.

Table 4 Design element of concept PC1 and PC2

Concept	Shape	Material	Feature	Design Element	Design Style	Surface Design	Design Color	Shape Cover
Standard – Simple (PC1)	Square	White Craft Carton	Window	Typography	Minimalist	Sticker	Grey	Header Card/ Topper
	X12	X22	X31	X44	X52	X63	X77	X87
Informative - Efficient (PC2)	Trapezoid	Art Carton	Window	Typography	Minimalist	Without Design	Black	Matchbox Style Box
	X14	X23	X31	X44	X52	X64	X76	X83

Packaging Design Mockups

The selected design elements have the longest histogram so it can be concluded that the category is an influential type. The design elements obtained from QTT-1 processing were applied in 3D mockups using Adobe Illustrator and Blender software. Before starting the digital design process, a brainstorming session was conducted to identify the elements. Mind mapping was used to collect ideas, while mood board became the design reference found in Fig. 5.

The packaging is visualized in a simple square-shaped concept with packaging made from white kraft cardboard, with a window feature. The square packaging is expected to package the rangi cookies safely and hygienically. The window feature on the lid serves to make it easier for consumers to see the product without having to open the packaging. In addition, this packaging uses typography in the text to give a simple impression but has a clear meaning about the product.

In addition, in PC2, the packaging of Rangi cake is trapezium shaped. The trapezium shape is considered more efficient because it is easier to package rangi cake. The window features on the packaging functions to provide information about the product without consumers having to open the packaging first. In addition, there is a sliding cover that can make it easier for consumers to open or close the packaging.

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Fig. 5 Simple concept Mockups result.

Fig. 6 Informative concept Mockups result.

Based on the results of Table 5, the R-Square results of the simple concept with an R Squared value of 0.9615 and an efficient concept with an R Squared value of 0.9515 are obtained, so it can be concluded that the simple concept is the selected concept because it has the largest R squared value of 0, 9615.The concept is selected based on the largest R-Square value, namely PC1 (Coghlan, 2014). Measuring the accuracy of the QTT1 method on the relationship between elements and design concepts requires the views and opinions of consumers on the design concepts that have been made. The conclusion of the data contained in Figure 11 in the survey results can be concluded that 90.5% that consumers choose the Informative-Efficient concept to be suitable packaging for rangi cake products, so it can be concluded that the use of the QTT1 method is not accurate and does not match the packaging of rangi cake.

Table 5 R Square result

Concept	PC1 Standard - Simpel	PC2 Efficient -Informative
R Square	0.9615	0.9515

Based on the results of Table 3, the R-Square results of the simple concept with an R Square value of 0.9615 and an efficient concept with an R Squared value of 0.9515 are obtained, so it can be concluded that the simple concept is the selected concept because it has the largest R squared value of 0, 9615.The concept is selected based on the largest R-Square value, namely PC1 (Coghlan, 2014). Measuring the accuracy of the QTT1 method on the relationship between elements and design concepts requires the views and opinions of consumers on the design concepts that have been made. The conclusion of the data contained in Figure 11 in the survey results can be concluded that 90.5% that consumers choose the Informative-Efficient concept to be suitable packaging for rangi cake products, so it can be concluded that the use of the QTT1 method is not accurate and does not match the packaging of rangi cake.

Mockups Evaluation by Fuzzy Logic

a. Identification of Input and Output Linguistic Variables
   Linguistic variables used as input in this study are taken based on the Partial Coefficient Component (PCC) value that has been obtained previously. The results of the mean coding table will be input. With the output value of value and Dos. All design elements are used to process fuzzy output. The variables obtained from the mean input coding consist of X1 - X8 while the output is in the form of a concept that has the highest PC value, namely, Standard-Simple
b. Determining the Membership Function of Linguistic Variables (FIGURE MEMBERSHIP FUNCTION)
   Fuzzification is a process to convert non-fuzzy variables (numeric variables) into fuzzy variables (numeric variables). Fuzzy numbers can have various shapes. Triangular or trapezoidal shapes often provide an adequate representation of expert knowledge and significantly simplify the

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computational process. For example, in the figure "Surface (X6)", which is an element of the shape "Surface (X6) has 4 types, namely Direct, Label, Sticker and without design" which forms a linguistic variable code (D, L, S, WD) based on morphological analysis. Types 1, 2, and 3 form a fuzzy triangle because they have a relationship while type 4 stands alone forming a straight line because it has no relationship. Scale values from 1-3 are assigned to a particular top shape to indicate its degree matching the first three top shape types as characterized by the corresponding terms (line, curve, and arc), respectively. With the fuzzy triangle formula used, namely:

$$\mu[x] = \begin{cases} 0 & \rightarrow \quad x \leq a \quad or \quad x \geq c \\ \left(\frac{x-a}{b-a}\right) & \rightarrow \quad a < x < b \\ \left(\frac{c-x}{c-b}\right) & \rightarrow \quad b < x < c \end{cases} \tag{3}$$

Membership function images are derived from morphology and design elements. In this study, triangular or trapezoidal membership functions are used to represent the values of the various types of the eight design elements used in the Fuzzy Logic rules as shown in Fig. 7.

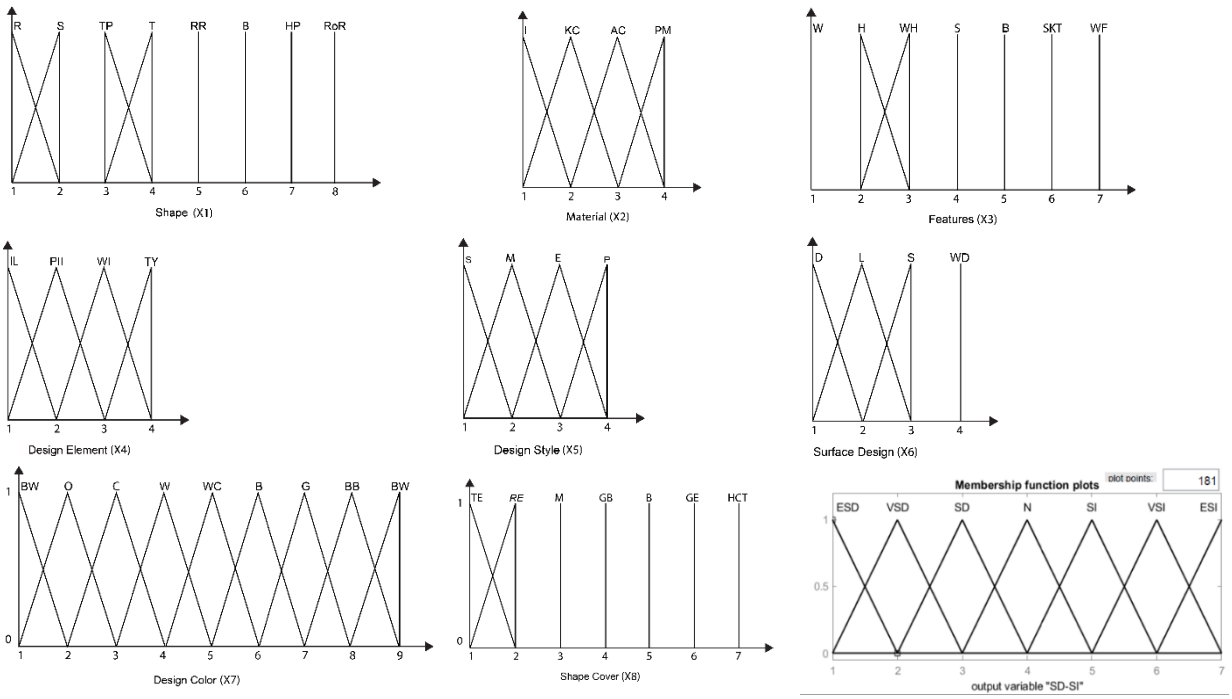

Fig. 7 Membership function.

c. Creating Fuzzy Rules

Fuzzy rules are obtained by rating 46 samples of rangi cake product packaging shapes on a scale of 1-7. The Mean value of the Standard-simple concept is used as the output of the fuzzy rule. For example, the Standard-Simple Mean in Table 3 for sample C is 4.4, which is a member of the linguistic tribe 'N' (Neutral) with a membership degree of 0.6 = (5-4.4)/(5-4)); and a member of the linguistic tribe "SI" Little fits simple with a membership degree of 0.4 =(4.44-4)/(5-4)).

Table 6 Fuzzy number “form (X1)” from morphology

Linguistik term	Rectangle	Square	Triangular prism	Trapezoid	Rectangle round	Bag	Hexagonal prism	Square round
	(R)	(S)	(TP)	(T)	(RR)	(B)	(HP)	(SR)
Membership Function	(1,1,2)	(1,2,3)	(2,3,4)	(3,4,5)	(4,5,6)	(5,6,7)	(6,7,8)	(7,8,8)

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Fuzzy rule: IF X_1 is A_1 AND X_2 is A_2...AND X_n is A_n THEN Y is B
A1, A2...An and B are fuzzy linguistics, which are taken by input linguistic variables X1, X2..., Xn and output linguistic variable Y respectively. These terms are represented by triangular fuzzy numbers. The fuzzy rules amount to (46 samples x 2) =92, where each fuzzy rule is a combination of morphological elements in the rangi cake packaging samples. However, because there are 3 samples that have round values (1,0) in samples G, J and AP, the number of rules is reduced by 3 rules to 89 rules

Table 7 Triangular Fuzzy Numbers for standard-simple

Istilah Linguistik	Extreme Standard (ES)	Very Standard (VS)	Standard (S)	Netral (N)	Simple (Si)	Very Simple (VSi)	Extreme Simple (ESi)
Membership Function	(1, 1, 2)	(1, 2, 3)	(2, 3, 4)	(3, 4, 5)	(4, 5, 6)	(5. 6. 7)	(6, 7, 7)

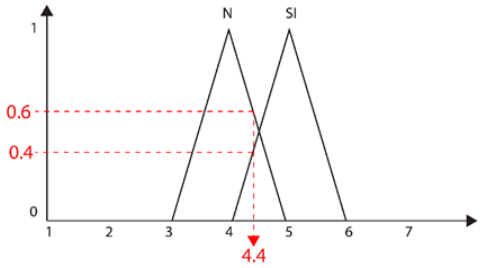

Fig. 8 Standard-simple value membership degree.

For example, rules 5 and 6 in Table 8 below for sample C in Figure 2, based on the analysis of design element factors in Table 2, it is known that sample C has a packaging form type 1 or X 1.1 (Rectangle), with material type 4 or X2.4 (Paper Mica), has features type 4 or X3.4 (Slide), has design elements type 4 or X4.4 (Typography), has design style type 1 or X5.1 (Simple), has surface design type 1 or X6.1 (Direct), has design colour type 1 or X7.1 (Black White), and has a cover shape type 3 or X8.3 (Matchbox). The design element category from X1-X8 will be input into the fuzzy rules, while the output is the selected concept, namely Standard-Simple as in Table 7. So that the fuzzy rules formed use the initials of each type in each sample. By following the method of creating fuzzy rules, namely:
Fuzzy rule: IF X_1 is A_1 AND X_2 is A_2...AND X_n is A_n THEN Y is B

Then the fifth rule for sample C is:
IF X1.1 (R) and X2.4 (PM) and X3.4 (S) and X4.4 (T) and X5.1 (S) and X6.1 (D) and X7.1 (BM) and X8.3 (M) Then Neutral (N)

While the sixth rule for sample C is:
IF X1.1 (R) and X2.4 (PM) and X3.4 (S) and X4.4 (T) and X5.1 (S) and X6.1 (D) and X7.1 (BM) and X8.3 (M) Then Simple (Si)

Each sample will have 2 rules with the same input but different outputs, because each sample has an average obtained from the results of the semantic differential questionnaire in Table 3, which will intersect with 2 membership function lines in Figure 8. For example, sample C which has an average in Table 3 of 4.4 will have two outputs, namely neutral with a crips or Degree of Support (DoS) value of 0.6 and simple with a crips value of 0.4 using formula 2. The results of all fuzzy rules from each sample are shown in Table 8 below.

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Table 8 Fuzzy rules

Sample	Rule	IF								THEN	
		X1	X2	X3	X4	X5	X6	X7	X8	SD - SI	DoS
A	1	HP	AC	WF	WI	P	WD	W	RE	N	0.6
	2	HP	AC	WF	WI	P	WD	W	RE	SD	0.4
B	3	T	AC	WF	WI	P	WD	W	RE	SD	0.9
	4	T	AC	WF	WI	P	WD	W	RE	VSD	0.1
C	5	R	PM	S	TY	S	D	BW	M	N	0.6
	6	R	PM	S	TY	S	D	BW	M	SI	0.4
…	…	…	…	…	…	…	…	…	…	…	…
	…	…	…	…	…	…	…	…	…	…	…
AX	91	B	PM	W	IL	M	D	B	B	N	0.8
	92	B	PM	W	IL	M	D	B	B	SI	0.2

d. Testing Samples

Sample Testing is carried out on selected concepts, according to the morphological analysis that has been determined. The result of this testing is a value that can show the suitability of the packaging elements in each sample against the Standard-Simple concept which has a scale of 1 to 7. The simple concept with a square shape, art cardboard material, window features, typography elements, grey colour, and header card cover gets a value of 4.0 as shown in Table 9.

Table 9 Sample testing result

Sampel	Shape	Materials	Feature	Element	Design Style	Surface	Colour	Cover	Value
PC 1	Square	Art Cartoon	Window	Typograph	Minimalist	Sticker	Grey	Header Card/Topper	4.0

Based on the discussion regarding the evaluation of the results of the selected design elements against the concept of practical packaging using the Fuzzy Logic method with the Fuzzy prediction type, it is concluded that the value obtained is 4.00, where the value is in the neutral category between the standard and simple concepts. The packaging leads to the standard concept because it has a box shape and no features, and the packaging leads to a simple concept because there is only one colour and one design element.

4. Conclusion

Based on the results of the research, several conclusions can be drawn, namely from the results of the sample selection, 46 samples of rangi cake packaging were obtained and 46 Kansei words were selected. Using Kansei words, the samples were analyzed with a semantic differential questionnaire on 30 respondents based on purposive sampling method. The results of the questionnaire were processed to become PCA input data using R software. Based on the results of data processing with R software, there are 2 concepts that interpret the selected design concept. The first concept produces the concept of "Standard-Simple" with a Cumulative Proportion value of 92.68%, and the second concept produces the concept of "Informative-Efficient" with a Cumulative Proportion value of 95.24%. The selected concept is the "Standard-Simple" concept because it has a greater R-square value of: 0.9615 compared to the "Informative-Efficient" concept of only 0.951. The design elements of the "Standard-Simple" concept consist of a square shape (X1.2), made from crafting cardboard (X2.3), using window features (X3.1), typography (X4.4), minimalism (X5.2), stickers (X6.3), gray (X7.7), (X6.2) on the Header Card/Topper lid. Then an evaluation of the design results using fuzzy logic on a simple concept sample gets a value of 4 which means neutral.

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References

Adrianty, A. D., & Sari, M. (2023). Penentuan Konsep Desain Kemasan Asinan Khas Betawi Dengan Metode Analisis Faktor. 2, 201–209.

Coghlan, A. (2014). A Little Book of R For Bioinformatics. In 2014. http://cdn.bitbucket.org/psylab/r-books/downloads/Coghlan2014.pdf

Fitrie, R., & Arnah Ritonga. (2022). Implementation of the Fuzzy Game Theory Logic Method in Competition for Local Skincare Brand Products (Ms. Glow with Scarlett Whitening). Formosa Journal of Applied Sciences, 1(7), 1357–1374. https://doi.org/10.55927/fjas.v1i7.1972

Guo, F., Qu, Q. X., Nagamachi, M., & Duffy, V. G. (2020). A proposal of the event-related potential method to effectively identify kansei words for assessing product design features in kansei engineering research. International Journal of Industrial Ergonomics, 76(195), 102940. https://doi.org/10.1016/j.ergon.2020.102940

Hartanto, S. (2017). Implementasi Fuzzy Rule Based System untuk Klasifikasi Buah Mangga. Techsi, 9(2), 103–122. https://doi.org/10.29103/techsi.v9i2.217

Indraswati Denok. (2017). Pengemasan Makanan. Forum Ilmiah Kesehatan (FORIKES). In Pengemasan Makanan.

Madin, M. M. (2024). Penggunaan Metode Fuzzy Mamdani Dalam Evaluasi Kepuasan Pelanggan: Studi Kasus Pada Layanan Perbankan Di Bank Bri. Jurnal Informatika Dan Teknik Elektro Terapan, 12(3). https://doi.org/10.23960/jitet.v12i3.4775

Parid, M., & Hasibuan, S. (2020). Mapping and Development Strategy of Small and Medium Food Industry in the Province of Jakarta. *Journal of Computational and Theoretical Nanoscience*, *17*(2-3), 950-956.

Peng Lu, S.-W. H. and F. W. (2021). Morphology Preference and Macroscopic Shape Information.

Prameswari, N. S., Suharto, M., & Wulandari, E. (2018). Strategi Branding Melalui Inovasi Desain Kemasan Bagi Home Industry Sabun Cair. Jurnal Desain Komunikasi Visual, 03(02). Jurnal Desain Komunikasi Visual, Manajemen Desain Dan Periklanan, 03(02), 35–54.

Puspitasari, A. (2017). Penggunaan Fuzzy Inference System (Fis) Metode Mamdani Untuk Menentukan Kinerja Pelayanan Pdam. Jurnal Teknik Komputer AMIK BSI, III(1), 51–59. http://ejournal.bsi.ac.id/ejurnal/index.php/jtk/article/view/1343/1092

Sari, N. P., Immanuel, J., & Cahyani, A. (2020). Aplikasi Kansei Engineering Dan Fuzzy Analytical Hierarchical Process Dalam Pengembangan Desain Kemasan. Journal Printing and Packaging, 1, 9–21. http://jurnal.pnj.ac.id/index.php/ppt/article/view/2469/0

Yuliara, I. M. (2016). Regresi linier sederhana. Regresi Linier Sederhana, 13, 2022.

Sari, N. P. (2019). PERENCANAAN DAN PENGEMBANGAN KEMASAN: KANSEI ENGINEERING. https://press.pnj.ac.id/?p=518

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