

Developing *Mie Lidi X* Packaging Concept Using *Kansei* Engineering Method

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Abstract

Packaging design plays a critical role in influencing consumer purchasing decisions, as it functions not only as a protective medium but also as a key marketing instrument. Although having an established market, *Mie Lidi X* currently employs overly simple packaging that offers limited visual appeal and inadequate product protection. This study aims to develop an improved packaging design concept that aligns with consumer preferences and emotional responses. A *Kansei* Engineering approach was employed to capture consumers' affective perceptions of packaging, supported by Principal Component Analysis (PCA) to identify dominant design dimensions. Data were collected through questionnaires distributed to 31 respondents, of whom 74.2% indicated that packaging design is very important, while the remainder considered it important. In addition, observational analysis identified 57 packaging samples and 37 *Kansei* words relevant to snack packaging. PCA results revealed four principal components with eigenvalues greater than one and a cumulative explained variance exceeding 80%. These components were subsequently interpreted with the assistance of expert panelists. The resulting design concepts were identified as PC1 "Simple-Vintage," PC2 "Attractive-Fragile," PC3 "Strong-Modern," and PC4 "Sustainable-Irrelevant." The findings provide a conceptual foundation for developing packaging designs that better reflect consumer preferences. However, this study is limited to the identification of design concepts and does not yet translate these concepts into specific visual or structural design elements. Future research is therefore recommended to operationalize the identified concepts into concrete packaging attributes and to evaluate their impact on consumer behavior and product performance.

Keywords: Packaging Development, *Kansei* Engineering, Principal Component Analysis, Stick Noodles, Design Concept

I. INTRODUCTION

The sale of *Mie Lidi X* is very much Indonesia, especially in North Sumatra. *Mie Lidi* are raw noodles that resemble spaghetti called stick noodles, stick noodles are usually processed into a typical Batak tribe culinary called Mi Gomak, this preparation is flavored with andaliman and can be served with soup or not [1]. Based on observations made by Transmedia, it is known that *Mie Lidi X* is able to produce 1000 pieces per day. *Mie Lidi* has been successfully exported to Singapore, it is common given the many enthusiasts mi gomak there. Products that have a wide market must be supported by good packaging in order to attract the attention of consumers. Unfortunately, the packaging of *Mie Lidi X* has not presented the best version of the packaging as in figure 1:



Figure 1 *Mie Lidi X* Product

The packaging of *Mie Lidi X* currently relies on thin, transparent center-seal plastic, which is highly susceptible to tearing and physical damage during handling and distribution. The use of clear plastic as the primary packaging material for stick noodle products is considered suboptimal, as such materials generally exhibit limited barrier properties against oxygen and moisture. This limitation facilitates oxygen permeation and moisture ingress, which can accelerate product deterioration, negatively affect texture and flavor, and ultimately shorten the shelf life of the noodles [2]. Beyond its functional shortcomings, the visual appearance of *Mie Lidi X* packaging is perceived as outdated and lacking aesthetic appeal. As a result, the packaging fails to effectively communicate product quality or brand value, thereby reducing its competitiveness in the market. Consequently, the current packaging is considered less attractive and less feasible for sustaining consumer interest, particularly in appealing to new customers while also maintaining the loyalty of existing consumers.

Good packaging not only protects the product, but is also visually appealing and informative [3]. Attractive packaging design can increase product appeal and influence consumer purchasing decisions [4]. In addition, packaging should also use materials that can extend the shelf life of the product, such as materials that have barrier properties against light and moisture [2]. Therefore, it is important to design packaging that meets these criteria so that the product can remain competitive in the market. The development of *Mie Lidi X* packaging is very necessary. This is done to increase competitiveness and foster good emotional consumers towards the product [5]. The questionnaire distributed to 31 respondents supported this because 74.2% of them agreed that the development of Lidi X Noodle packaging was very important to develop. Basically, businesses need to conduct research on consumer emotions that arise about the concept of design, color, and type of packaging [6].

The *Kansei Engineering* method will be used because it is very relevant in the context of Packaging Development [7]. This method allows researchers to translate the impression preferences, emotional, and willingness of consumers and then pour it into the concept of the product. Consumer emotions become the best bridge in determining the design concept through the translation of *Kansei words* that produce more specific concepts [5]. The concept of packaging is important because a good concept can increase *awareness* consumer awareness of the product [6]. Furthermore, the Principal Component Analysis (PCA) method is used as an aid to analyze the resulting design concept [8]. In the PCA method, researchers can determine the most influential packaging design concepts based on consumer perceptions [8] the PCA method is able to Group various *Kansei words* that have been collected, resulting in groups of words that can be interpreted in various design concepts. Another advantage of PCA is that it can be integrated with other methods, such as the *Kansei Engineering* method, to optimize product features or concepts based on multiple *Kansei* responses, and ultimately streamline the decision [9].

To date, limited research has addressed the development of packaging for raw noodle products. especially *Mie Lidi* which applies *Kansei Engineering* approach. In fact, this approach proved to be able to produce a design concept in accordance with consumer preferences. An example of the success of previous research is shown by the development of bread packaging that successfully captures the aesthetic and functional feedback of packaging through *Kansei Engineering* and PCA [7]. Sanjai Chips cope with uninteresting and boring design concepts [10]. In other cases, the development of Excelsa Wonosalam coffee packaging is expected to increase the interest of potential consumers thanks to its innovative concept [11]. Therefore, the purpose of this study is to develop the concept of *Mie Lidi X* packaging design using *Kansei Engineering* in order to meet consumer preferences.

II. METHOD

This study applies the *Kansei Engineering* method, supported by Principal Component Analysis (PCA), to facilitate the development of packaging for *Mie Lidi X* by systematically identifying and formulating packaging design concepts that align with consumer preferences. *Kansei Engineering* is an affective design approach that emphasizes the integration of consumers' emotional responses, perceptions, and subjective evaluations into the product development process. Through this method, abstract consumer feelings toward packaging, such as attractiveness, simplicity, strength, and modernity, can be translated into structured design concepts that reflect both functional and emotional expectations. The incorporation of PCA serves as a statistical tool to reduce data complexity and to identify dominant patterns within consumer perception data, thereby enabling a more objective interpretation of emotional responses. By combining *Kansei Engineering* with PCA, this study aims to bridge the gap between subjective consumer emotions and systematic design decision-making. PCA assists in grouping related *Kansei* words into principal components, which represent underlying dimensions of consumer perception toward packaging. These principal components form the basis for defining coherent and meaningful packaging design concepts for *Mie Lidi X*. This integrated approach not only enhances the reliability of the design concept formulation but also provides a structured foundation for future packaging development. Ultimately, the method supports the creation of packaging designs that are more responsive to consumer needs, emotionally appealing, and competitive in the market [12], as in the following figure 1 research flow:

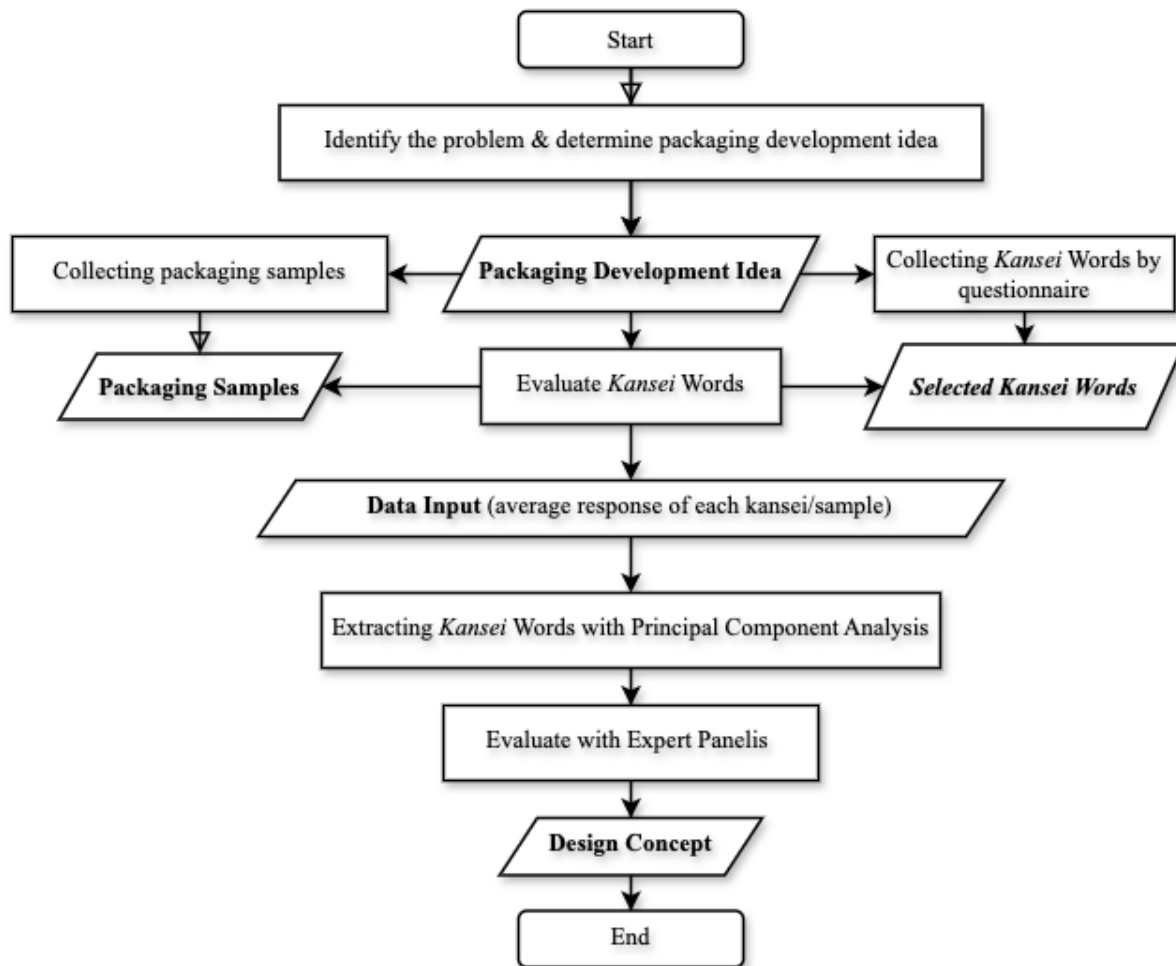


Figure 2 Research Flowchart

As illustrated in Figure 1, the research flow begins with problem identification and the formulation of initial design ideas, followed by the collection of packaging samples and *Kansei* words through questionnaires. The selected *Kansei* words are then evaluated, after which Principal Component Analysis (PCA) is applied to extract dominant perception dimensions. The final design concepts are obtained through an evaluation process involving expert panelists. The problem identification stage aims to define the research scope by identifying feasible ideas for development and assessing the importance of improving product packaging based on respondent perceptions gathered through direct or indirect surveys. Packaging sample collection is conducted to obtain comprehensive information on existing design elements, forms, materials, aesthetics, and functional aspects. A diverse range of packaging samples is required to provide both general and detailed insights into packaging design concepts, supporting the initial stage of *Kansei* Engineering, which focuses on consumer identification from ergonomic and psychometric perspectives. Subsequently, *Kansei* words are collected to capture consumers' emotional responses to packaging. These words, typically expressed as adjectives, are identified through direct and indirect interviews with purposively selected respondents, supported by visual and video stimuli such as existing packaging examples, packaging regulations, and current design trends to ensure accurate emotional elicitation. The selected *Kansei* words are then evaluated using a semantic differential questionnaire with a seven-point scale to quantify the extent to which each packaging sample represents specific emotional attributes. Finally, PCA is employed as a multivariate statistical tool to analyze the relationships between packaging samples and *Kansei* words. Questionnaire data are processed to obtain mean values, which are then analyzed using statistical software to identify principal components based on the Kaiser criterion, standard deviation, and cumulative proportion. These principal components represent the underlying packaging design concepts, which are subsequently validated and interpreted with the assistance of expert panelists.

III. RESULTS AND DISCUSSION

The packaging development process of *Mie Lidi X* constitutes the central focus of this study and is systematically structured using the *Kansei* Engineering method as the primary research framework. This method is selected due to its ability to integrate consumers' emotional perceptions and subjective evaluations into the product development process, thereby ensuring that the resulting packaging concepts align with user expectations and preferences. By adopting *Kansei* Engineering, this study seeks to translate abstract consumer feelings into concrete and measurable design attributes that can guide the improvement of *Mie Lidi X* packaging. The planning stage of the research involves several well-defined and sequential steps. It begins with the identification of existing problems related to the current packaging, which serves to establish the scope and direction of the study. This is followed by the collection and selection of relevant packaging samples to provide comprehensive references for design comparison and evaluation. Subsequently, *Kansei* words are identified to capture consumers' emotional responses toward packaging, representing perceptions such as attractiveness, simplicity, strength, and modernity. The collected data are then analyzed using Principal Component Analysis (PCA) with the assistance of R software to reduce data complexity and identify dominant perceptual dimensions. Finally, packaging design concepts are determined based on the extracted principal components, providing a systematic and data-driven foundation for the development of packaging that is both emotionally appealing and functionally appropriate for *Mie Lidi X*.

A. Problem Identification & Determination

The distribution of the first questionnaire (open) to 42 respondents was carried out to determine which ideas have the greatest urgency for development. Each product packaging has a problem will be selected by the respondents, the choice of products that need to be done research that is *Mie Lidi X*, Sanitayy Napkins, and Porang Rice. Obtained from 42 respondents stated that 61.9% choose *Mie Lidi X*, 21.4% chose Beras Porang, and 16.7% chose Sanitary Napkins. Therefore, the object of this study is not based on the subjectivity of the researcher, but also the choice of respondents. The next step is to disseminate a second questionnaire to loyal *Mie Lidi X* consumers to assess whether the planning and development of packaging really needs to be done or not [12].

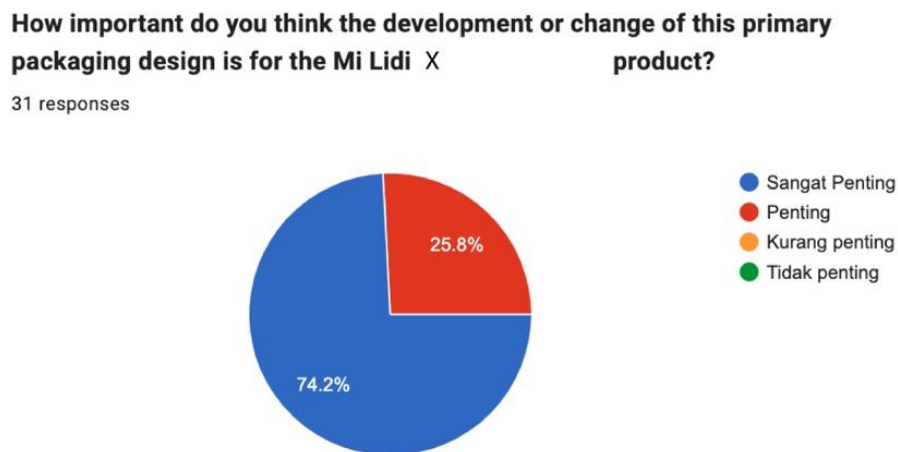


Figure 3 The Importance of Planning and Development on *Mie Lidi X*

In the questionnaire results, the color blue represents responses categorized as very important, red indicates important, yellow corresponds to less important, and green denotes not important. Based on the distribution of questionnaires to 31 respondents, the findings reveal a strong consensus regarding the importance of packaging development for *Mie Lidi X*. A majority of respondents (74.2%) rated packaging development as very important, indicating a high level of awareness of the role of packaging in influencing product quality, protection, and consumer appeal. The remaining 25.8% of respondents classified packaging development as important, further reinforcing the necessity of improving the existing packaging. Notably, no respondents selected the categories less important or not important, suggesting that packaging development is universally perceived as a critical factor among consumers and highlighting the relevance of this research in addressing market expectations.

B. The Collection of Samples

The collection of packaging samples provides a comprehensive overview as well as detailed insights into existing packaging design concepts. In this study, packaging samples are obtained through systematic searches on the internet and other relevant media sources by identifying packaging used for stick noodle products and comparable food products. These samples serve as visual and functional references that help capture a wide range of design elements, such as packaging form, material, color, typography, graphics, and protective features. By analyzing various packaging examples from the market, the study is able to identify prevailing design trends and common characteristics, which support the development and evaluation of packaging concepts that are relevant, competitive, and aligned with consumer expectations.[12]. Selected packaging samples can be seen in the following figure 4.





Figure 4 Selected Packaging Samples

Packaging samples must have different shapes, types of Materials, features, sizes and designs [22]. The collected samples will be filtered and then different packaging can be selected based on the material or shape, as well as the design that includes color and typography, dimensions and characteristics [23]. From the 60 packaging samples, 3 packages were eliminated because they had the same shape, this makes the total packaging samples that will be used as a benchmark for the next stage.

C. Kansei Word Collection

The word *Kansei* is a field that integrates emotional or feeling elements in product development, aiming to create designs that are not only functional but can also evoke positive feelings for their users. *Kansei's* collection of words was collected by distributing questionnaires and conducting interviews to loyal consumers. This process

involves the use of stimulus videos and images of selected packaging samples as information that will explain problems in packaging products [12]. What is not disclosed or requested directly (emotionally) by the customer can be data valuable data for the service provider. Product managers must be able to explore and understand the hidden needs of customers [24]. Based on this, this type of sampling was chosen because it is distributed only to consumers who often consume or buy products.

No	Kansei Word	Antonym	No	Kansei Word	Antonym
1	Easy to store	Not easy to store	20	Medan themed design	Design without a typical Medan theme
2	Reusable	Non reusable	21	Transparent packaging	Non-transparent packaging
3	Playful design atmosphere	Playful design atmosphere	22	Efficient	Not efficient
4	Traditional	Not Traditional	23	Eye catching design	Design not eye catching
5	Innovative design	Non innovative design	24	Strong packing	Weak packaging
6	Attractive design	Unattractive design	25	Packaging design contains smoke	Smokeless packaging design
7	Rigid Packaging	Not Rigid Packaging	26	Informative	Uninformative
8	Design describes crispiness	The design does not describe crispiness	27	Packaging depicts delicacy	Packaging does not describe delicacy
9	Easy to read fonts	Font is not easy to read	28	Striking	Inconspicuous
10	Flexible packaging	Inflexible packaging	29	The design depicts a chewy texture	The design does not depict the chewy texture
11	Hygienic	Unhygienic	30	Safe packaging	Unsafe packaging
12	Contemporary design	Uncontemporary design	31	Colourful	Not colourful
13	Design describes filling	Design does not describe filling	32	Modern	Not modern
14	Biodegradable	Non-biodegradable	33	Easy-to-close packaging	Packaging is not easy to close
15	Elegant	Not Elegant	34	The design shows the salty taste	The design does not show salty taste
16	Ergonomic Packaging	Unergonomic	35	The design shows the pleasure of processed noodles	The design does not show the pleasure of processed noodles
17	Complex	Uncomplicated	36	Easy to open packaging	Packaging is not difficult to open
18	Unique design	Design not unique	37	Minimalist design	Non-minimalist design
19	Fancy	Not fancy			

Table 1 Kansei Word Noodle Sticks X

The number of 31 respondents who often consume processed noodle sticks has met the minimum limit of data adequacy [25]. Minimum number is determined to be at least 30 respondents to meet the requirements of the normal distribution [26]. Based on the results of surveys and observations that have been made, 166 *Kansei* words and grouped by the meaning of the same word. The final result after elimination is 74 pairs of *Kansei words* and antonyms.

D. Evaluation Of Kansei Words

Evaluation of *Kansei* words is done by giving semantic differential questionnaires to at least 30 people, and must use purposive sampling. Determination of respondents using purposive sampling is based in accordance with the objectives of the study [17]. Respondents in this study are consumers who often consume noodles sticks. The questionnaire consists of 37 questions consisting of 57 samples, the questions are made from 74 pairs of *Kansei* words. The questionnaire uses 7 scales consisting of -3, -2, -1, 0, 1, 2, 3. The word *Kansei* is a positive word, while the antonym is negative.

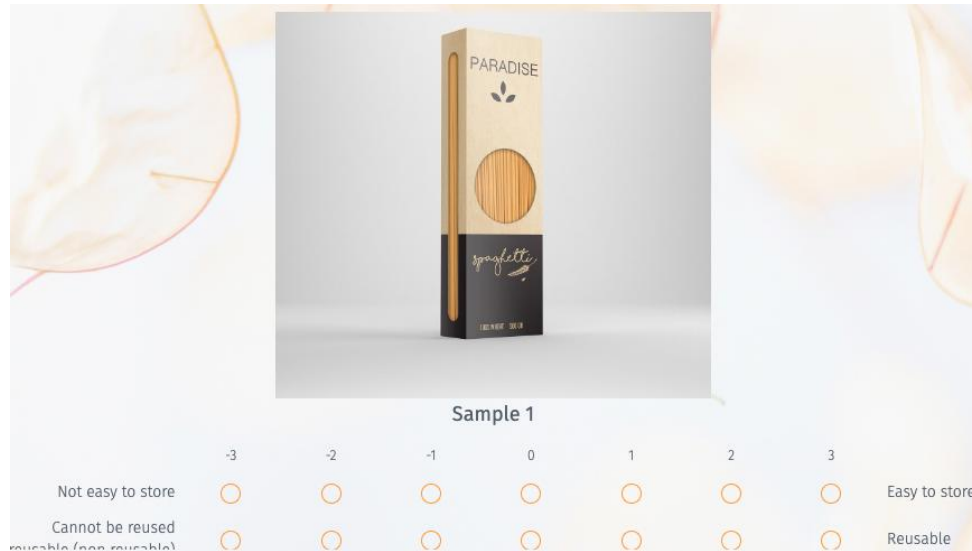


Figure 5 Semantic Differential Questionnaire

Filling out the semantic differential questionnaire shown in Figure 4, by filling out the survey, information is generated in the form of numbers which are then calculated on average for each packaging sample per *Kansei* word and its antonyms.

E. Kansei Word Extraction with Principal Component Analysis

1. Determining the Number of Principal Components

The number of Principal Components (PC) is determined based on data analysis using R software. The average value Data of *Kansei* word is inputted into PCA analysis coding to be processed. The result Data of running software R generates *Kansei* word spread graph, scree plot graph, variation value, cumulative proportion, and standard deviation. Furthermore, the data is used to determine the results of the design concept based on the PC (Principal Component). The following method is used to find out the number of PCs.

The Kaiser Method

```
> screeplot(datakanseipca.pca, type="lines")
> (datakanseipca.pca$sdev)^2
[1] 4.536433e+01 4.264424e+00 2.687224e+00 1.870762e+00 9.361901e-01
[6] 5.673200e-01 3.934692e-01 2.281108e-01 1.787270e-01 1.393935e-01
[11] 1.012392e-01 7.343152e-02 4.290440e-02 2.998984e-02 1.831144e-02
[16] 1.499291e-02 1.272644e-02 1.219026e-02 1.013315e-02 8.312266e-03
[21] 6.696679e-03 5.447275e-03 4.086387e-03 3.565857e-03 3.099522e-03
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Figure 6 Nilai Variasi PC > 1

The determination of the number of principal components in this study is carried out using the Kaiser criterion, which retains components with eigenvalues (variation values) greater than 1, as such components are considered to explain a meaningful amount of variance in the data [27]. This approach is commonly applied in Principal Component Analysis to ensure that only statistically and conceptually significant components are included in further interpretation. Based on the results presented in Figure 5, four principal components satisfy the Kaiser criterion, namely PC1, PC2, PC3, and PC4. These components exhibit eigenvalues of 4.536433×10^1 , 4.264424, 2.687224, and 1.870762, respectively. The relatively high eigenvalues of these components indicate that they contribute substantially to explaining the variability in the *Kansei* word data. Consequently, these four principal components are retained for subsequent analysis and interpretation, as they represent the dominant perceptual dimensions underlying consumer evaluations of the packaging design.

Standard Deviation

Importance of components:

	PC1	PC2	PC3	PC4	PC5	PC6
Standard deviation	6.7353	2.06505	1.63928	1.36776	0.96757	0.75321
Proportion of Variance	0.7959	0.07481	0.04714	0.03282	0.01642	0.00995
Cumulative Proportion	0.7959	0.87068	0.91782	0.95064	0.96707	0.97702
	PC7	PC8	PC9	PC10	PC11	PC12
Standard deviation	0.6273	0.4776	0.42276	0.37335	0.31818	0.27098
Proportion of Variance	0.0069	0.0040	0.00314	0.00245	0.00178	0.00129
Cumulative Proportion	0.9839	0.9879	0.99106	0.99351	0.99528	0.99657

Figure 7 PC Standard Deviation Value

The determination of the principal components using the standard deviation method is based on examining the magnitude of the standard deviation for each component, where a higher standard deviation indicates a greater contribution of the component in explaining the variability of the data [27]. Components with larger standard deviation values are considered more significant, as they represent stronger and more meaningful variation among the observed variables. This method complements the Kaiser criterion by providing additional confirmation of the importance of each component retained in the analysis. As illustrated in Figure 7, the results show that four components exhibit the highest standard deviation values, namely PC1, PC2, PC3, and PC4. The respective standard deviation values for these components are 6.7353 for PC1, 2.06505 for PC2, 1.63928 for PC3, and 1.36776 for PC4. The noticeably higher standard deviation of PC1 indicates that it captures the largest proportion of variability among the *Kansei* words, followed by PC2, PC3, and PC4, which also contribute substantially to the overall data structure. Therefore, these four principal components are considered the most representative dimensions for further analysis and interpretation of consumer perceptions toward packaging design.

Cumulative Proportion (of Variance)

The determination of the principal components using the cumulative proportion method is based on the total percentage of variance explained, where a cumulative value above 80% is considered sufficient to represent the information contained in the data set [26]. As shown in Figure 8, PC1 alone accounts for 80% of the total variance, while the inclusion of PC2, PC3, and PC4 increases the cumulative proportions to 87%, 91%, and 95%, respectively. These results indicate that the first four principal components collectively explain the majority of the variance in the data, and therefore are adequate to represent the underlying structure of the observed variables for further analysis.

Importance of components:

	PC1	PC2	PC3	PC4	PC5	PC6
Standard deviation	6.7353	2.06505	1.63928	1.36776	0.96757	0.75321
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Cumulative Proportion	0.9839	0.9879	0.99106	0.99351	0.99528	0.99657

Figure 8 Variation Value Reaches 80%

Based on the results obtained from the three evaluation methods; namely the Kaiser criterion, the standard deviation analysis, and the cumulative proportion approach. It can be concluded that PC1, PC2, and PC3 are the principal components that should be retained for further analysis. These components consistently satisfy the established selection criteria by exhibiting eigenvalues greater than one, indicating that they explain a meaningful amount of variance in the data. In addition, they demonstrate relatively high standard deviation values, reflecting their strong ability to capture variability in consumer responses. Furthermore, the cumulative proportion results show that these components collectively account for a substantial percentage of the total variance, exceeding the threshold considered sufficient to represent the overall data structure. Together, these findings confirm that PC1, PC2, and PC3 play a dominant role in explaining the underlying patterns of consumer perceptions. Consequently, these three principal components are deemed adequate to represent the essential perceptual dimensions and are therefore selected as the basis for subsequent analysis and interpretation in the packaging design study.

2. Principal Component Interpretation

The processing of the Principal Component Analysis (PCA) method in determining the design concept in accordance with consumer preferences ends at the stage of interpretation and grouping of the main components. The interpretation and grouping of the main components are determined based on the distribution of *Kansei* words in the positive or negative quadrant. Each straight line leading diagonally will be a paired component [27]. The determination of the Principal Component (PC) must be carried out with expert panelists who have more than 10 years of experience in the related field [26].

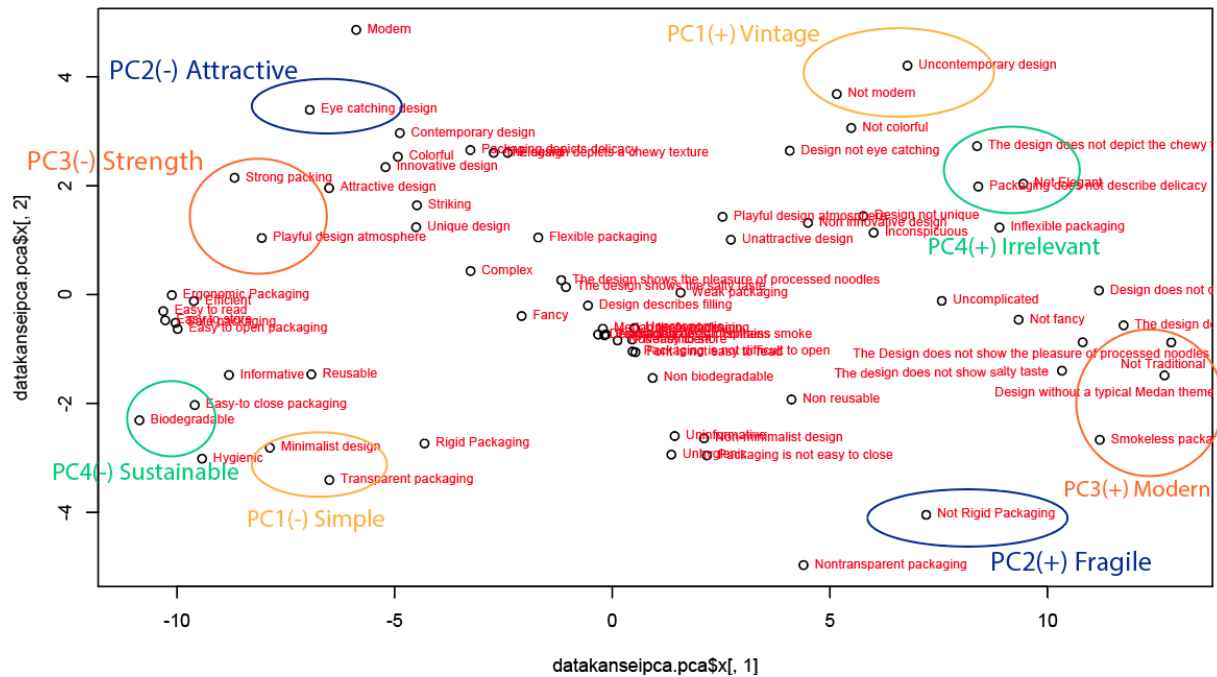


Figure 9 Kansei Word Distribution Map

After a discussion with expert panelists, the design concept based on the spread of the word *Kansei* resulted in a different concept. PC1 negative Quadrant has minimalist and transparent variables, positive Quadrant has not modern and uncontemporary design variables. Based on these variables PC1 produces a design concept of “Simple-Vintage”. For PC2, the negative quadrant consists of eye catching and the positive is not rigid packaging, it is interpreted as “Attractive-Fragile”. Furthermore, PC3 which is a negative quadrant consists of a strong and playful design atmosphere, then the positive quadrant consists of smokeless packaging design, design without a typical Medan, and not traditional is considered “Strength-Modern”. Finally, the negative quadrant containing biodegradable and easy to close packaging, then the positive quadrant containing not depict the chewy, not elegant, not describe delicacy is interpreted as “Sustainable-Irrelevant”.

IV. CONCLUSION

This study successfully identifies and develops the concept of packaging design for *Mie Lidi X* by utilizing *Kansei* Engineering methods supported by Principal Component Analysis (PCA). The main findings of this study indicate that the development of packaging is essential to increase the attractiveness of products and meet consumer preferences. The results of a survey involving 31 respondents showed that 74.2% of them agreed that it is necessary to develop packaging, which reflects the presence of a real need in the market. Through the process of collecting *Kansei* words, a total of 166 words were identified and narrowed down to 37 *Kansei* words. The PCA analysis revealed that four main components (PC1, PC2, PC3 and PC4) have a significant influence on consumer perception, with each resulting in a different design concept, such as “Simple-Vintage”, “Attractive-Fragile”, “Strength-Modern”, and “Sustainable-Irrelevant”. These concepts provide clear guidance for the development of more attractive and functional packaging. This study contributes to understanding the relationship between packaging design and consumer preferences by demonstrating the integration of *Kansei* Engineering and PCA to generate market-oriented design concepts. However, it is limited by a small sample size and focuses only on design concepts without detailing applicable design elements. Future research is recommended to involve more respondents, analyze specific design elements, and consider external influences such as market trends and packaging innovations.

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