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Determination of Packaging Design Elements of Baby Fish Crispy MSMEs Using Kansei Engineering Method

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A B S T R A C T

The current packaging of baby fish crispy has problems, namely packaging design elements such as not having an identity on the packaging and the packaging becomes less attractive, making it difficult to compete with similar products. The research objective is to identify packaging design elements that are in accordance with consumer perspectives. The research method uses Kansei Engineering with the supporting method used is Quantification Theory Type-1 (QTT1), to analysis the interaction between design elements and design concepts by converting independent variable categories (design elements) into quantitative data in KE. The research results obtained 7 categories of design elements based on 42 predetermined samples. The selected concept 'Standard - Protection' obtained the highest R-Square value of 0.9909 with design elements namely: aluminum (X1.7), tall tube (X2.2), lift-off lid (X3.2), corporation & window (X4.9), modern (X5.1), large (X6.3), and direct printing (X7.2). The results of the priority of design elements obtained from the Partial Correlation Coefficient (PCC) value with the highest value on the concept of 'Standard - Protection' are the type of body design element (X2) with a value of 0.98598.

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1. INTRODUCTION

The current packaging of baby fish crispy has several problems that can affect the product itself. Baby fish crispy packaging does not have product identity such as brand, composition, content value, expiration date, halal certificate and license to circulate on the product. The next problem lies in the packaging design elements that are less attractive, making it difficult to compete with similar products. Packaging design elements in food products generally include packaging structure and packaging design. Packaging structure includes technical aspects such as material, size, and additional features. Packaging design involves aesthetic aspects such as colors, images, and typography to create an attractive visual impression (Anwari et al., 2018). So that packaging design can be designed according to the identity of a strong and clear packaging product.

Visual packaging design has an important role in packaging products with design elements. According to Chang (2018), product packaging acts as “the silent salesman” in improving the initial impression of a product in the eyes of potential consumers and increasing consumers' desire to buy a product. Consumer satisfaction with a product is highly dependent on the design of the product and its packaging. Packaging design, which consists of various physical features such as color, shape, and material, plays an important role in shaping consumer perceptions of product quality and value (J. Zhang, 2023). According to Erlyana (2018), the role of design elements is able to convey an impression and message to consumers in determining buying decisions, as well as the identity of a product (Erlyana, 2018). Packaging design elements must be tailored to the packaging product and the intended segmentation, targeting, and positioning (Siswanto et al., 2022). So that design elements are needed in creative, informative, communicative aspects that are interpreted into verbal and visual language.

The initial stage of developing baby fish crispy packaging by finding a design concept that guides in determining design elements. The packaging design concept will be planned as the identity of a packaging product. The concept that has been obtained will be associated with design elements as a reference for packaging development. The packaging design concept has been obtained using the Principal Component Analysis (PCA) support method, the packaging design concept produces the main component selected PC 2 “Standard - Protection”. The concept obtained can be used as a reference in designing the design elements of baby fish crispy packaging. Therefore, determining the appropriate design elements is essential in the packaging development process.

According to Nagamachi & Lokman (2015), Kansei Engineering (KE) approach has been developed with a consumer-oriented approach and systematic consumer feelings or emotional responses are expressed by using appropriate samples. The KE approach incorporates consumers' preferences and sentimental and psychological emotional feelings into the specification of design elements (Wu & Chen, 2022). KE has proven to be very effective for identifying in measuring the correlation between design elements and the perceptual evoked in consumers about the product. It is concluded that this process has the potential to engineer consumers' emotions by translating them into design elements. So it can be used if the QTT1 analysis method is a suitable solution to explore and identify the relationship between packaging products and consumers' emotional responses in this study (Chang et al., 2018).

The identification of baby fish crispy packaging design elements was conducted using the Quantification Theory Type-1 (QTT1) method as a supporting method, to evaluate and quantify the relationship between each pair of Kansei words and design elements in each sample (Yasin et al., 2024). QTT1 is highly beneficial due to its simplicity and transparency, as well as its accuracy in modeling the correlation between independent and dependent variables (B. Zhang et al., 2023). The results of QTT1 provide a reliable representation of the weighting relationships among subjective demands, objective attributes, and sub-attributes. (B. Zhang et al., 2023). Some products have successfully applied the KE method seen in products such as: bottled beverage containers (Chang et al., 2018), creating a new action figure (Chang et al., 2016), design food photos for advertising (Wu & Chen, 2022), the new SMEs e-commerce website design (Habyba et al., 2018), mining cake packaging at MSMEs Sumber Jaya (Yasin et al., 2024), and packaging design for fried meatballs (*Basreng*) (Sari et al., 2023).

The objective of this study is to determine packaging design elements that align with consumer perspectives, enabling the

identification of design elements for each sample collected and evaluated in accordance with the new packaging design (Habyba et al., 2018). The supporting method used is QTT1, a multiple linear regression analysis to analyze the interaction between design elements and design concepts, converting independent variable categories (design elements) into quantitative data in KE (Nagamachi, 2016). Therefore, the QTT1 supporting method proves to be useful due to its simplicity and transparency, as well as its reliable estimation when identifying relationships between design elements (Chang et al., 2018).

2. LITERATURE REVIEW

Baby fish crispy is one of the MSMEs in the food sector with a fairly good sales level. This baby fish crispy has sold over 10,000 pcs and received a 4.7 out of 5 rating on the online sales platform. This product has a production capacity of 150-250 kg per week with an average profit of IDR 1,500,000 - IDR 2,000,000 per month and employs more than 15 people (Churiyah et al., 2022). So, this product has the potential to continue to grow with good sales (Saraswati et al., 2015). According to Nagamachi & Lokman (2015), Kansei Engineering (KE) is an approach that is systematically designed and focused on consumers, where emotional responses or feelings of consumers are expressed through the right samples. This approach integrates psychological preferences and emotional sentiments of consumers into design element specifications (Wu & Chen, 2022). The term "Kansei" refers to a concept in psychology that involves the integration of consumers' various senses (such as sight, hearing, smell, and touch) and perceptions influenced by factors such as size, color, performance, price, and other product attributes. Therefore, KE can be used as a product design and visual aspect (López et al., 2021).

The QTT1 method is designed for quantitative and categorical multiple regression analysis and allows the inclusion of categorical and qualitative independent variables (Han & Ma, 2019). Research by Zhang et al. (2023) QTT1 is very useful because of its simplicity and transparency, as well as its ability to provide accurate estimates when modeling the correlation between independent and dependent variables. The results of QTT1 offer a reliable representation of the weighted relationships among subjective demands, objective attributes, and sub-attributes. However, contradictory relationships may often appear in these data, as their numerical weights may reflect inconsistencies caused by differences in respondents' subjective preferences (B. Zhang et al., 2024). Due to these contradictions, which may affect subsequent design decisions, further research needs to resolve these contradictions with structured methods to solve the problem reasonably.

This study has a gap with previous research, where previous research related to baby fish crispy products only focused on product quality, product brands, and product diversification. Research by Ratnaningsih et al. (2021) improves product quality by improving the production process, while packaging improvements are only carried out subjectively without involving consumer perceptions. Meanwhile, research by Kurniasari et al. (2022) focuses on analyzing the effect of quality and packaging on product brand image. This study shows that partial packaging has a significant effect on product image. Research related to packaging development by considering consumer perceptions and emotions quantitatively has never been conducted for baby crispy products, so this study needs to be conducted.

3. RESEARCH METHOD

The research utilized a KE approach supported by the QTT1 method to determine the development of design elements for baby fish crispy packaging. QTT1 is a simple and transparent method, offering accurate

estimations when modeling correlations between independent and dependent variables (Chang et al., 2018). The procedure is described in the process study framework which can be seen in Figure 1.

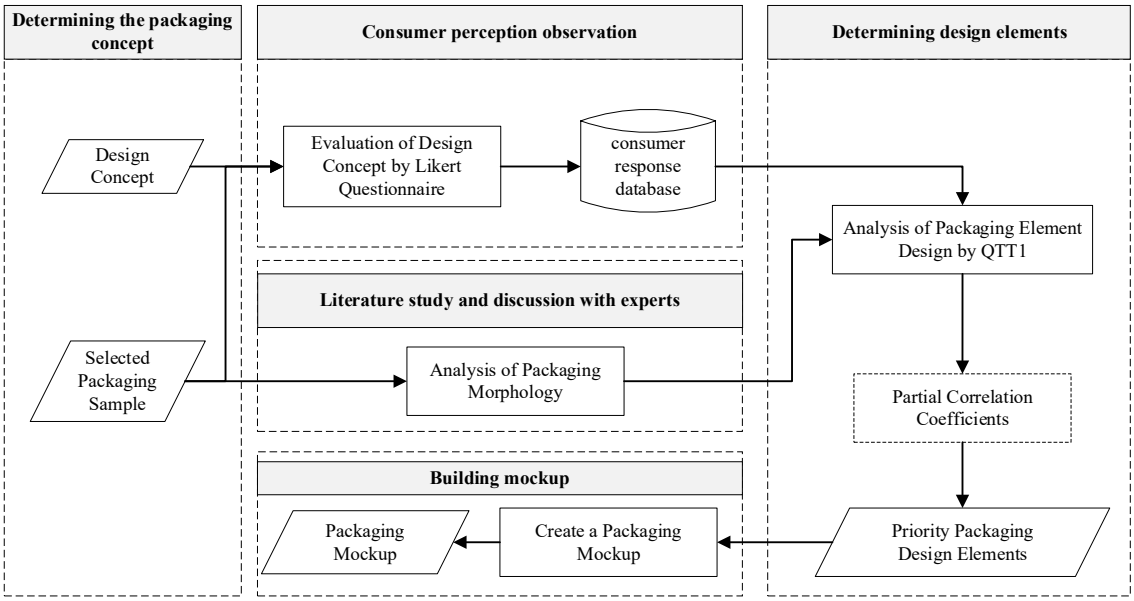


Figure 1. Process study framework

The initial stage of the research was the collection of packaging samples. Packaging samples are based on Segmentation, Targeting, and Positioning (STP) and product characteristics. Packaging samples are collected based on research on the internet and other sources that are in accordance with STP and product characteristics. According to Nagamachi (2016), the number of samples used as a product reference is 25-30 samples. The determination of packaging samples was selected with expert panelists also based on material, shape, design variations, features, and size. Packaging samples are analyzed and identified for each sample collected and evaluated according to the packaging design elements in each sample (Habyba et al., 2018).

KE approaches generally rely on the concept of morphological analysis to describe product or product details. Morphological analysis is based on human sentimentality towards specific component features, generally relying on qualitative "element/factor" and "feature/type" concepts that use pictorial profiles with text descriptions to describe packaging features in each element (Chang et al., 2018). According to Chang (2018), determining the design elements of packaging samples involves a morphological analysis process to describe each packaging product sample. This process breaks down a system or product into main sub-samples, with each sample representing a category in a multi-dimensional matrix (Chang et al., 2018). Therefore, new ideas are found by searching the matrix for new combinations of features.

The evaluation of concepts obtained from PCA with 42 samples was conducted using a semantic differential questionnaire. Subsequently, consumer responses were evaluated with a Likert scale questionnaire consisting of 7 points (1, 2, 3, 4, 5, 6, 7) for each sample (Chen & Huang, 2019), where the 1-7 scale represents the standard appearance and the most attractive appearance (Habyba et al., 2018). The application of a 7-point scale increases the points much more specifically (Sari, 2019). In the creation of this questionnaire, the concept to be measured is always placed on the left on the number 1 for the standard display and the number 7 for the

most attractive display on the right. This will make it easier for subjects to interpret that positive values are located on the right side of the scale (Sari, 2019).

The results of the evaluation were then analyzed using the QTT1 method. This method will obtain data obtained from the results of the questionnaire used to calculate the mean, standard deviation, Multiple R-Square, and Partial Correlation Coefficient (PCC) of each design concept that has been determined using R software. QTT1 can be said to be a quantitative and categorical multiple regression analysis method, which allows for the inclusion of categorical and qualitative independent variables (Djatna & Kurniati, 2015). QTT1 consists of the following six steps (Djatna & Kurniati, 2015):

1. Define the Kansei relational model associated with the Kansei measurement scale of the experimental sample with respect to image word pairs. The categorical multiple regression model can be defined as follows:
   $\hat{y}_s^k = \Sigma_{i=1}^{E} \Sigma_{j=1}^{ci} \beta_{ij} x_{ijs} + \varepsilon$
   Where:
   $\hat{y}_s^k$ = the predicted value of the criterion variable for the s^{th} product sample at the k^{th} image word.
   i = index of design elements
   E = number of design elements
   j = index of the category
   C_i = number of categories of the i^{th} design element
   ε = stochastic variable whose expected value is $E(\varepsilon) = 0$
   β_{ij}= j^{th} style category value in the i^{th} design element
   x_{ijs}= coefficient of the dummy variable
2. Calculate the standardized regression coefficients and standardized constants in the model. The model of categorical multiple regression analysis can be redefined as follows:
   $\hat{y}_s^k = \Sigma_{i=1}^{E} \Sigma_{j=1}^{ci} \beta_{ij} * x_{ijs} + \bar{y}_s^k$
   $\beta_{ij} * = \beta_{ij} - (1/n) \Sigma_{j=1}^{ci} \beta_{ij} * x_{ijs}$
   $\bar{y}_s^k = (1/n) \Sigma_{j=1}^{ci} y_s^k$
3. Determine the CCR matrix from the correlation coefficients of all variables.
4. Calculate the multiple correlation coefficient (R) which is considered as the degree of relationship between the external criterion variable and the explanatory variables.
5. Calculate the partial correlation coefficient (PCC) of design elements to clarify the relationship between product elements and product image.
6. Determine the statistical ranges of the categorical variables that indicate their level of contribution to the prediction model with respect to the given product image.

4. RESULT AND DISCUSSION

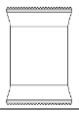
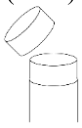
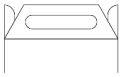
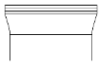
The process of identifying samples according to reference-based products, 82 product packaging samples have been collected. According to Sari (2019), the number of samples is recommended by collecting around 20-25 similar samples as a reference. The sample collection process also considers the principles of Segmentation, Targeting, and Positioning (STP) and product characteristics, by involving expert panelists with a minimum of 3 years of experience (Chen & Huang, 2019) and a minimum of 3 expert panelists (Bidin et al., 2021). Based on STP, products with demographics aged 19-35 years old who live in the Jabodetabek area, especially work in offices or are still students. The nature of the product is easily oxidized, the ideal packaging must have sufficient thickness, airtight, and equipped with features such as a window to see the contents of the product, zip lock to maintain freshness, and tear notch to facilitate opening. The use of materials that match the characteristics of the product is also very important to provide extra protection to the product. Based on comparative analysis, the number of packaging samples was reduced to

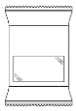
42 by comparing similar samples. These selected samples show significant diversity in terms of design, shape, size, features and materials, and have been customized according to STP principles and product characteristics (Chen & Huang, 2019). The details of the selected packaging samples are shown in Figure 2.

Figure 2. Packaging samples

The next process involves performing morphological analysis on the collected and selected samples to identify design elements and features by defining the overall design (Chen & Huang, 2019). The results of this analysis are presented in Table 1. Based on these results, seven form elements were identified, with each element comprising three to fourteen types. Subsequently, the 42 samples were assigned codes based on the results of the morphological analysis, as listed in Table 2.

Table 1. Morphology of 42 samples

Type	1	2	3	4	5	6	7
X1 (Material)	Plastic PP (X1. 1)	Plastic LLDPE (X1. 2)	Plastic HDPE & Mett (X1. 3)	Plastic PET (X1. 4)	Plastic PET & Tin Plate (X1. 5)	Tin Plate, PET, & Board paper (X1. 6)	Aluminum (X1. 7)
	Plastic Multilayer (X1.8)	Craft Paper 400 GSM (X1. 9)	Craft Paper 210 GSM (X1. 10)	Ivory Paper (X1. 11)			
X2 (Body)	Short Tube (X2. 1) 	Tall Tube (X2. 2) 	Beam Vertical (X2. 3) 	Standing Pouch (X2. 4) 	Gusset Vertical (X2. 5) 	Gusset Horizontal (X2. 6) 	Thin Wall (X2. 7) 
	Center seal (X2. 8) 	Unique (X2. 9) 					
X3 (Lock)	Screw (X3. 1) 	Lift-off Lid (X3.2) 	Lock (X3. 3) 	Snap-on Lid (X3. 4) 	Flip Top (X3. 5) 	Folding (X3. 6) 	Sealing (X3. 7) 

X4 (Features)	Hanging Hole (X4. 1) 	Handle (X4. 2)	Ziplock & Handle (X4. 3) 	Ziplock & Tear Notch (X4. 4) 	Ziplock (X4. 5) 	Window & Ziplock (X4. 6) 	Window (X4. 7) 
	Window Unique (X4. 8) 	Porporation & Window (X4. 9) 	Porporation (X4. 10) 	Tear Notch (X4. 11) 	Tin Tie (X4. 12) 	Open Easy (X4. 13) 	No Features (X4. 14)
X5 (Style Design)	Modern (X5. 1)	Fun Illustrative (X5. 2)	Illustrative (X5. 3)	Good Complex (X5. 4)	Bad Complex (X5. 5)	Retro (X5. 6)	Simple (X5. 7)
	Minimalist (X5. 8)						
X6 (Volume)	Small (80-300 gr) (X6. 1)	Medium (301-600 gr) (X6. 2)	Large (601-1000 gr) (X6. 3)				
X7 (Surface)	Label/ sticker (X7. 1)	Direct Printing (X7. 2)	Indirect Printing (X7. 3)				

The morphological analysis process adheres to several key principles: elements must be easily recognizable as parts of the sample design, and each element must be distinguishable from the others. Overall, these elements should encompass the full range of shape variations present in the samples, and each element must include several shape features, with unique and independent relationships between the features (Chen & Huang, 2019). Each sample represents only one category within each design element (Wu & Chen, 2022). The visualization factors and features are determined based on the following principles (Chang & Chen, 2016): (1) each feature seen in the sample should be clear and important to the visualization of the packaging; (2) factors and features should be able to explain the main features of the packaging. Design element identification for each sample is also conducted through discussions with expert panelists who are skilled in their respective fields (Sari, 2019).

In this study, expert panelists were required to identify packaging samples from the physical form and design elements. This technique can make evaluation values on a more scientific, objective, and precise basis for each sample (González et al., 2024). This research uses 3 expert panelists, who are packaging material experts, packaging experts, and design experts who are experienced in their fields. Afterward, one image from each sample was selected to represent the category, and the analysis took into consideration which resulted in the removal of unsuitable samples and the addition of alternative images when deemed necessary on morphological factors (Q. Zhang et al., 2023). As a result, seven elements (X1–X7) were identified for the morphological analysis of the baby fish crispy packaging, as shown in Table 2. For example, sample A has the following design elements: X1.8, X2.4, X3.7, X4.4, X5.1, X6.1, and X7.3, meaning that the values listed sequentially in columns X1 through X7 are 8, 4, 7, 4, 1, 1, and 3.

Table 2. Numerical data from samples

Sample	X1	X2	X3	X4	X5	X6	X7	NEF - F Value				S - P Value	
								Mean	Min	Max	Stand. Dev	Mean	Stand. Dev
A	8	4	7	4	1	1	3	5.16	3	6	1.08	5.13	1.10
B	8	8	7	10	1	1	3	3.72	2	6	1.11	4.72	0.89
C	8	8	7	1	1	1	3	4.09	2	7	1.15	4.88	1.04
D	4	5	6	7	6	2	3	4.53	2	7	1.22	4.91	1.00
E	4	2	1	2	5	2	1	4.91	2	7	1.33	5.59	1.01
F	8	8	7	7	8	1	3	3.94	2	6	0.98	4.38	1.16
G	4	1	1	14	7	1	1	5.50	2	7	1.19	5.41	1.32
H	4	3	1	14	8	3	1	5.81	3	7	1.00	6.03	1.20
I	9	3	3	7	8	3	2	4.78	1	7	1.24	4.56	1.16
J	2	5	6	12	8	1	1	4.50	2	7	1.32	4.72	1.33
…	…	…	…	…	…	…	…	…	…	…	…	…	…
AO	5	2	5	13	5	1	1	4.31	1	7	1.51	5.16	1.59
AP	1	2	1	2	3	1	1	5.09	2	7	1.55	5.63	1.34

The mean and standard deviation results in Table 2. obtained with each sample were analyzed through a semantic differential questionnaire with purposive sampling distributed to 30 subjects (Sari et al., 2023). The purposive sampling technique was chosen based on the characteristics of the subjects following the research objectives (Lenaini, 2021). In each sample, consumer responses were evaluated using a 7-point Likert scale, where the 1-7 scale represents the standard display and the most attractive display (Habyba et al., 2018).

The result mean and standard deviation values from Table 2 were used to calculate the Multiple R-Square and PCC, processed using the QTT1 method with R software. Based on the results of the data analysis conducted in R, presented in the form of a histogram, it can be concluded that the product type with the highest preference graph is the most influential on consumer responses (Sari, 2019). From Table 3, the Multiple R-Square values indicate that the selected concept is PC 2 (Standard - Protection), with the highest Multiple R-Square value of 0.9909.

Table 3. Multiple R-square value

Concept	Multiple R-Square Value
PC 1 (Not Eco-Friendly - Functional)	0.9839
PC 2 (Standard - Protection)	0.9909

The results of the design elements for PC 2 “Standard - Protection” were obtained by identifying through the histogram bar graph in Figure 3. The histogram bar results have two right and left sides, the right side shows the elements selected for the Protection concept and the left side the elements for the Standard concept. The result of the highest element value or the longest bar of the histogram bar is

selected as the design element (Sari et al., 2023).

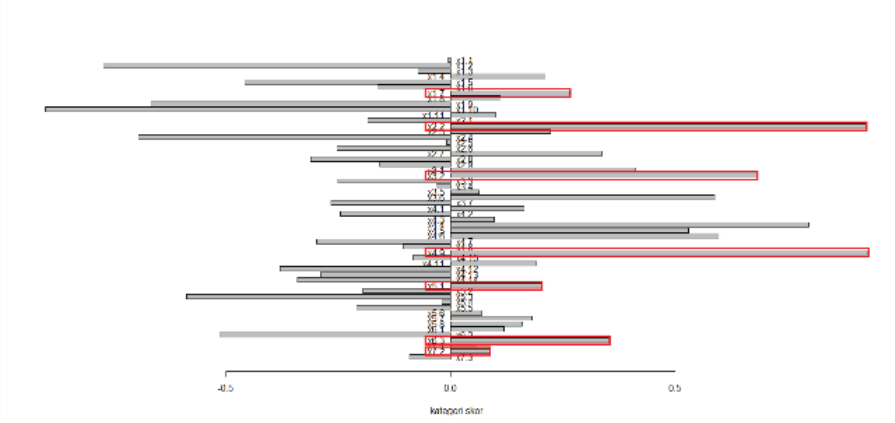


Figure 3. Graphical results of running QTT1 concept “standard - protection”

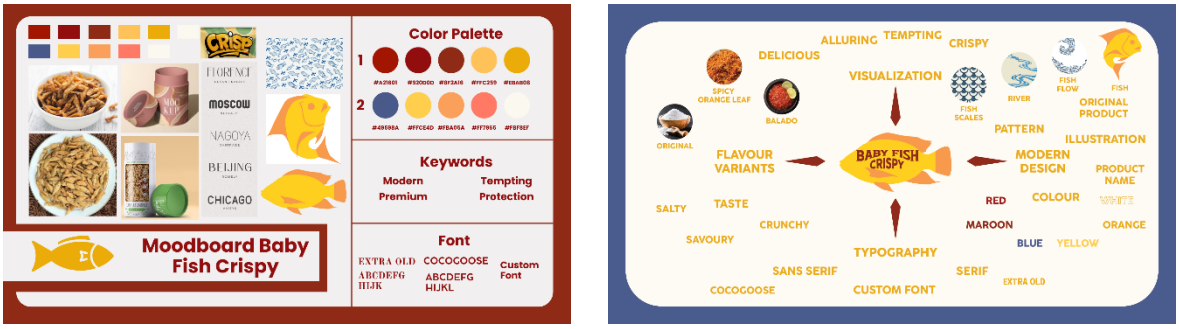
The identified design elements for the "Protection" concept are as follows: aluminum material (X1.7), tall tube shape (X2.2), lift-off lid closure (X3.2), perforation & window feature (X4.9), modern design style (X5.1), large volume (X6.3), and direct printing surface (X7.2). These design elements become recommendations and are used by MSMEs to create mockups that will be developed into Protection packaging designs with a modern design style that precisely targets the desired emotional connection with consumers.

Table 4. Partial Correlation Coefficient (PCC) Value

	X1 Material	X2 Body	X3 Lock	X4 Features	X5 Style Design	X6 Volume	X7 Surface
PCC Value	0.97837	**0.98598**	0.96012	0.98027	0.96886	0.96414	0.72369

The prioritization of design elements is determined by the highest Partial Correlation Coefficient (PCC) value for each factor/element. The highest PCC value indicates that the corresponding element has a significant impact on consumer responses (Chang et al., 2018). PCC also reflects the degree of contribution of a design element to predictions related to a specific sample (Wu & Chen, 2022). For the Standard - Protection concept, the design element with the highest PCC value is the body (X2), with a value of 0.98598. Table 4 displays the PCC values for the Standard - Protection concept. These results align with the Standard - Protection concept, highlighting the body element as the most critical for representing this concept. After performing morphological analysis using the QTT1 method, the design elements identified are used to create a mockup. The packaging design to be developed is the Protection design, with design elements identified through a mood board and mind-mapping techniques tailored to the design characteristics, as shown in Figures 4a and 4b. These design characteristics serve as a guide for designing packaging based on consumers' emotional responses (Sari et al., 2024). The final digital sketches are then visualized as 3D mockups using Blender 3D software, as shown in Figure 5. Based on the results and discussion that have been presented, the visualized packaging will become a new

identity for baby fish crispy MSME products, establishing a distinctive brand presence in the market that was previously lacking. This transformation extends beyond mere aesthetics, as the packaging has been strategically designed to impact and transform their product development in several impactful ways. So that the packaging can protect the contents of the product inside and the design style can attract consumers to purchase the product. Simultaneously, the design style can attract consumers to purchase the product through its strategic use of colors, typography, and imagery that evoke positive emotional responses identified through Kansei methodology, thereby increasing shelf appeal and purchase intention among potential customers.



(a) (b)

Figure 4a. Moodboard and **Figure 4b.** Mind mapping

Figure 5. Baby fish crispy packaging mockup result

5. CONCLUSION

This study aims to validate the design elements based on the results of the packaging development concept. The selected concept is "Standard - Protection," which achieved an R-squared value of 0.9909. Morphological analysis is necessary as a reference material for determining packaging design elements. We conducted an open questionnaire using a 7-point likert scale with a minimum of 30 subjects. The results, analyzed using R software, identified the following preferred design elements: aluminum (X1.7), tall tube (X2.2), lift-off lid (X3.2), corporation & window (X4.9), modern aesthetics (X5.1), large size (X6.3), and direct printing (X7.2). In terms of prioritizing design elements according to the PCC value within the "Standard - Protection"

concept, the type of body design element (X2) received the highest value of 0.98598. These elements are crucial for establishing the appropriate packaging design concept for crispy baby fish products. However, further research is needed to minimize subjective bias in interpreting these elements. It is believed that additional research will help optimize the overall packaging design.

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