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PERANCANGAN KEMASAN PLATELET LYSATE NUSANTARA (PL-NUSA) DENGAN PENDEKATAN DESAIN NIGEL CROSS

DESIGNING THE PACKAGING OF PLATELET LYSATE NUSANTARA (PL-NUSA) USING THE NIGEL CROSS DESIGN APPROACH

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***Abstrak*—** Industri bidang kesehatan berkembang pesat saat ini. Salah satu produknya adalah *Platelet Lysate*. *Platelet Lysate* adalah sebuah produk yang banyak digunakan dalam bidang kesehatan dan ilmu hayat. Salah satu produk *Platelet Lysate* yang dikembangkan di dalam negeri adalah *Platelet Lysate* Nusantara (PL-Nusa). Karena produk ini sangat rentan rusak, kemasannya dirancang dengan spesifikasi khusus untuk melindungi *Platelet Lysate* di dalamnya. Penelitian ini bertujuan untuk menentukan spesifikasi teknis yang sesuai dalam perancangan desain kemasan *Platelet Lysate* Nusantara (PL-Nusa), dengan mempertimbangkan perlindungan produk serta preferensi pengguna dalam proses pembuatannya. Penelitian ini menggunakan pendekatan desain *Nigel Cross* yang mencakup klarifikasi tujuan, menetapkan fungsi, menyusun kebutuhan, menentukan karakteristik, menghasilkan alternatif, dan memilihnya. Diketahui juga pendekatan desain *Nigel Cross* merupakan pendekatan yang menekankan proses berpikir kreatif dan iteratif yang melibatkan analisis masalah, generasi ide, pembuatan prototipe, dan evaluasi, dengan fokus pada pemecahan masalah secara inovatif dan reflektif. Dari hasil penelitian, dapat diketahui spesifikasi teknis yang diperlukan serta rancangan desain kemasan PL-Nusa. Spesifikasi teknis yang dibutuhkan dalam pembuatan kemasan PL-Nusa antara lain menggunakan bahan *Polypropylene* (PP), kapasitas 100 ml, penutup lingkaran bergerigi yang dapat diputar, serta bentuk kemasan berupa tabung dengan diameter atas dan bawah yang sama.

***Kata kunci* —** Kemasan Produk, *Nigel Cross*, *Platelet Lysate*

***Abstract*—** The healthcare industry is rapidly growing. One of its products is Platelet Lysate, which is widely used in the fields of healthcare and life sciences. One of the Platelet Lysate products developed domestically is Platelet Lysate Nusantara (PL-Nusa). Due to its high susceptibility to damage, the packaging is designed with specific specifications to protect the Platelet Lysate inside. This study aims to determine the appropriate technical specifications for designing the Platelet Lysate Nusantara (PL-Nusa) packaging, considering both product protection and user preferences in the manufacturing process. The study employs the Nigel Cross design approach, which includes clarifying objectives, defining functions, identifying requirements, determining characteristics, generating alternatives, and selecting the best option. The Nigel Cross design approach emphasizes a creative and iterative thinking process that involves problem analysis, idea generation, prototyping, and evaluation, focusing on innovative and reflective problem-solving. The research results identify the necessary technical specifications and the final packaging design for PL-Nusa. The required technical specifications for PL-Nusa packaging include the use of Polypropylene (PP) material, a 100 ml capacity, a serrated circular lid that can be rotated, and a tubular shape with a uniform diameter at the top and bottom.

***Keywords*—** Nigel Cross, Platelet Lysate, Product Packaging

I. INTRODUCTION

The healthcare industry has been experiencing rapid growth in recent years. One of the emerging products in this sector is Platelet Lysate, which is widely used in healthcare and life sciences. Due to its highly perishable nature, Platelet Lysate requires

specialized packaging to preserve the integrity and quality of the product.

A domestically developed variant of Platelet Lysate is *Platelet Lysate Nusantara* (PL-Nusa). As a newly developed product, PL-Nusa necessitates a packaging design with specific technical criteria to ensure that the product remains stable and protected from damage.

Given the sensitive composition of Platelet Lysate, its packaging must meet particular specifications, as the product is susceptible to degradation due to environmental exposure [1]. Packaging serves as the final outcome of the packaging process and plays a crucial role in enhancing both the value and functionality of a product. Its primary functions are to store and protect the product. Well-designed packaging also contributes to consumer satisfaction, as it takes into account various factors such as consumer preferences for color, size, and visual appearance [2]. In addition to consumer preferences, effective packaging design must also prioritize product protection.

Design can be defined as an effort to obtain, organize, or create new solutions that offer benefits to human life. A comprehensive design process must consider multiple aspects, including aesthetics, functionality, safety, and comfort [3]. One of the methodologies that can be adopted in the design process is the Nigel Cross approach.

The Nigel Cross design approach is an alternative method that can be applied in product development. This method integrates both the structural aspects of design and the design program itself [4]. In addition to addressing consumer needs, the Nigel Cross approach offers several advantages over other methods. It allows for a complete, systematic design process and supports continuous development. This is made possible through its eight structured steps that guide the planning and design process [5].

II. LITERATURE REVIEW

A. Platelete Lysate

Platelet Lysate (PL), often referred to as *Human Platelet Lysate* (HPL), is an alternative medium for cell growth [6], [7]. It is commonly produced through a repeated freeze-thawing process applied to Thrombocyte Concentrate (TC), which results in the release of proteins and growth factors [8], [9]. This product is widely used in the fields of healthcare and life sciences. *Platelet Lysate Nusantara* (PL-Nusa) is a domestically produced version of Platelet Lysate. This locally developed product aims to enhance national self-reliance and reduce dependence on imported Platelet Lysate, which currently dominates the market.

B. Packaging

Packaging is a form of enclosure designed to protect the contents within [10]. It serves both as a protective barrier and as a representation of the product's identity [11]. Based on these definitions, packaging can be understood as a container or wrapping that functions not only to protect and preserve product quality, but also to reflect the product's branding and identity.

C. Product Design

Product design is a process of defining what is to be created using various techniques that involve descriptions of the architecture, component details, and constraints encountered during development [12]. A product is defined as anything that can be offered to the market for attention, acquisition, use, or consumption to satisfy a desire or need [13]. From these definitions, product design can be interpreted as the process of creating, organizing, or developing new items—goods or services—that are useful, meet specific needs and wants, and provide value to society through the application of diverse technical methods.

D. Nigel Cross

The Nigel Cross method is an alternative approach that can be used in product design. This method integrates both structural and programmatic aspects of design [14]. It represents a systematic and structured framework for product development, introduced and developed by Nigel Cross, an emeritus professor at the University of Brighton, United Kingdom. The stages of the Nigel Cross method are illustrated in Figure 1 [14].

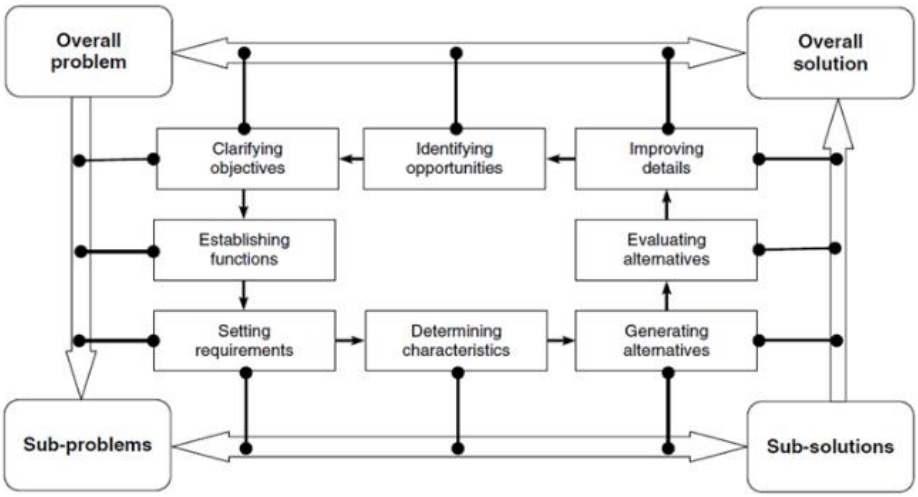

Figure-1. Stages of the Nigel Cross Design Method

E. Computer-Aided Design (CAD)

Computer-Aided Design (CAD) refers to computer systems used to aid in the creation, modification, analysis, or optimization of a design [15], [16]. CAD is employed to improve design quality, increase designer productivity, enhance communication through documentation, and establish a database for manufacturing operations [17].

III. METHODS

This study employed both primary and secondary data. Primary data were obtained through field observations, questionnaires, and interviews with the product developers of PL-Nusa at the Indonesian Red Cross (PMI) Yogyakarta. Secondary data were gathered from literature relevant to the research topic. The study began with problem identification, literature review, field studies, determination of research objectives, and the establishment of problem boundaries and assumptions. Subsequently, the research proceeded through a series of stages, from data collection and analysis to product design, following these steps:

A. Data Collection

Data collection was carried out through a customer needs questionnaire and direct interviews with respondents.

B. Data Processing

The objective of data processing was to obtain relevant information for the design of PL-Nusa packaging. This process was conducted systematically to ensure the resulting data supports user needs and preferences through the following stages:

1) Clarifying Objectives

This stage aimed to identify the main and sub-objectives of the PL-Nusa packaging design using the objective tree method.

2) Defining Functions

At this stage, key packaging functions were determined using the function analysis method.

3) Establishing Requirements

Design problems were identified based on customer needs questionnaire data. Each specification was classified as either a *Demand (D)* or a *Wish (W)* using the performance specification method.

4) Determining Characteristics

This stage included the development of the voice of the customer, the construction of a relationship matrix between consumer needs and design parameters, and the development of the House of Quality (HoQ).

C. Product Design

At this stage, the packaging design for Platelet Lysate Nusantara (PL-Nusa) was developed based on the analyzed data—from clarifying objectives to determining design characteristics. The resulting designs were then presented to respondents to select the most suitable option. The PL-Nusa packaging design was created using SolidWorks software, utilizing 3D Part Design & Assembly features, with millimeter (mm) as the unit of measurement and

employing modeling features such as revolve, helix, pattern, shell, and fillet.

1) Generating Alternatives

This stage involved generating multiple design alternatives for the packaging cap and body using the morphological chart method. Respondents then selected the most appropriate design.

2) Evaluating Alternatives

The generated alternatives were evaluated by assigning weighted criteria based on the eight quality dimensions derived from the customer needs questionnaire. Respondents conducted the weighting, and each design alternative was rated to calculate a weighted score.

3) Refining Details

This final stage aimed to refine the selected alternative in terms of materials, dimensions, and design features.

IV. RESULTS AND DISCUSSION

A. Data Collection

The data collection process was conducted through questionnaires and interviews. This study utilized a customer needs questionnaire. The results are presented in Table 1 and further illustrated in Figure 2.

Table-1. Results of the Customer Needs Questionnaire

No	Question	Necessary	Not Necessary
	Performance		
1.	Is it necessary for the packaging volume to match the product content?	6	0
	Features		
2.	Is a cap necessary for the product packaging?	6	0
3.	Should the cap design be user-friendly? Please describe the shape (e.g., circular, square, etc.).	6	0
	Reliability		
4.	Should the packaging be durable against unwanted conditions (e.g., being dropped or thrown)?	6	0
	Conformance		
5.	Should the packaging contain product information (e.g., volume, recycling instructions)?	6	0
6.	Should the packaging shape reflect the product content? Please describe the shape (e.g., cylindrical, block, etc.).	6	0
	Durability		
7.	Should the packaging use high-quality material?	6	0
	Aesthetics		
8.	Is it necessary for the packaging to have an aesthetic design?	0	6

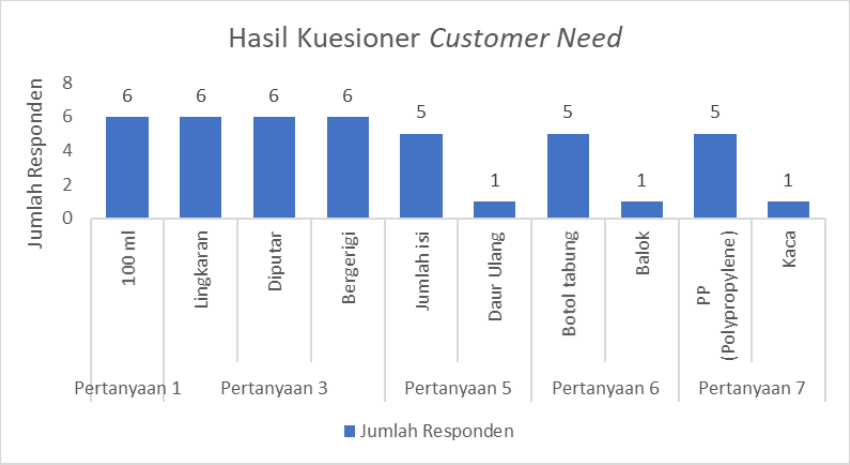

Figure-2. Summary of Customer Needs Questionnaire Results

B. Data Processing

All data collected in the research were subsequently processed using the Nigel Cross design methodology. This data processing phase resulted in the final packaging design for the PL-Nusa product.

1) Clarifying Objectives

The method employed at this stage was the *objective tree method*, which was used to identify the main and sub-objectives of the PL-Nusa packaging design. These objectives were visualized in a diagram form. The objective tree diagram for the PL-Nusa packaging design is shown in *Figure 3*.

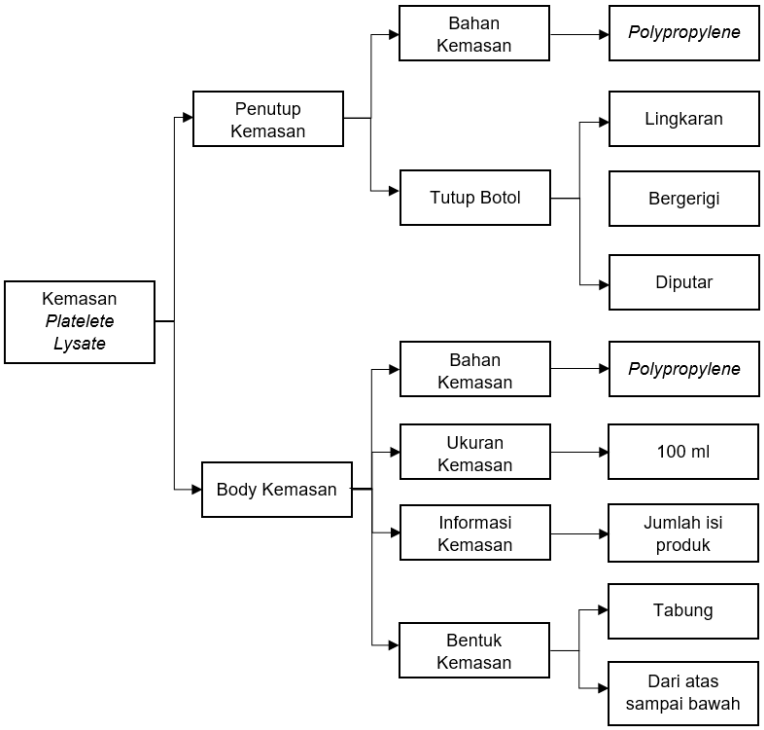

Figure-3. *Objective Tree Method*

2) Defining Functions

Defining functions was the next step following the clarification of objectives. This stage applied the *function analysis method*, which aims to identify and evaluate key functions of the packaging and the degree to which the design addresses them. The *black box* and *transparent box* representations of the PL-

Nusa packaging design are presented in *Figure 4* and *Figure 5*, respectively.

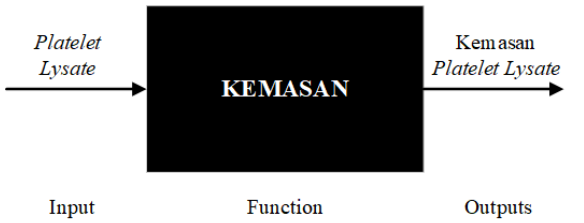

Figure 4. *Black box*

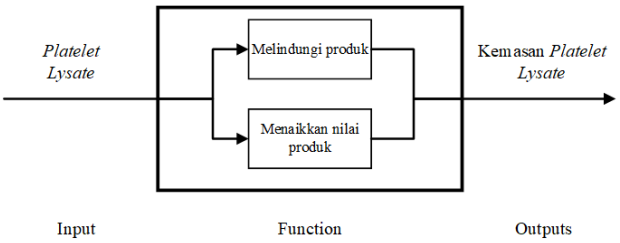

Figure-5. *Transparent box*

3) *Establishing Requirements*

Based on the results of the customer needs questionnaire, product specifications were identified to reflect the characteristics required for the PL-Nusa packaging. These specifications are listed in *Table 2*. Items classified as *Demand (D)* were derived from the sub-functions previously identified, while *Wishes (W)* represent additional expectations gathered from the questionnaire responses.

Table-2. *Performance specification method*

No	Category	Specification	D/W
1	Packaging Size	100 ml capacity	D
2	Packaging Cap	Circular shape	W
		Twist-open mechanism	W
		Textured (rigged) surface	W
3	Packaging Information	Contains information on product volume	D
4	Packaging Shape	Cylindrical bottle shape	W
		Uniform shape from top to bottom	W
5	Packaging Material	*Polypropylene* (PP)	W

4) *Determining Characteristics*

Based on the third stage (requirement establishment), technical specifications for the PL-Nusa packaging design were derived. This stage utilized the *Quality Function Deployment (QFD)* approach. The first step involved generating the *voice of the customer* from the customer needs questionnaire. This is shown in *Table 3*.

Table-3. *Voice of customer*

Customer Needs	Technical Specifications
Packaging Size	Adjusted to the volume of the PL-Nusa product
Packaging Cap	Easy to open/close and maintains product integrity
Packaging Information	Includes product volume information
Packaging Shape	Proportional to product content
Packaging Material	Made of high-quality materials that preserve product condition

The second step was to develop a relationship matrix between customer needs, technical specifications, and matrix values, based on the information from the previous step. This is shown in *Table 4*.

Table-1. Relationship between Customer Needs, Technical Specifications, and Matrix Values

No.	Customer Needs	Technical Specifications	
		Matrix	Matrix Value
1	Packaging Size	Adjusted to the volume of the PL-Nusa product	100 ml capacity
2	Packaging Cap	Easy to open/close and capable of maintaining product quality	Circular, ridged, twist-off cap
3	Packaging Information	Contains information about the product volume	Displays volume in milliliters
4	Packaging Shape	Proportional to the product content	Cylindrical bottle with uniform size from top to bottom
5	Packaging Material	Made from high-quality material that does not	Polypropylene (PP) material

No.	Customer Needs	Technical Specifications	
		Matrix	Matrix Value
		damage the product	

The third step involved establishing the relationship between customer needs, the matrix, and matrix values obtained in the previous steps. These results were then used to construct the *House of Quality*. The relationship matrix is presented in *Table 5*.

Table- 2. Relationship Matrix Between Customer Needs, Matrix, and Matrix Values

	100 ml capacity	Circular, Ridged, Twist-Off Cap	Displays volume in milliliters	Cylindrical bottle with uniform size from top to bottom	Polypropylene (PP) material
Packaging Size	●		●	●	
Packaging Cap		●		●	
Packaging Information	●		●	●	
Packaging Shape	●	●		●	
Packaging Material					●

In the *House of Quality*, correlations and relationships between customer needs, matrix elements, and matrix values are further analyzed. The levels of consumer need prioritization are also detailed in *Tables 6*, *7*, and *8*.

Table-3. Relationship Value Legend

Relationship Type	Description	Value
◎	*Strongly linked*	9
○	*Moderately linked*	3
△	*Possibly linked*	1
	Not Linked	0

Table-4. Correlation Values

Relationship Type	Description
√√	*Strong positive impact*
√	*Moderate positive impact*
<blank>	*No impact*
x	*Moderate negative impact*
xx	*Strong negative impact*

Table-5. Customer Need Importance Scale

Value	Description
1	Not important
2	Slightly important
3	Moderate
4	Important
5	Very Important

After determining the relationship values and correlation levels among customer needs, the matrix, and matrix values, as well as assigning importance ratings to each customer requirement (based on respondent input), the final step was to construct the *House of Quality*. The resulting *House of Quality* diagram is shown in *Figure 6*.

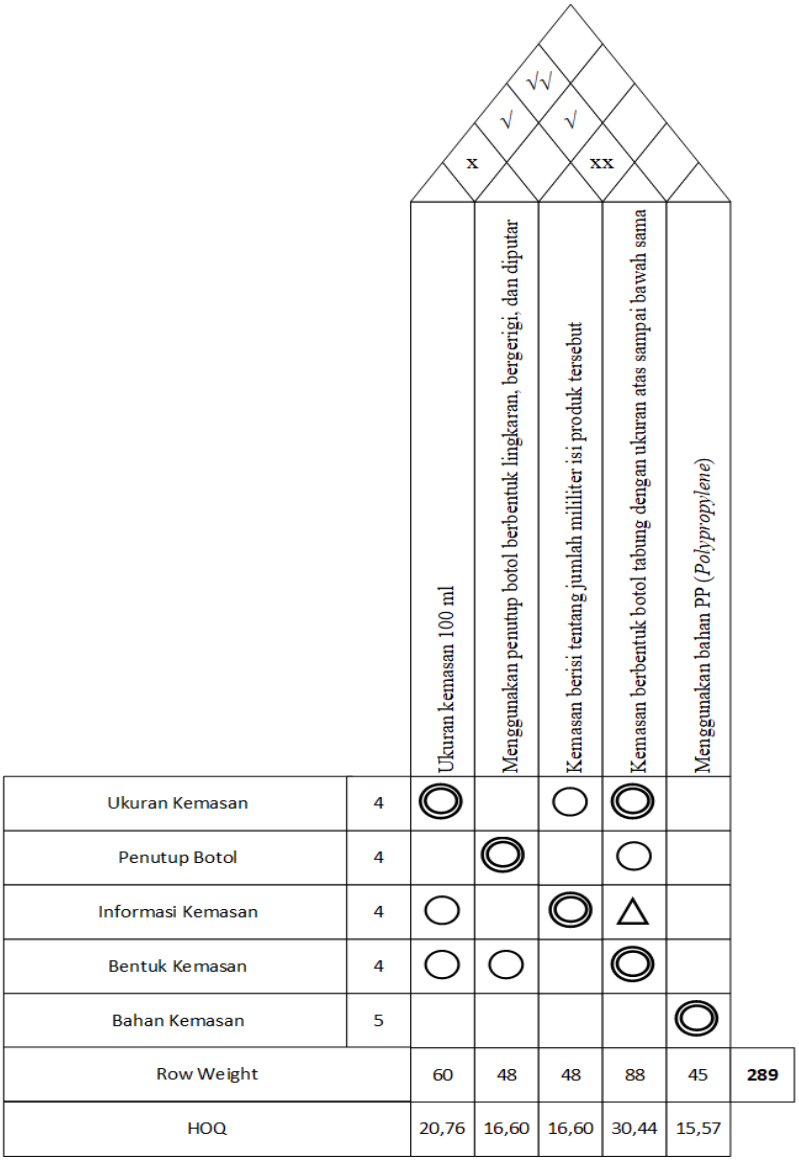

Figure-1. House of quality

C. Product Design

At this stage, the design of the Platelet Lysate Nusantara (PL-Nusa) packaging was developed based on the previously processed data, starting from objective clarification to the determination of product characteristics. The generated packaging designs were then evaluated by respondents to identify the most appropriate design. The packaging was modeled using *SolidWorks*, employing the *3D Part Design & Assembly* feature with millimeter (mm) units. Modeling techniques such as revolve, helix, pattern, shell, and fillet were utilized.

1) Generating Design Alternatives

Several design alternatives for both the bottle cap and body were created for respondent selection. The *morphological chart method* was used to generate these alternatives. The morphological charts for the bottle cap are presented in *Tables 9* and *10*, and those for the bottle body are shown in *Tables 11* and *12*.

Table-6. Morphological Chart – Bottle Cap

Packaging Component	Alternatives			
	Alternative 1.1	**Alternative 1.2**	**Alternative 2.1**	**Alternative 2.2**
Packaging Cap				

Table-7. Morphological Chart – Bottle Cap (Continued)

Packaging Component	Alternatives			
	Alternative 3.1	**Alternative 3.2**	**Alternative 4.1**	**Alternative 4.2**
Packaging Cap				

Table-8. Morphological Chart – Bottle Body

Packaging Component	Alternative			
	Alternative 1.1	**Alternative 1.2**	**Alternative 2.1**	**Alternative 2.2**
Packaging Body				

Table-9. Morphological Chart – Bottle Body (Continued)

Packaging Component	Alternatives			
	Alternative 3.1	**Alternative 3.2**	**Alternative 4.1**	**Alternative 4.2**
Packaging Body				

2) Evaluating the Alternatives

At this stage, the criteria were weighted, and each alternative was rated accordingly. The evaluation criteria were derived from the customer needs questionnaire, which was based on the eight dimensions of product quality. The weighting of each criterion was provided directly by respondents, and the resulting weights are shown in Table 13.

Table-10. Selected Criteria Weights

Criterion	Weight
Performance	22,50%
Features	11,67%
Reliability	18,33%
Conformance	16,67%
Durability	25,83%
Aesthetics	5,00%

Subsequently, each respondent rated every design alternative. These ratings were then used to calculate a weighted score to determine the most preferred packaging design for PL-Nusa. The final weighted scores are presented in Table 14.

Table-11. Final weighted score

Respondent	Alternatives							
	1.1	1.2	2.1	2.2	3.1	3.2	4.1	4.2
	Weighted Score	*Weighted Score*	*Weighted Score*	*Weighted Score*	*Weighted Score*	*Weighted Score*	*Weighted Score*	*Weighted Score*
Respondent 1	4.67	4.67	4.67	4.67	4.88	4.88	4.88	5.00
Respondent 2	2.48	2.90	2.73	3.07	2.54	2.78	2.95	3.62
Respondent 3	2.98	3.18	2.73	2.72	2.78	3.43	3.53	4.95
Respondent 4	4.00	4.61	4.38	4.61	4.30	4.61	4.61	4.73
Respondent 5	3.57	3.00	3.30	3.00	4.88	3.00	3.00	5.00
Respondent 6	3.30	3.00	3.00	3.00	3.72	2.65	3.73	4.56
Total Score	**20.99**	**21.35**	**20.80**	**21.06**	**23.10**	**21.35**	**22.70**	**27.85**
Rank	7	4	8	6	2	5	3	1
Continue	*No*	*No*	*No*	*No*	*No*	*No*	*No*	***Yes***

Based on Table 14, the selected alternative is Alternative 4.2, which received the highest total weighted score of 27.85.

3) Refining the Details

In the final stage, refinements were made to the selected alternative in terms of material, dimensions, and design. The detailed design of the PL-Nusa product packaging is illustrated in Figure 7.

Figure-7. Finalized Design Details of PL-Nusa Packaging with Product Label

V. CONCLUSION

A. Conclusion

The technical specifications obtained from the customer needs questionnaire were processed using Nigel Cross's design approach. The technical specifications that align with consumer requirements for the PL-Nusa packaging design include: (1) 100 ml capacity, (2) Circular, ridged, twist-off cap, (3) Displays volume in milliliters, (4) Cylindrical bottle with uniform size from top to bottom, and (5) Polypropylene (PP) material.

The selected design is Alternative 4.2. The PL-Nusa product packaging utilizes Polypropylene (PP) for both the cap and bottle body. The cap has an outer diameter of 32 mm and a height of 22 mm, while the bottle body has a top diameter of 28 mm, a total height of 78 mm, and a base diameter of 45 mm. Additionally, the packaging includes a 60 × 50 mm label for displaying product information.

B. Recommendation

Based on the results of the PL-Nusa packaging design study, several improvements are recommended to enhance future design quality. Comprehensive testing of the Polypropylene (PP) material under various storage conditions is necessary to ensure the product's integrity. Manufacturing aspects should also be addressed through economic feasibility analysis to optimize production efficiency. Furthermore, a mechanism for collecting user feedback after design implementation is essential for evaluating and refining the ergonomic and functional aspects of the packaging. This continuous improvement process will support the development of a more optimal packaging design.

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