Development of Packaging Design and Shelf-Life Determination for Rendang Powder Seasoning at UD Serba Guna Abadi

Zahra Faradisyi*,[1], Guntarti Tatik Mulyati[1], and Arita Dewi Nugrahini[1]
[1]Department of Agroindustrial Technology, Faculty of Agricultural Technology
Universitas Gadjah Mada, Jl. Flora No.1 Bulaksumur 55281, Indonesia.
Email: zahrafdisyi@gmail.com*

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Abstract

According to the National Socio-Economic Survey (SUSENAS) in 2020, the average consumption of packaged seasoning from 2016 to 2020 grew the highest compared to other types of food at 9.13%. One of the most popular packaged seasonings is rendang powder, often accompanied by problems such as easily torn primary packaging, poor packaging, and incomplete packaging label information. To overcome these problems, developing a packaging design and determining the shelf-life is necessary. This research aims to create a concept for packaging powdered rendang seasoning that offers the highest value and to determine the product's shelf-life using the chosen packaging. The packaging design for powdered rendang seasoning was developed using value analysis and shelf-life was determined using the Arrhenius model through Accelerated Shelf-Life Testing (ASLT). Based on the research, out of five packaging concepts tested, it was found that packaging concept 2 has the highest value of 1.31 with packaging specifications using a packaging material of aluminum foil combined with plastic. A stand-up bag with a rectangular clear section, the package has a notch, zipper, and full labeling. Packaging concept 2 is the chosen packaging concept that meets the research objectives. It addresses the issue of easily torn packaging and includes improvements in packaging quality and more comprehensive packaging labeling. Based on the shelf-life determination of 3 packaging that has the highest values and 1 control package, packaging concept 2 has the longest shelf-life of 131 days, and based on the results of the proximate test conducted, packaging concept 2 is packaging with a sample that does not differ significantly (p value>0.05) with the control sample for all parameters quality.

Keywords: *packaging; proximate; seasoning; SNI; value analysis*

1. INTRODUCTION

Indonesia is one of the largest producers of spices in the world. Data from the Food and Agriculture Organization (FAO) in 2016 showed that Indonesia is the fourth-largest spice-producing country, with a total production of 113.649 tons. Many people use spices as essential in cooking. According to the National Socio-Economic Survey (SUSENAS) (2020), the average consumption of condiments per inhabitant in annual consumption, condiments/packages of prepared foods grew the most from other food types, which is 9.13%. The average consumption of other spices per inhabitant is shown in Table 1.

Table 1. Average consumption of spices per capita

Utensils	Unit	Year					Average growth (%)
		2016	2017	2018	2019	2020	
Cooking flavoring	Grams	339.87	340.69	366.04	362.54	360.01	1.51
ready-made chili sauce/ketchup	140 ml	-	-	2.00	3.00	4.00	-
Ready-to-eat seasonings/package	Ounces	1.57	1.65	2.00	2.02	2.21	9.13
Other kitchen seasonings	-	5.90	5.28	6.23	6.69	7.25	5.81

Source: National Socio-Economic Survey (SUSENAS) (2020)

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The quality requirements of the product must be considered to maintain the quality of the packaged product. SNI is used to assess and test a product owned by a business or trademark owner. SNI encourages the creation of products with certain standards, which can only be produced if the production process meets certain criteria (Sujayanto, 2016). Based on SNI 01-3709-1995 for powdered spices, powdered spice products must meet some quality requirements, as shown in Table 2.

Table 2. SNI 01-3709-1995 for powdered spices

No.	Test Criteria	Unit	Requirement
1	Condition		
1.1	Odor	-	Normal
1.2	Taste	-	Normal
2	Water	%b/b	Max 12.0
3	Ash	%b/b	Max 7.0
4	Acid Insoluble Ash	%b/b	Max 1.0
5	Smoothness escapes sieve No.40		Max 90.0
6	Metal Contamination		
6.1	Lead (Pb)	mg/kg	Max 10.0
6.2	Copper (Cu)	mg/kg	Max 30.0
7	Arsenic contamination (USA)	mg/kg	Max 0.1
8	Microbial contamination		
8.1	Total plate numbers	colony/g	Max 10^6
8.2	*Escherichia coli*	APM/g	Max 10^3
8.3	Mold	mg/kg	Max 10^4
9	Aflatoxin	mg/kg	Max 20

One of the most popular seasoning powders is rendang powder seasoning. Rendang was voted the most delicious food in the world by more than 35000 CNN Travel readers in a poll in 2011 (Benayoun, 2014). In the preliminary research, at least 10 samples were collected from packages of rendang spice bought at mini markets from traditional markets to commercial places, and then the packages were grouped. The grouping is done independently based on the package's realization from the package's functional and visual appearance. According to Cenadi (2000), it is stated that the functional/practical aspects of packaging are the effectiveness and efficiency of packaging, which consists of the ability to protect the package, the ease of opening the package, the ease of closing the package, can be carried, or held, can be reused. Visual aspects include colors, shapes, illustrations, package charts, layouts, and package label integrity. All packages that mainly correspond to the functional and visual aspects of the package are grouped in Class I. All packages that meet only 5-7 functional aspects and the visual aspect of the package are grouped in class II. All packages that do not meet the functional and visual aspects of the package or that only meet up to five functional and visual aspects of the package are then grouped in Class III. The resulting sample class grouping is shown in Table 3.

Table 3. Sample class grouping

Class	Fulfillment of Packaging Aspects (%)	Percentage (%)
Class I	> 70	20
Class II	50-70	60
Class III	<50	20

One of the classes II rendang powder seasoning is from UD Serba Guna Abadi. The main packaging used for rendang powder seasoning from UD Serba Guna Abadi is a plastic stamp doll made of polypropylene (PP) with a thickness of 0.3 mm and a size of 12 x 20 cm. Samson paper is used as a secondary packaging material. In addition, there have been several complaints about seasoning powder packaging circulating in the market, including primary packaging that was torn during transport, causing spillage of spices, incomplete packaging labels such as use, expiration date, and production code, and seals on the main package are not tight enough.

Therefore, it is necessary to develop a packaging design for rendang powder seasoning that can functionally protect and preserve the packaged product and can visually contain packaging labels. This research aims to produce a packaging design concept for powdered rendang seasoning products that has the highest value, can maintain the quality of the packaged product, and can determine the shelf-life of the packaged product from the selected packaging.

Three methods can be used in packaging design development, including Quality Function Deployment (QFD), Value Engineering (VE), and Value Analysis (VA). Quality Function Deployment (QFD) can translate consumer needs into technical characteristics of the company. However, this QFD method makes it difficult to distinguish the many different needs of consumers and the conceptual differences between consumers and companies. Value Engineering (VE) can also be used for product development, but the value engineering method requires more time in the product development process and is more suitable for products that are still in the development stage. Value Analysis (VA) is an effective method to improve product performance by reducing costs while maintaining the quality of the product itself. Packaging development can also be done by knowing the packaging specifications desired by consumers, which can later be developed into packaging that has high performance at minimal cost.

Shelf-life was determined using the Arrhenius model through Accelerated Shelf-Life Testing (ASLT). Shelf-life calculations were carried out to evaluate the packaging, and whether the 3 packages with the highest values could store the product properly or not. Proximate analysis was conducted after the product was packaged using the 3 highest-value packages to ensure that there is no significant difference between the product quality using the 3 highest-value packages and the control sample.

2. MATERIAL AND METHODS

This research was conducted in June-December 2022, and the subject of the study was 250g packaged rendang powder seasoning produced by UD Serba Guna Abadi. The respondents of this study are packaging experts and consumers of UD Serba Guna Abadi rendang powder. Expertise is a person who has competence in a field. In this study, filling out the questionnaire by expertise was carried out by 5 people, including 2 academics and 3 people from the Agriculture and Food Security Service. Furthermore, the consumers in question were people who have bought powdered rendang seasoning products within the last 6 months. As well as 100 consumers of powdered rendang seasoning participated in filling out the questionnaire. The research was conducted by going through 5 steps of value analysis, after which the shelf-life and close testing of the three highest-value packages continued.

2.1 Value Analysis

There are 5 steps in value analysis to find the most valuable result of packaging design.

1. Information Phase

   The information phase is the phase where the necessary information is collected. Part of the things done in the information phase are preliminary observations, the purpose of which is to find out information related to the product used as a research object, formulation of the problem and definition of the goal, literature studies that help the research process, and data analysis and the basis for finding out the quality indicators of the package, the purpose of which is to find out the quality indicators to be developed.

2. Creation Phase
   In the creation phase, priority is developed by package functions. The priority of the development of the packaging functions is carried out through the expert evaluation method using a questionnaire, where experts in the packaging industry are asked to answer the survey by choosing one answer from the three existing scales, i.e., important, useful, and unimportant. A Content Validity Ratio (CVR) test is performed to test the content validity of the claim using the following formula:

$$CVR = \frac{\left(ne - \frac{N}{2}\right)}{\frac{N}{2}} \tag{1}$$

3. Analysis Phase
   The analysis phase is carried out using the results of the Function Analysis and System Technique (FAST) diagram. FAST diagrams are schematic techniques organized to systematically identify activities and describe the relationships between these activities (Pasaribu and Puspita, 2016). FAST diagrams are arranged in a hierarchy of functions, with high-level functions on the left and low-level functions on the right. FAST graphs are created with questions about how and why. Fast plotting starts with a predefined basis function, which is usually processed by the basis function (Nuruddin and Andesta, 2008).
4. Development Phase
   The development phase is carried out by creating a new packaging concept. When doing packaging development, several inputs add value to the packaging of rendang powder seasoning from Serba Guna. After obtaining alternatives, we will develop, and then conduct packaging tests for Water Vapor Transmission Rate (WVTR) and transform existing alternatives into multiple packaging concepts and prototypes of actual product packaging.
5. Recommendation Phase
   The recommendation phase is the phase where recommendations for finished prototypes are processed. Several things are done during the recommendation stage, including testing prototypes with questionnaires, determining product performance, determining the value of each concept, and determining new packaging concepts. The respondents of this study were consumers of powdered rendang spice living in the Jabodetabek district. Sampling using non-probability sampling methods and determining the number of samples to use using the Lemeshow formula as follows:

$$n = \frac{Z^2 \times p \times (1-p)}{d^2} \tag{2}$$

   After the questionnaire has been tested on respondents, the importance and relative importance of each attribute can then be calculated. The determination of importance and relative importance can be carried out using the following formula:

$$importance\ level = \frac{number\ of\ respondent\ answer\ scores\ per\ attribute}{number\ of\ respondents} \tag{3}$$

$$\%\ relative\ importance\ level = \frac{importance\ level}{total\ importance\ level} \tag{4}$$

   Product performance can be determined by adding the coefficients of the total value of the questionnaire to the weight of the quality characteristics of the product development.

Attribute weights are derived from a preliminary study related to the identification of quality attributes desired by consumers using the zero-to-one method, based on the principle of determining the proportionality of one attribute as "more important" or "less important" compared to other features. The purpose of the zero-one method is to help prioritize activities/criteria (Kurniawan et al., 2021). Performance can be determined using the following formula:

$$Performance = \sum(concept\ weight\ \times attribute\ weight) \tag{5}$$

The value calculation for each concept can be calculated by combining the performance value and price of each concept. The formula to calculate the value is:

$$Value = \frac{performance}{product\ cost} \tag{6}$$

Once the value of each package concept is found, it can be determined by assigning a new package concept by looking at the most valuable package concept.

2.2 Determination of Shelf-life

Shelf-life is determined using the Arrhenius model using the Accelerated Shelf-Life Test (ASLT) method. To achieve a correct correlation, at least 3 product storage temperatures are needed, with at least 5 observation points during storage. Commonly used test temperatures for dry food are 25, 30, 35, 40, and 45°C (Asiah et al., 2018). This study used storage temperatures of 25, 35, and 5°C and a storage time of 21 days, and data was viewed and retrieved daily. Once the data is collected, it is plotted against the old storage and decay data. Then, the linear regression equation and its ordering value (R2) appeared. In addition, the order of the reaction is determined by looking at the closest species value of 1. After that, a graph of the relationship between 1/T and ln k is constructed. Additionally, shelf-life can be determined using the following equation:

Order 0
$$t = \frac{(Q_0 - Q_s)}{k} \tag{7}$$

Order 1
$$t = \frac{ln(\frac{Q_0}{Q_s})}{k} \tag{8}$$

2.3 Proximate Analysis

A proximate analysis was performed to determine the nutritional value of the sampled food ingredients. Proximate analysis is important in this study to determine product quality consistency, production process control, efficiency optimization, and regulatory compliance. The analysis carried out includes the content of moisture, ash, fat, protein, and carbohydrates.

1. Water content
   The moisture content can be determined using the oven method by drying the sample at a temperature of 100-105 °C for 3-5 hours. The sample is then cooled in a desiccator and weighed. This is done until a constant weight is reached (the weight difference is <0.02 mg). Moisture content can be determined using the following formula:

$$Water\ Content(\%) = \frac{initial\ sample\ weight - final\ sample\ weight}{initial\ sample\ weight} \times 100\% \tag{9}$$

2. Ash content
   Ash content can be determined using a thermogravimetric method where up to 2 g of samples are placed in a porcelain crucible placed in a furnace and burned to ash. The enslavement process is then carried out in a furnace with a temperature of 600 °C. After completion, the sample is cooled in a desiccator, and is weighed. The ash content can be determined using the following formula:

$$Ash\ Content(\%) = \frac{final\ weight\ of\ sample\ (ash)}{initial\ weight\ of\ sample} \times 100\% \quad (10)$$

3. Fat content
   The Soxhlet method can generally be used to determine the fat content of a food ingredient. In this method, the sample is wrapped in paper and then extracted with a Soxhlet for several hours. Then, when the extraction is complete, the sample is placed in an oven until it reaches a constant weight and then weighed. The fat content can be determined using the following formula:

$$Fat\ Content(\%) = \frac{Initial\ weight\ (b) - \ final\ weight\ (c)}{Sample\ initial\ weight\ (a)} \times 100\% \quad (11)$$

4. Protein content
   The Kjeldahl method can be used to determine the protein content of a food ingredient. In this method, the process of determining the content of protein passes through digestion, distillation, and titration. For titration, the distillate is titrated with a standard solution of 0.02 N HCL to the endpoint of the titration (blue color to pink). Protein levels can be determined using the following formula:

$$Nitrogen\ (\%) = \frac{Vol\ Titration\ \times Normality\ \ HCL \times Nitrogen\ Atoms}{Sample\ Weight\ \ (mg)} \times 100\% \quad (12)$$

$$Protein\ Content\ (\%)\ = Nitrogen\ content\ x\ Correction\ factor\ \ (6{,}25) \quad (13)$$

5. Carbohydrates content
   Carbohydrate levels can be determined quantitatively using the Nelson-Somogyi method. The principle of the Nelson-Somogyi method is to analyze the amount of reducing sugar by looking at the ability of the saccharide to reduce to free copper ions from copper oxides, which are converted into copper oxide.

3. RESULTS AND DISCUSSION

3.1 Value Analysis

3.1.1 Information Phase

One of the most important steps in the information phase is to find out the quality characteristics of the package. The definition of the quality characteristics of the packaging is based on previous observations, starting from interviews with manufacturers, brainstorming with manufacturers, literature research, and independent observation of similar products on the market (Zulkarnain et al., 2020). A preliminary study was conducted by collecting 10 samples of powdered rendang seasoning packaging obtained from minimarkets, traditional markets to marketplaces, then grouping the packaging based on the fulfillment of the functional aspects and visual aspects of the packaging. Based on the grouping conducted, it was found that 60% of the packaging of powdered rendang seasoning products only fulfilled 50-70% of the functional aspects and visual aspects of the packaging. The average powdered rendang seasoning product is packaged using plastic only as primary packaging, making it difficult for consumers to close/store the product that has been used, in some cases, the packaging used is easily torn so that the contents of the product come out of the packaging and the incomplete packaging label such as expiration date and how to use. Using the above methods, some of the primary quality attributes of packaging were found to be packaging material, packaging shape, packaging design, ease of packaging, labeling, and packaging cost. This also applies to Anarghya et al. (2020), according to which the main characteristics of packaging are material, shape, convenience, graphic design, and labels. In addition to the primary attributes, there are also secondary attributes that are listed in Table 4.

Table 4. Packaging quality attributes

No.	Primary	Secondary
1	Material	Type of Material (plastic, aluminum foil, etc.)
2	Shape	Packaging Shape (rectangular/standing pouch) Packaging size (length and height) Transparent section shapes (rectangles, circles, etc.)
3	Ease	Ease of unpacking (there is a notch, using tools, jagged ends of the packaging) Ease of closing packaging (zip lock, additional covering tools) Ease of carrying packaging (with straps or handheld directly)
4	Graphic design	Color combination of labels and packaging Attractive and easy-to-read typeface Interesting illustrations/images
5	Label	Label making techniques (stickers, screen printing, printing) Product name Raw material information Net weight Name and address of the manufacturer Halal Production date and code Permit number (P-IRT) Expiry date, month, and year
6	Cost	Manufacturing cost per pack

On the other hand, proximate analysis testing has been carried out on the initial sample of powdered rendang seasoning. The test results are as follows: moisture content 1.80±0.035%; ash content 0.07±0.000%; fat content 0.18±0.012%; protein content 0.32±0.025%; and carbohydrate content 2.48±0.002%. The results of the testing of powdered rendang seasoning samples against SNI 01-3709-1995 found that the moisture content and ash content for the product samples used were still below the maximum percentage that had been set.

3.1.2 Creative Phase

Furthermore, in the creative phase of creating effective packaging, it is essential to fulfill three main functions of packaging: as a product protector, as a container, and as a promotional medium. If these three main functions are met, it will result in packaging that attracts consumers and functions at its best (Wahyudi & Satriyono, 2017). The prioritization of the package functions to be developed is used in the expert evaluation study to evaluate the priority of the development of the package functions made by several parties. An expert opinion is a person who qualifies in a field. In this study, 5 people, including 2 researchers and 3 people from the Department of Agriculture and Food Safety, completed the questionnaire with expert judgment. The prioritization of the package functions to be developed is used in the expert evaluation study to evaluate the priority of the development of the package functions made by several parties. After filling out the questionnaire, the Content Validity Ratio (CVR) test is continued, by which the compatibility of the content of each sentence in the questionnaire with the subject under consideration is determined, and the value of each feature is determined. According to the CVR table, with a significance level of 5%, the rating scale of the CVR test is -1 to 1. This peer-review survey has 20 statements that the panelists then rate. package development priority. The evaluation uses a scale of 1-3, where scale 3 means "important", scale 2 "useful but not important" and scale 1 is "not important". The results of developing the design of the rendang powder package selected by expert judgment are shown in Table 5.

Table 5. Priority of developing rendang powder seasoning packaging design

Statement	Code
Type of Material (Plastic, aluminum foil, etc.)	M1
Transparent section shapes (rectangles, circles, etc.)	S3
Ease of unpacking (there is a notch, using tools, jagged ends of the packaging)	E1
Ease of closing the packaging (zip lock, additional covering tools)	E2
Attractive and easy-to-read typeface	D2
Product name	L1
Raw material information	L2
Net weight	L3
Name and address of the manufacturer	L4
Halal	L5
Production date and code	L6
Permit number (P-IRT)	L7
Expiry date, month, and year	L8

3.1.3 Analysis Phase

In the analysis phase of packaging design development, the product tries to find and develop as many different alternative ideas as possible that can fulfill the main function (Friadi et al., 2022). In the analysis phase, the FAST diagram is used, which facilitates the mapping of the activities to be carried out. A FAST diagram is a technique for systematically describing product characteristics (Pasaribu & Puspita, 2016). In the FAST scheme, high-level functions are placed on the left, and low-level functions on the right. FAST is an efficient technique for finding the relationship between functions. The FAST diagram shows which functions are executed by which component if the components are presented. The FAST diagram becomes even more valuable and useful in the value measurement phase if cost and importance are allocated and posted for the functions on the diagram. The function analysis categorizes the components based on their functions; either there is a primary or a secondary function of components (Khan et al., 2018).

The results of the FAST diagram feature mapping are shown in Figure 1.

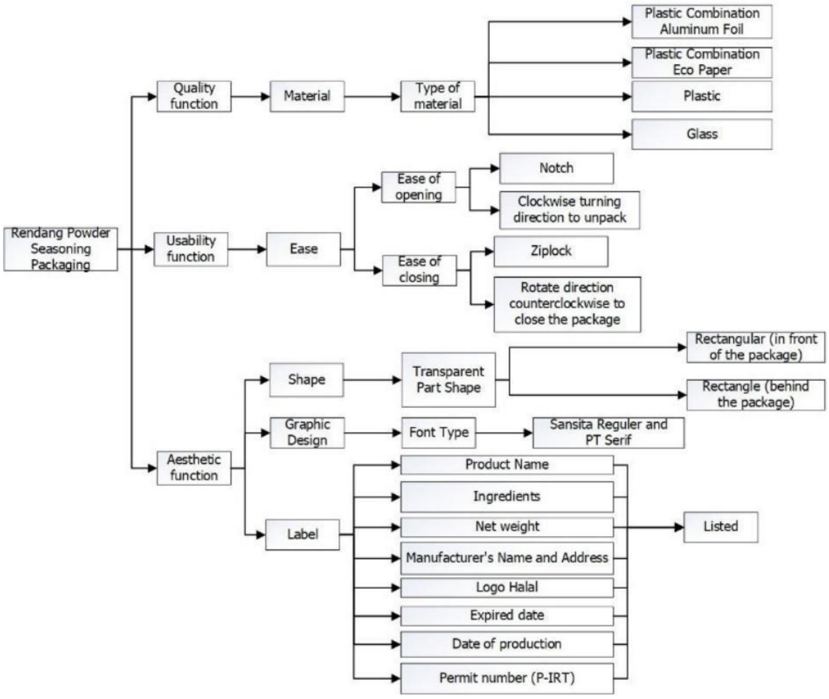

Figure 1. FAST diagram of rendang powder seasoning packaging

3.1.4 Development Phase

The development phase will be carried out by creating a new packaging concept based on the results of the packaging experts identification of packaging needs (Arif, 2017). After this, the alternative development work of Powdered Rendang Seasonings will be carried out for each package attribute, and the results are shown in Table 6.

Table 6. Alternative development of rendang seasoning packaging

No.	Packaging Quality Attributes	Development Alternatives
1	Types of Packaging Materials	Plastic combination of transparent aluminum foil Plastic combination of white aluminum foil PP Plastic Plastic combination eco paper Glass
2	Packaging form	Standing pouch Bottle Jar
3	The shape of the transparent part	Rectangle in front of the packaging Rectangle behind the packaging Entire packaging
4	Ease of opening	Notch Clockwise direction of rotation to open
5	Ease of closing	Ziplock Counterclockwise direction of rotation to close
6	Font	Sansita Regular and PT Serif
7	Packaging labels	Listed

Source: (Putri et al., 2021)

When choosing a packaging material, it is very important to consider the characteristics of the packaging and the nature of the packaging properties (Julianti, 2014). 5 different types of packaging materials are used in the development of alternative packaging material types. These include aluminum packaging combined with white plastic, aluminum packaging combined with clear plastic, eco-paper combined with plastic packaging, polypropylene packaging (PP), and glass packaging (Rokilah et al., 2018). Four The drying method is used in this test, and the five packages used are multi-layered. According to Julianti (2017), multi-layer multi-material packaging is the packaging of two or more layered materials formed into a single thin film sheet. A combination of plastic, paper, and aluminum foil is usually used. Website ukmpack.com, based on the data, the packaging combination of transparent plastic and white plastic aluminum foil has a layer of OPP / SPE-VMOPP / SPE material. Then, the PP package has OPP/CPP cover material, and the eco-paper composite plastic package has Litho/PET/CPP cover material. Packaging testing can be done using several methods, one of which is the WVTR method. The water vapor permeability (WVTR) test can be used to determine the ability of the package to withstand the entry and exit of water vapor. The advantage of the WVTR method is that it can provide information on how well the packaging material can withstand water vapor, which can affect the product's shelf-life, freshness, and safety (Wahyu et al., 2017). The WVTR value can be obtained using the dryer or water method (Lastriyanto et al., 2007). The drying method is used in this test. The drying method is used to ensure that all samples begin with uniform moisture conditions. This consistency is essential for obtaining accurate and reliable results in the packaging performance evaluation, as it eliminates variability that could arise from differing initial moisture levels in the samples. The higher the WVTR number of the package, the worse the protective properties of the package under test. The WVTR test results for the alternative packages are shown in Table 7.

Table 7. WVTR Packaging test results

Packaging	Material layer	WVTR ($g/m^2/day$)
Plastic combination of transparent aluminum foil	OPP/SPE-VMOPP/SPE	0.1486
Plastic combination of white aluminum foil	OPP/SPE-VMOPP/SPE	0.1300
PP Plastic	OPP/CPP	0.3408
Plastic combination eco paper	Litho/PET/CPP	0.3729

Based on Table 7, it is found that the package with the lowest WVTR value is the package of aluminum foil combined with plastic, with the package material layer in the form of OPP / SPE-VMOPP / SPE. This package has a thickness of 16 and 17 μm and results in WVTR values of 0.0186 and 0.1300 $g/m^2/day$. It is Syafira et al. (2018) that the WVTR value of 16 μm aluminum packaging is 0.1506 $g/m^2/day$. Finally, the development phase involves prototyping the product packaging. Based on the alternative development of the packaging quality functions, several rendang powder Seasoning Packaging concepts are prepared and arranged based on the existing alternative compatibility so that the packaging function works optimally. The results of some packaging concepts for Powdered Rendang Condiment can be seen in Table 8.

Table 8. Conceptual production results for rendang powder seasoning packages

Alternative concepts	Packaging Quality Attributes					
	Types of Packaging Materials	The shape of the transparent part	Ease of opening	Ease of closing	Font	Product information
Concept 1	Plastic combination of transparent aluminum foil	Rectangle	Notch	Ziplock	Sansita Regular & PT Serif	Listed
Concept 2	Plastic combination of white aluminum foil	Rectangle	Notch	Ziplock	Sansita Regular & PT Serif	Listed
Concept 3	PP Plastic	Rectangle	Notch	Ziplock	Sansita Regular & PT Serif	Listed
Concept 4	Plastic combination eco paper	Rectangle	Notch	Ziplock	Sansita Regular & PT Serif	Listed
Concept 5	Glass	Bottom of the packaging	Clockwise direction of rotation to open	Counterclockwise direction of rotation to close	Sansita Regular & PT Serif	Listed

3.1.5 Recommendation Phase

The testing phase involves several tests. First, consumer package testing is conducted through questionnaires. Based on the results of a survey distributed to 100 respondents, the rating points for each concept are found in Table 9.

Table 9. Packaging Concept Assessment Score

Packaging Attributes	Concept				
	1	2	3	4	5
Types of Packaging Materials	272	302	301	222	349
Transparent Part Shape	318	233	344	336	334
Ease of Packaging	292	323	338	337	338
Graphic Design Packaging	325	335	326	332	340
Packaging Labelling	322	339	320	329	336

In the data collection process, 100 respondents were required to be consumers of rendang powder seasoning. Differences in how respondents evaluate the attributes may affect the result of the analysis. To manage this, appropriate statistical methods are employed to address variability in the data. Then, the importance and the reactive importance level of each package attribute is calculated. The results of the calculation of the importance level and attribution importance level are shown in the following Table 10.

Table 10. Summary of the results of the favorite questionnaire test on the packaging concept

Packaging Attributes	Concept					Sum	Importance level	Relative importance (%)
	1	2	3	4	5			
Types of Packaging Materials	272	302	301	222	349	1446	14.46	18.20
Transparent Part Shape	318	233	344	336	334	1565	15.65	19.70
Ease of Packaging	292	323	338	337	338	1628	16.28	20.50
Graphic Design Packaging	325	335	326	332	340	1658	16.58	20.87
Packaging Labelling	322	339	320	329	336	1646	16.46	20.72
	Sum					7943	79.43	100.00

In addition, the performance of each package is determined. First, the performance of each package is determined using the Zero One method, which aims to help determine the priority order of functions (criteria) (Kurniawan et al., 2021). With the zero-one method, several concepts can be compared based on each respondent's criteria and rating points. The results of the performance value calculation for each package concept are as follows in Table 11.

Table 11. Determination of performance of each packaging

	Item	Types of Packaging Materials	Transparent Part Shape	Ease of Packaging	Graphic Design Packaging	Packaging Labelling	Performance
Relative importance (%) (R)		18.20	19.70	20.50	20.87	20.72	
Concept 1	Score (S)	10	10.00	0	0	10	**586.30**
	S × R	**182.05**	**197.03**	**0**	**0**	**207.23**	
Concept 2	Score (S)	30	0.00	11.11	30.00	40	**2228.99**
	S × R	**546.14**	**0.00**	**227.73**	**626.21**	**828.91**	
Concept 3	Score (S)	0	40.00	33.33	10.00	0	**1680.05**
	S × R	**0.00**	**788.12**	**683.20**	**208.74**	**0.00**	
Concept 4	Score (S)	0	30.00	22.22	20.00	20	**1878.48**
	S × R	**0.00**	**591.09**	**455.47**	**417.47**	**414.45**	
Concept 5	Score (S)	40	20.00	33.33	40.00	30	**3262.08**
	S × R	**728.19**	**394.06**	**683.20**	**834.95**	**621.68**	

In addition, value calculations are made by dividing the performance by the package costs. The cost table for each package concept is shown in Table 12.

Table 12. Manufacturing Price per Unit Packaging

Material	Unit Price (Rp)	The cost of the concept (Rp)				
		1	2	3	4	5
Al. foil + transparent plastic and printing		1,700				
Al. foil + white plastic and printing			1,700			
Transparent PP plastic packaging and printing				1,700		
Plastic Packaging + eco paper and printing					1,700	
Glass Bottle						4,653
Sticker logo	5,000					500
Total		1,700	1,700	1,700	1,700	5,153

The results of calculating the value of each package are shown in the following Table 13.

Table 13. Value of each packaging concept

	Performance	Cost	Value
Concept 1	586.30	1,700.00	0.34
Concept 2	**2,228.99**	**1,700.00**	**1.31**
Concept 3	1,680.05	1,700.00	0.99
Concept 4	1,878.48	1,700.00	1.10
Concept 5	3,262.08	5,153.00	0.63

Based on the calculation results in Table 13 above, it can be stated that package concept 2 is the package concept with the highest value at 1.31. The selected packaging concept is shown in Figure 2.

Figure 2. Selected Packaging Concepts with Size 23x14 cm

Packaging concept 2 uses aluminum packaging material combined with white plastic on the back of the packaging, which has a transparent rectangular shape as the chosen concept. The size of the pouch is 23x14 cm. Based on a previous study by Zuniarto et al. (2021), aluminum foil is a stable package consumers prefer in instant powder packages. Packaging concept 2 is in the form of a stand-up bag, with a notch/opening point in the upper right and left corners of the package to facilitate consumer opening of the package and a zipper at the top. of the package, which makes it easier to reseal an open package. The font used in Packaging Concept 2 is Sansita Regular and PT serif, and the pack has images, namely *Rumah Gadang* and cows, as well as several spicy images. The addition of the label to packaging concept 2 complies with BPOM Regulation No. HK. 03.1.5.12.11.09955 of 2011 on the registration of processed foods, which states that the labeling of processed foods must have at least the name of the processed food, net weight, name and address of the manufacturer, list of ingredients used, registration of foods number, expired information, and production code. Given the problems identified in the introduction, the selected packaging concept can address issues of easily damaged packaging, thereby improving packaging quality. The chosen packaging concept also meets packaging labeling requirements.

3.2 Determination of Shelf-life

The shelf-life of the product is determined for 3 selected packages that have the highest value using the ASLT method of the Arrhenius model. The products were stored using the Arrhenius model ASLT method in the Bioindustry Laboratory of the Faculty of Agricultural Technology for 21 days. Three different temperatures are used to store the products, namely 25, 35, and 45°C, and product control points are made daily during storage. Product checks are carried out daily, especially for fragrances. Shelf-life calculations using formulas 7 and 8 can be seen in Table 14.

Table 14. Shelf-Life Calculation

	Arrhenius Equation		
	Packaging 2	Packaging 3	Packaging 4
	ln kt = 33,714 - 11020x(1/T)	ln kt = 27,99 – 9217.4x(1/T)	ln kt = 17,138 - 5798x(1/T)
ln kt	-3.265865772	-2.940872483	-2.318375839
kt	0.03816388	0.052819624	0.098433327
Shelf-life	131.013934	94.66178636	50.79580393
	131 days	95 days	51 days

Based on the table above, packaging 2, in which aluminum packaging material is combined with plastic, has a longer shelf-life compared to other types of packaging. The shelf-life of packaging 2 is 131 days, or equivalent to 4 months and 11 days. After that, packaging 3 with PP plastic packaging material has a shelf-life of 95 days, and finally, the package, which combines plastic packaging materials with eco-paper, has a shelf-life of 51 days.

According to the study conducted by Ijayanti et al. (2020), *wedang uwuh* powder stored at room temperature in aluminum foil, PP plastic, and a combination of aluminum foil and plastic packaging, respectively have shelf lives of 30, 44, and 45 weeks. This means that the combination packaging has the longest shelf-life compared to other packaging tested.

3.3 Proximate Analysis

Proximate analysis is performed according to the SNI 01-2891-1992 standard for testing food and beverages. The evaluation of the package exceeded the original samples, and the samples were packed in the three most valuable packages, which are package 2 (aluminum foil composite plastic), package 3 (plastic PP), and package (Plastic composite eco-paper). 3-month shelf-life, used as samples. Testing for moisture content using the thermogravimetric method by evaporating all the water in the sample. The ash content is obtained from the combustion process of the sample to determine the trace element content. The fat content is determined by the Soxhlet method, and the protein content by the Kjeldahl method. Carbohydrate content based on total sugars is determined by the Nelson-Somogyi method. The results of the close test of reference samples with package samples 2, 3, and 4 can be seen in Table 15.

Table 15. Results of general proximate analysis

Proximate Levels (%)	Packaging			
	Control	2	3	4
Moisture Content	1.80 ± 0.035	1.870 ± 0.48	1.94 ± 0.007	1.95 ± 0.016
Ash Content	0.07 ± 0.000	0.08 ± 0.004	0.09 ± 0.007	0.08 ± 0.004
Fat Content	0.18 ± 0.012	0.014 ± 0.021	0.18 ± 0.002	0.14 ± 0.009
Protein Levels	0.32 ± 0.025	0.34 ± 0.004	0.32 ± 0.007	0.33 ± 0.001
Carbohydrate Levels	2.48 ± 0.002	2.31 ± 0.005	1.80 ± 0.003	2.44 ± 0.001

The data are presented in mean ± SD, n = 2

To determine whether the data is normally distributed, a normality test was performed using the Shapiro-Wilk method since the sample data had less than 50 samples. Based on the normality test, it was concluded that the measurement data for water, ash, protein, and fat content are normally distributed. This can be seen from its significance value > 0.05. Since the data are normally distributed, the experiment can be continued with a parametric test using the independent sample t-test method. For carbohydrate levels, the significance value is based on the Shapiro-Wilk normality test, the significance value < 0.05 to conclude that the data are not normally distributed, and the test can be continued with a non-parametric test using the Mann-Whitney method. When tested by the independent sample t-test method, the p-value of each package was found in Tables 16, 17, and 18.

Table 16. Proximate Analysis comparison of control samples and Packages 2

Proximate Levels (%)	Control	Packaging 2	*P Value*
Moisture Content	1.80 ± 0.035	1.870 ± 0.480	0.238
Ash Content	0.07 ± 0.000	0.080 ± 0.004	0.095
Fat Content	0.18 ± 0.012	0.014 ± 0.021	0.130
Protein Levels	0.32 ± 0.025	0.340 ± 0.004	0.333
Carbohydrate Levels	2.48 ± 0.002	2.310 ± 0.005	0.121

Table 17. Proximate Analysis comparison of control samples and packages 3

Proximate Levels (%)	Control	Packaging 3	*P Value*
Moisture Content	1.80 ± 0.035	1.94 ± 0.007	0.036*
Ash Content	0.07 ± 0.000	0.09 ± 0.007	0.095
Fat Content	0.18 ± 0.012	0.18 ± 0.002	1.000
Protein Levels	0.32 ± 0.025	0.32 ± 0.007	1.000
Carbohydrate Levels	2.48 ± 0.002	1.80 ± 0.003	0.121

Table 18. Proximate Analysis comparison of control samples and packages 4

Proximate Levels (%)	Control	Packaging 4	*P Value*
Moisture Content	1.80 ± 0.035	1.95 ± 0.016	0.033*
Ash Content	0.07 ± 0.000	0.08 ± 0.004	0.095
Fat Content	0.18 ± 0.012	0.14 ± 0.009	0.057
Protein Levels	0.32 ± 0.025	0.33 ± 0.001	0.771
Carbohydrate Levels	2.48 ± 0,002	2.44 ± 0.001	0.121

The data are presented in mean ± SD, n = 2
The sign (*) indicates a significantly different result (P value<0.05) based on the independent sample t-test

The characteristics of packaging material greatly affect the durability of the product. The higher the packaging barrier, the better the packaging is at maintaining the packaged product to extend its shelf-life. Factors that cause changes in food products become the basis for determining the critical point of shelf-life. One of the factors that greatly affects the decline in the quality of food products is changes in product moisture content.

Packaging 2 is made of aluminum foil combined with plastic, with a thickness of 17 µm, and has a WVTR value of 0.1300 g/m2/day. Based on statistical analysis of independent sample t-test and Mann-Whitney test, it was found that after the product was stored for 3 months using packaging 2, there was no significant difference in its quality content based on proximate analysis. Then based on shelf-life testing, the shelf-life of products packaged using packaging 2 is 131 days.

Packaging 3 is made of PP plastic material with a thickness of 14 µm and has a WVTR value of 0.3408 g/m2/day. Based on the statistical analysis of the independent sample t-test and Mann-Whitney test, it was found that there were significant differences in the quality content of the products based on proximate analysis, especially in moisture content. Then based on shelf-life testing, the shelf-life of products packaged using packaging 3 is 95 days.

Packaging 4 is made of eco-paper combination plastic material with a thickness of 19.4 µm and has a WVTR value of 0.3729 g/m2/day. Based on the statistical analysis of the independent sample t-test and Mann-Whitney test, it was found that there were significant differences in product quality content based on proximate analysis, especially in moisture content. Then based on shelf-life testing, the shelf-life of products packaged using package 4 is 51 days. According to the study conducted by Ijayanti et al. (2020), *wedang uwuh* powder stored at room temperature in aluminum foil, PP plastic, and a combination of aluminum foil and plastic packaging respectively have shelf lives of 30, 44, and 45 weeks.

4. CONCLUSIONS

Packaging Concept 2 uses aluminum packaging material combined with rectangular clear white plastic has a higher value of 1.31. The packaging specifications of packaging concept 2 are the top of the package has a notch/opening and a zipper, the font used in package 2 is Sansita Regular and PT serif, and the inclusion of labels in packaging concept 2 complies with BPOM regulation number HK. 03.1.5.12.11.09955 of 2011 on the registration of processed foods. Based on shelf-life determination, out of the 3 packaging with the highest value tested, packaging concept 2 is the best in terms of shelf-life, which is 131 days. In addition, packaging concept 2 is a package in which the products can be stored without significant differences compared to the control samples.

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