Journal of Engineering and Technology for Industrial Applications

ISSN ONLINE: 2447-0228

ITEGAM-JETIA

Manaus, v.11 n.54, p. 43-52. July/August., 2025.

DOI: https://doi.org/10.5935/jetia. v11i54.1708

RESEARCH ARTICLE OPEN ACCESS

PRODUCT DESIGN AND VALUE ANALYSIS IN FOOD PRODUCT (CASE STUDY OF VEGETABLE NUGGET PRODUCT)

Endang Retno Wedowati[1], Diana Puspitasari[2], Fungki Sri Rejeki[3] Tri Rahayuningsih[4] and Johan Paing Heru Waskito[5]

[1, 2, 3, 4] Agroindustrial Technology - Engineering Faculty, Universitas Wijaya Kusuma Surabaya, Surabaya, Indonesia.
[5] Civil Engineering - Engineering Faculty, Universitas Wijaya Kusuma Surabaya, Surabaya, Indonesia.

[1]http://orcid.org/0000-0002-2699-4053, [2]http://orcid.org/0000-0001-5157-2808, [3]http://orcid.org/0000-0001-6335-5835, [4]http://orcid.org/0000-0001-9180-0510, [5]http://orcid.org/0009-0003-8636-1551

Email: wedowati@uwks.ac.id, diana.puspitasari@uwks.ac.id, fungki_tip@uwks.ac.id, tri_rahayu@uwks.ac.id, johan.paing@uwks.ac.id

ARTICLE INFO

Article History
Received: March 14, 2025
Revised: April 20, 2025
Accepted: June 15, 2025
Published: July 31, 2025

Keywords:
Product design,
Product value,
Conjoint analysis,
Food product,
Vegetable nugget.

ABSTRACT

Processed food products that are ready to cook and ready to eat are available because of the needs of today's society, which are very practical. One of the processed food products that suit these needs is nuggets. In general, nuggets are made from animal ingredients, but in this study, a vegetable nugget product design was developed. The study's purpose was to develop a product design and analyze the value of vegetable nugget products to meet consumers' needs and desires for the availability of ready-to-eat processed food products that have health benefits. The product design developed used the Conjoint Analysis method combined with Orthogonal Design to determine the product configuration. Furthermore, a value analysis is carried out on each product configuration form based on product benefits and production costs. The product variations provided were eight product variants that combined five product attributes: shape, flavor, weight, packaging material, and packaging design. The selected product is the product that has the highest value, which is based on product benefits and production costs for each product variant.

I. INTRODUCTION

Customer wants and needs are constantly changing and tend to be diverse. Changes in customer desires and needs tend to be increasingly diverse in terms of design, quality, and delivery process [1–3]. The increasingly diverse needs and wants of customers require producers to be able to produce a variety of products. In addition, the availability of processed food products that are ready to cook and eat is due to the practical needs of modern society. One of the processed food products that suit these needs is nuggets. Nuggets are made from seasoned ground meat, molded, coated in breadcrumbs, and fried. The main ingredient for making nuggets is animal meat, such as fish, chicken, or beef. Efforts to replace animal-based ingredients in nuggets use plant-based ingredients. This alternative is done to provide healthy food for consumers who do not consume animal foods. Red beans are an alternative plant-based ingredient that can be used in the processing of vegetable nuggets. Many choices of nugget design with various features make consumers more selective in choosing products that suit their needs and desires. Therefore, a new design of red bean nuggets can be made to find out consumer preferences for vegetable nugget products.

Red beans have a high protein content. Protein is an important nutrient needed by the body. The research of Utama and Anjani [4] concluded that analog red bean meat with 15% soy protein isolate substitution has the highest protein content (11.6%), the highest fiber (1.90%), and the lowest fat (1.48%). According to Astawan [5], red beans have the advantage of being cholesterol-free compared to animal protein. The selection of red beans as the basic ingredient in making red bean nugget products is expected to have several advantages, namely high protein and fiber, low fat, cholesterol-free, can be enjoyed by all levels of society, affordable prices, and can be used as an alternative to meat consumption. Previous research on consumer preferences for nugget products was conducted by Akantu [6], Ikhsanu [7], and Rahardjo [8]. The results of the study of Akantu [6] with the title Consumer Preferences in purchasing chicken nuggets, selected attributes that are considered by consumers include taste, aroma, and texture. Ikhsanu's research [7] groups consumer

preferences based on respondent characteristics where the attributes used are aroma, texture, ease of absorbing oil, tenderness, and taste. Rahardjo [8] examined the factors that are consumer preferences in purchasing frozen food products, the results of the study showed that the most important factor in influencing consumer preferences is taste, where the most preferred tastes are savory, salty, and spicy, and the next factor is price, packaging, and brand.

Meanwhile, Wedowati et al. [9], [10] have reviewed consumer preferences for customized products based on three aspects, namely functionality, usability, and pleasure. Attributes in each aspect consist of taste, color, aroma, and nutritional content (functionality aspect), shape and packaging of materials (usability aspect), health benefits, appearance, and type of topping (pleasure aspect). Analysis of product value, which is the ratio between product benefits and product costs, has been reviewed by Wedowati et al. [11].

Based on the existing background, the formulation of the problem in this study is how to design a vegetable nugget product that can meet the needs and desires of consumers who want the availability of fast food but healthy with high benefit value. The objectives of this study are: 1) To determine the attributes of vegetable nugget products that are to the desires and needs of consumers; 2) To design a vegetable nugget product design that follows the desires and needs of consumers; and 3) To determine the value of vegetable nugget products as healthy fast-food products. The benefits of this study are: 1) to produce a variety of vegetable nugget product designs that can meet the desires and needs of consumers and 2) to provide healthy ready-to-eat food products.

II. THEORETICAL REFERENCE

The concept of food product quality can generally be divided into two factors, namely intrinsic attributes and extrinsic attributes. Intrinsic attributes are attributes that measure the quality of a product based on its function and physical properties. Intrinsic attributes are specific to each product. These attributes will disappear when the product is consumed and cannot be changed without changing the nature of the product itself. Extrinsic attributes are aspects that are related to the product but are not physically part of the product itself, such as name or image, brand, and price. These attributes are known as variables that provide product information and must be considered in the evaluation of product characteristics. Quality can be defined as the moment when consumers receive information about the characteristics of a product at the time of purchase or after consuming it [12]. Thus, consumers can evaluate the function or benefits of the product based on their needs. According to Espejel et al. [13], based on product attributes, there are three categories of quality, namely:

1. Search quality (quality in the shop). This category refers to intrinsic and extrinsic product attributes at the time of purchase and is an important quality selection process.
2. Experience quality (eating quality). This category is an intrinsic attribute that is available at the time the product is used or consumed and is an important category for customer perception of organoleptic quality.
3. Credence quality. This category describes the intrinsic and extrinsic attributes that consumers pay attention to but are not captured during the purchasing process or consumption. Consumers rely on information conveyed by the media or word of mouth.

Several previous studies have studied product quality attributes in the food industry, as shown in Table 1.

Table 1: Food product attributes.

No.	Authors	Product	Product Attributes
1.	Iop *et al.* [14]	Food Product	Intrinsic: color, aroma, taste, and texture Extrinsic: brand, price, and context
2.	Espejel *et al.* [13]	Traditional Food	Intrinsic: color, taste, odor, and appearance Extrinsic: brand, denomination of origin, and traditional product image
3.	Hersleth *et al.* [15]	*dry-cured ham*	Intrinsic: sensory quality (appearance, smell, taste, texture) Extrinsic: price, nutritional value, and processing conditions
4.	Lee *et al.* [16]	Fruit juice	Extrinsic: *brand*, nutritional content, ingredient label, shelf life, price, and country of manufacture
5.	Verain *et al.* [17]	milk, meat, fruit and vegetables, fish	Attributes: sustainability, health, taste, price
6.	Nishimura *et al.* [18]	Onion concentrates	Taste, aroma, and texture
7.	Wedowati *et al.* [9–11]	Ice cream	Functionality: taste, color, aroma, texture, and nutritional content Usability: shape, size, and packaging materials Pleasure: brand/image, health benefits, appearance, and packaging design
8.	Wedowati *et al.* [19]	Chocolate	Functionality: taste, color, aroma, texture, and sweetness level Usability: shape, size, packaging material, and packaging method Pleasure: brand/image, health benefits, appearance, and profile

Source: Authors, (2025).

A product is anything that can be offered to a market to meet a desire or need. Products marketed include goods and physical services, places, organizations, and ideas [20]. The many choices of nugget products available on the market will make consumers more selective in determining the choice of nugget products that suit their needs and desires. The development of red bean nugget products can be done by finding out consumer preferences for new products. Consumer preferences for a product can be known by determining the attributes attached to the product that can influence someone as a consideration for choosing the product.

III. MATERIALS AND METHODS

This research was carried out from April 2024 to December 2024 at the Food Laboratory of the Agro-industrial Technology Study Program, Faculty of Engineering, Universitas Wijaya Kusuma Surabaya, and The Industrial Research and Consultation Laboratory,

Surabaya, East Java. The materials used in this research are ingredients for making and packaging materials for vegetable nuggets. The tools used in this research were a steamer, stove, large plastic bowl, scales, mixer, and nugget maker.

This research was designed in four stages, as shown in Figure 1. The first stage is empirical research using the survey method, the second and third stages are analytical research using mathematical-statistical modeling, and the fourth stage is a laboratory experiment to realize the selected product design. The stages of the research can be briefly explained as follows:

1. The product attribute determination stage, namely the stage of collecting consumer preferences related to the desired vegetable nugget product attributes, which will later be used as the basis for product design. At this stage, a survey method will be used;
2. The product design stage, to determine the variation of nugget products desired by consumers; at this stage, using Orthogonal Design to build product configuration, and Conjoint Analysis to select product variations;
3. The value analysis stage is carried out to determine the selected product design alternative by comparing production costs and product benefits; and
4. The stage of realizing the selected product design, namely the stage of processing the selected vegetable nugget product and testing the product quality.

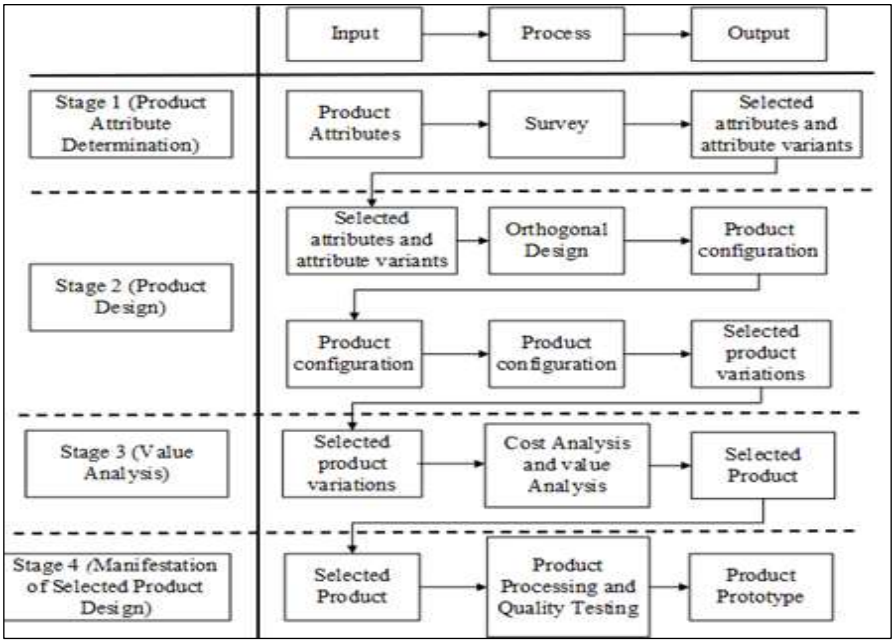

Figure 1: Research stages.
Source: Authors, (2025).

III.1 RESEARCH STAGES

Product attribute determination stage

The first stage in this study is the stage of determining product attributes. This stage is carried out to capture consumer preferences related to the attributes of vegetable nuggets products desired by consumers which will later be used as the basis for product design. The product attribute capture is based on the intrinsic and extrinsic attributes of the product. This stage uses a survey method conducted online.

The questionnaire is composed of two parts; the first part is the demographic aspect of the respondents, and the second part is related to the product attributes desired by consumers. In the demographic aspect of the respondents, questions include age, gender, education level, occupation, and income. The product attributes reviewed in this study include intrinsic and extrinsic product attributes.

Data was collected using an online questionnaire distributed via social media over a predetermined period. Social media is used with the aim that only respondents who are interested in the product being studied will fill out the questionnaire. The target respondents are consumers of the products studied. Data about respondent characteristics and preferences were analyzed using descriptive analysis.

Product design stage

Alternative product configurations are developed using orthogonal design. Each aspect of the intrinsic attribute is represented by two attributes that are most in demand by consumers, and each attribute has at least two variants that are most often chosen by consumers. Based on the alternative product configurations formed, a ranking process is then carried out to determine the ranking of the alternative product configurations. The ranking process uses the Conjoint Analysis method. Conjoint Analysis is used to determine the ranking of the product configurations formed. Conjoint Analysis is one of the most popular techniques for assessing customer preferences for alternative products with multiple attributes [10], [21], [22]. At this stage, the top 3 rankings will be selected as selected products.
The general formulation of the Conjoint Analysis mathematical model is presented in Equation (1) [22].
Conjoint Analysis Mathematical Model

$$U_k = \beta_0 + \sum_{i=1}^{m} \sum_{j=1}^{n} u_{ijk} \quad (1)$$

Where:

U_k = total utility of each product configuration alternative
β_0 = a constant
u_{ijk} = utility of product configuration alternative k for attribute i and level j
m = number of attributes
n = number of levels

Value analysis stage

Value analysis is conducted to determine the best product design in terms of product benefits and product production costs. Product benefits are based on product utilities from the results of conjoint analysis. Product value is a comparison between product benefits and the cost of producing it. The value of a product is determined using Equation 2.
Product Value Equation

$$Value = \frac{\text{Utility}}{\text{Cost}} \quad (2)$$

The stage of realizing the selected product design

At this stage, vegetable nuggets will be produced with the selected design from Stage 3. Next, product quality testing will be carried out to determine whether the resulting product meets the quality standards according to existing provisions.

III.2 OBSERVATION PARAMETERS

Parameters for testing vegetable nugget products, namely protein content, carbohydrate content, fat content, water content, and ash content, as well as organoleptic tests (taste, color, aroma, and texture). Product nutritional content testing is carried out to determine the nutritional content of selected vegetable products following applicable provisions. The method of measuring the chemical content of products refers to [23].

This Organoleptic Test was conducted to determine the level of consumer preference for the parameters of taste, color, flavor, and texture of vegetable nugget products. This organoleptic test uses a hedonic scale by randomly presenting 30 general panelists to conduct tests based on five scales: 1 (very dislike), 2 (dislike), 3 (neutral), 4 (like), and 5 (very like). The results of this organoleptic test were then analyzed using descriptive analysis.

IV. RESULTS AND DISCUSSIONS

IV.1 VALIDITY AND RELIABILITY

The results of the questionnaire validity test obtained a value for the r table of 0.195, with a confidence level of 95% and a significance value (error rate) of 5% = 0.05. The statement in the questionnaire is said to be valid if the statement has a positive r count value and is greater than the r table value. Based on the results of the validity test conducted, it is known that all statements used in the study are valid.

A questionnaire is reliable if a person's answer to a statement is consistent or stable over time. A construct or variable is declared reliable if it provides a Cronbach Alpha (α) value > 60. Based on the results of the reliability test, the Cronbach Alpha value was 0.859, so it can be said that the questionnaire is reliable.

IV.2 DESCRIPTIVE ANALYSIS

The selection of intrinsic and extrinsic attributes of vegetable nugget products is based on consumer preferences. Intrinsic and extrinsic attributes are selected based on the percentage of 50% to >50% of the total calculation. Based on the results of the analysis, the intrinsic attribute levels desired by respondents are the shape of the nugget by 67%, flavor (taste and aroma) by 55%, and the weight of the nugget per piece by 50%. The results of the extrinsic attribute levels desired by respondents are packaging materials by 75% and packaging design by 51%.

The selected attribute level is determined from the sum of the "Desired" and "Highly Desired" scores in the frequency distribution of each attribute. The total value of the attribute level that shows a percentage of 50% to >50% is determined as the attribute level consumer's desire. The selected attributes and levels for making vegetable nugget product designs can be seen in Table 2.

Table 2: Selected attributes and variants of vegetable nugget product design.

Intrinsic Attributes		**Extrinsic Attributes**	
Attributes	**Variants**	**Attributes**	**Variants**
Shape	Animal Shape	Packaging Materials	Vacuum Plastic
	Alphabet Pieces		Laminated Cardboard
	Dimension Cut	Packaging Design	Simple Design
Flavor (Taste and Aroma)	Dominant Vegetables		Variative Design
	Dominant Content Variants		
Weight per piece	15-20 grams (medium)		
	20-25grams (large)		

Source: Authors, (2025).

IV.3 PRODUCT DESIGN

Conjoint Analysis

The orthogonal array is used to design efficient experiments and analyze experimental data. Therefore, an orthogonal array is used to help create stimuli configurations so that all stimuli do not need to be analyzed further. The orthogonal array procedure uses orthogonal design so that the configuration of the vegetable nugget product design is produced in the form of stimuli cards, where each stimulus card has a different characteristic configuration or attribute level. The results of the orthogonal array study display eight stimulus cards or eight vegetable nugget product design configurations. The configuration was then distributed as a second-stage questionnaire. Respondents were asked to rank the configurations from the most preferred (1) to the least preferred (8) according to each respondent's opinion.

The utility value of each attribute level can be obtained using conjoint analysis. Conjoint analysis in principle aims to estimate the pattern of respondents' opinions. The results of this estimation are then compared with the actual opinions of respondents. The process of comparing estimates with actuals is called predictive accuracy, which measures the level of production accuracy. To test this accuracy, correlation measurements are carried out [24]. Correlation measurements in conjoint analysis were carried out using Pearson's R and Kendall's tau. A correlation is said to be strong if R is above 0.5 (R > 0.5) with a probability (significance) less than 0.05. The result of the Conjoint Analysis Correlation Test is shown in Table 3.

Table 3: Conjoint Analysis Correlation Test.

Criteria	Value	Sig.
Pearson's R	0.983	0.000
Kendall's tau	0.929	0.001

Source: Authors, (2025).

The results of the conjoint analysis correlation test (Table 3) show an R-value> 0.5 with a value on the Pearson's R criteria of 0.983 and Kendall's tau of 0.929 and a significance value below 0.05, namely a value of 0.000 for Pearson's R and 0.001 for Kendall's tau. This means that the accuracy of consumer preference prediction is stated as significant. Thus, it can be said that the 5 selected attribute factors can produce a design configuration that describes consumer wants for vegetable nugget products.

The utility value of the level is the preference value given by respondents to each level attached to the design attribute of vegetable nugget products. The greater the utility value of the attribute level at the attribute level, the more preferred it is than other attribute levels. The results of the conjoint analysis show the utility value of the highest level of each attribute that is most preferred by respondents. The utility value of the attribute level of vegetable nugget products can be seen in Table 4.

Table 4: Utility value of product attribute level.

Attributes	Level	Utility Value
Shape	Animal Shape	0.150
	Dimension Cut	-0.107
	Alphabet Pieces	-0.043
Flavor (Taste and Aroma)	Dominant Content Variants	-0.040
	Dominant Vegetables	0.040
Weight per piece	15-20 grams (medium)	-0.082
	20-25grams (large)	0.082
Packaging Materials	Vacuum Plastic	0.113
	Laminated Cardboard	-0.113
Packaging Design	Simple Design	-0.070
	Variative Design	0.070
(Constanta)		**4.462**

Source: Authors, (2025).

The Importance Level is the average value of all stimuli factors from the utility value of each respondent's attributes. The attribute importance level is the level of consumer preference or interest in the desired attribute. The greater the attribute importance value indicates the greater the influence of the attribute in determining consumer preferences, and conversely, a low attribute importance value indicates that the attribute is relatively less considered. The results of the analysis on the most considered attribute importance levels in sequence, shown in percentage, are nugget shape at 36.26%, nugget flavor (taste and aroma) at 17.84%, nugget weight per piece (size) at 17.74%, packaging material at 13.64%, and packaging design at 14.51%.

The value of total utility is used to see the configuration and attribute level that is most preferred by consumers of red bean nugget products. The higher the satisfaction obtained, the higher the utility value of the product. The total utility value in Table 5, describes the most preferred choice by respondents from the eight stimulus configurations offered. The highest total utility value indicates the design configuration of the vegetable nugget product that is most desired by consumers, and the lowest total utility value indicates the design configuration of the vegetable nugget product that is least preferred by consumers. Based on Table 5, the design configuration of the red bean nugget product that is by consumer preferences or most preferred is the configuration ranked first or stimulus card number three. The selected design configuration of the vegetable nugget product is the shape of the nugget, the flavor (taste and aroma) is predominantly vegetable, the weight of the nugget is 20-25 grams (large size), and the packaging material is made of vacuum plastic with a simple packaging design.

The level of attribute importance is the utility value of each attribute used as a parameter. The level of attribute importance is the average value of a particular factor from all stimuli resulting from the value of the attribute utility results of each respondent. The level of attribute importance is the level of preference or liking or consumer interest in the specified attribute. The Level of Importance of

Vegetable Nugget Product Attributes can be seen in Table 6. This value is most considered by consumers in terms of the level of attribute importance. Table 4 produces values from the highest to the lowest levels.

Table 5: Total utility.

Card ID	Product Configuration	Total Utility
1	Animal Shape, Dominant Content Variants, 15-20 grams (medium), Vacuum Plastic, Simple Design	4.533
2	Animal Shape, Dominant Vegetables, 20-25 grams (large), Laminated Cardboard, Variative Design	4.692
3	Animal Shape, Dominant Vegetables, 20-25 grams (large), Vacuum Plastic, Simple Design	4.778
4	Animal Shape, Dominant Content Variants, 20-25 grams (Large), Laminated Cardboard, Simple Design	4.279
5	Animal Shape, Dominant Content Variants, 20-25 grams (Large), Vacuum Plastic, Variative Design	4.581
6	Dimension Cut, Dominant Vegetables, 15-20 grams (medium), Laminated Cardboard, Simple Design	4.130
7	Animal Shape, Dominant Content Variants, 15-20 grams (medium), Laminated Cardboard, Variative Design	4.447
8	Alphabet Pieces, Dominant Vegetables, 15-20 grams (medium), Vacuum Plastic, Variative Design	4.560

Source: Authors, (2025).

Table 6: Importance level of vegetable nugget atributes.

Attributes	Attributes Importance Level (%)
Shape	36.26
Flavor (Taste and Aroma)	17.84
Weight per piece	17.74
Packaging Materials	13.64
Packaging Design	14.51

Source: Authors, (2025).

Based on the results of the conjoint analysis, a relative importance value was obtained, which indicates the level of importance of each attribute. The greater the importance value of an attribute indicates the greater influence of the attribute in determining consumer preferences, and conversely, a low importance value indicates that the attribute is relatively less considered. Table 5 shows that the most considered attributes are nugget shape, flavor (taste and aroma), weight per piece (size), nugget packaging design, and nugget packaging material. The most important attribute of vegetable nuggets to respondents is the shape of the nugget, which is shown by a percentage of 36.26%. The second most important attribute of vegetable nuggets is flavor (taste and aroma), which is shown by a percentage of 17.84%. The third most important attribute of vegetable nuggets is the weight per piece (size) of the nugget, which is shown by a percentage of 17.74%. This is followed by the attributes of packaging design and packaging materials which received the lowest importance values, namely 14.51% and 13.64%, respectively, indicating that both attributes are relatively considered by respondents.

Consumer Preferences for Selected Attributes and Levels

Consumer preferences can be interpreted as a person's choice of likes or dislikes for a product or service. Based on the results of the analysis using the conjoint method, the results of respondent preferences for the design attributes of vegetable nuggets are obtained, which can be seen in Table 7. The selected level is consumer preference, seen from the utility with a positive value. Respondents' preferences for vegetable nugget products include several attributes, namely the shape of the nugget with animal pieces, a flavor (taste and aroma) with a dominant vegetable, the weight of the nugget per piece is 20-25 grams or large, vacuum plastic packaging, and packaging with a variety of designs.

Table 7: Consumer Preferences.

Attributes (Importance)	Utilities	Level	Preference
Shape (36,26)	0.150	Animal Shape	Animal Shape
	-0.107	Dimension Cut	
	-0.043	Alphabet Pieces	
Flavor (Taste and Aroma) (17,84)	0.04	Dominant Vegetables	Dominant Vegetables
	-0.04	Dominant Content Variants	
Weight per piece (17,74)	-0.082	15-20 grams (medium)	20-25 grams
	0.082	20-25 grams (large)	
Packaging Materials (13,64)	0.113	Vacuum Plastic	Vacuum Plastic
	-0.113	Laminated Cardboard	
Packaging Design (14,51)	-0.07	Simple Design	Variative Design
	0.07	Variative Design	

Source: Authors, (2025).

This is when compared with the research results of [25], the attributes wanted by consumers in purchasing instant noodles, including the level of the shape attribute chosen is noodles in a round shape, this shows that consumers prefer a shape that is more familiar to consumers, namely a round shape. The level of the taste attribute chosen is noodles with a savory taste. Consumers can sometimes consume instant noodles without having to cook them first. The level of the size attribute chosen is the size of noodles with a large size of 100 grams because most consumers consider 100 grams to be the right size when consumed. The level of the packaging material attribute chosen by consumers is plastic packaging material. This is because plastic packaging material is more familiar among consumers and is simpler in the storage process.

In contrast to the research results of [26] and [10] which stated that taste is a key indicator of food product performance, in this research, the taste attribute is ranked second after shape. Implementation of packaging factors according to the research results of [8] is adjusted to consumer preferences by making the packaging design more attractive and adding product information attributes such as expiration date, storage and presentation methods, product images, and application of bright colors.

Consumer Preferences for Stimulus Configurations

According to [27] consumer behavior towards certain goods can be analyzed through the theory of utility. Utility is the satisfaction obtained by someone in consuming a certain good. The higher the satisfaction obtained in consuming a certain good, the higher the utility value of the good. The value of the total utility is used to see the configuration and level of attributes most preferred by consumers of vegetable nuggets. The total utility value in Table 8, describes the most preferred choice by respondents from the 8 (eight) stimulus configurations offered. The highest total utility value indicates the configuration that consumers prefer the most, and the lowest total utility value indicates the configuration that respondents dislike the most regarding vegetable nugget attributes.

Table 8: Consumers' Most Preferred Stimulus Configuration (Total Utility Value).

Card ID	Product Configuration	Total Utility	Ranking
1	Animal Shape, Dominant Content Variants, 15-20 grams (medium), Vacuum Plastic, Simple Design	4.533	5
2	Animal Shape, Dominant Vegetables, 20-25 grams (large), Laminated Cardboard, Variative Design	4.692	2
3	Animal Shape, Dominant Vegetables, 20-25 grams (large), Vacuum Plastic, Simple Design	4.778	1
4	Animal Shape, Dominant Content Variants, 20-25 grams (Large), Laminated Cardboard, Simple Design	4.279	7
5	Animal Shape, Dominant Content Variants, 20-25 grams (Large), Vacuum Plastic, Variative Design	4.581	3
6	Dimension Cut, Dominant Vegetables, 15-20 grams (medium), Laminated Cardboard, Simple Design	4.130	8
7	Animal Shape, Dominant Content Variants, 15-20 grams (medium), Laminated Cardboard, Variative Design	4.447	6
8	Alphabet Pieces, Dominant Vegetables, 15-20 grams (medium), Vacuum Plastic, Variative Design	4.560	4

Source: Authors, (2025).

Based on Table 8, the most preferred attribute configuration or the number one ranking of respondents' choices is the ID card configuration number 3, namely the design of the nugget product with the shape of animal cut nuggets, dominant vegetable flavor, nugget weight of 20-25 grams (large size), vacuum plastic packaging material, and simple packaging design. The least preferred configuration or the last ranking of respondents' choices is configuration number 4, namely the shape of the nugget cut dimensions, the dominant flavor of the content variant, a nugget weight of 15-20 grams (medium size), packaging material of laminated cardboard, and simple packaging design. Therefore, it can be said that the configuration of the highest attribute levels above can produce the highest preference which can provide the highest utility for consumers towards vegetable nugget products.

IV.4 VALUE ANALYSIS

The ratio of any product variant's advantages to its manufacturing costs is known as the product value. The overall utility value of each product variant based on conjoint analysis is what is meant by product benefits. The cost of the manufacturing process for every product variation is also known as the production cost.

The calculation of product value is based on Equation (2). The total utility and cost production of each product configuration is shown in Table 9. The results of the product value analysis are shown in Figure 2.

Table 9: Total utility and cost production.

Card ID	Product Configuration	Total Utility	Cost (IDR)
1	Animal Shape, Dominant Content Variants, 15-20 grams (medium), Vacuum Plastic, Simple Design	4.533	52,500
2	Animal Shape, Dominant Vegetables, 20-25 grams (large), Laminated Cardboard, Variative Design	4.692	42,500
3	Animal Shape, Dominant Vegetables, 20-25 grams (large), Vacuum Plastic, Simple Design	4.778	42,500
4	Animal Shape, Dominant Content Variants, 20-25 grams (Large), Laminated Cardboard, Simple Design	4.279	51,500
5	Animal Shape, Dominant Content Variants, 20-25 grams (Large), Vacuum Plastic, Variative Design	4.581	53,500
6	Dimension Cut, Dominant Vegetables, 15-20 grams (medium), Laminated Cardboard, Simple Design	4.130	41,500
7	Animal Shape, Dominant Content Variants, 15-20 grams (medium), Laminated Cardboard, Variative Design	4.447	52,500
8	Alphabet Pieces, Dominant Vegetables, 15-20 grams (medium), Vacuum Plastic, Variative Design	4.560	43,500

Source: Authors, (2025).

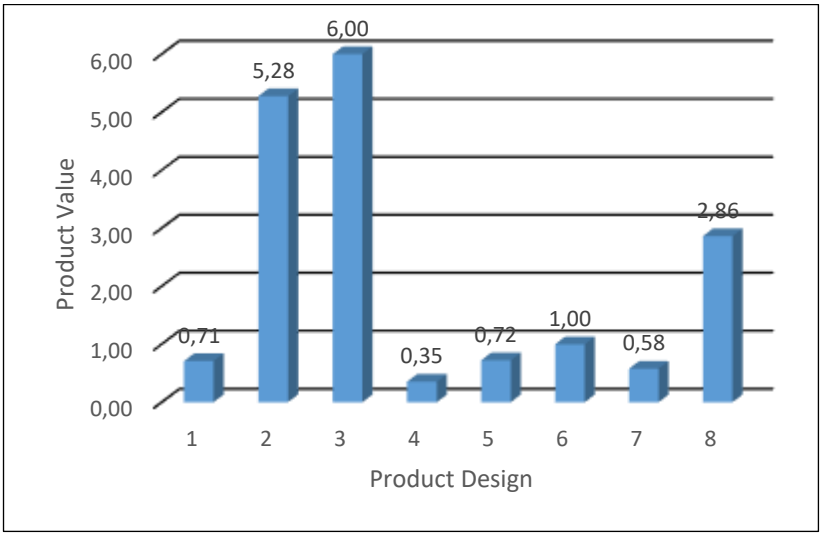

Figure 2: Product value.
Source: Authors, (2025).

The results of the study indicate that the configuration of the highest attribute levels produces selected preferences that can provide the highest utility for consumers of vegetable nuggets. In addition, it will be the right basis for producers or entrepreneurs to set strategies in marketing vegetable nugget products. The use of consumer preferences can capture the right product attributes. The implementation of conjoint analysis accommodates more details of each consumer's desire for a product. Conjoint analysis is also able to analyze the creation of value for consumers, assist in decisions to choose product designs that are considered optimal, and build strategic policies in marketing.

However, to realize the selected product must consider the production cost. Based on Figure 2, the product that has the highest value is Card ID 3. This product design has the highest total utility but with adequate production costs. The product design configuration of Card ID 3 has a product value of 6.00.

IV.5 PRODUCT MANIFESTATION

Based on the product value for each product design (Table 8), the product design that has the highest product value is the Card ID configuration number 3, namely the nugget product design with the shape of the animal shape, dominant vegetables, nugget weight of 20-25 grams (large size), vacuum plastic packaging material, and simple packaging design. The product design with the lowest product value is the Card ID configuration number 4, namely the animal shape, dominant content variants, nugget weight of 20-25 grams (large size), packaging material of laminated cardboard, and simple packaging design. The product design that has the highest value is realized by the processing of vegetable nuggets. Based on the result of the chemical test, the selected vegetable nugget products have a nutritional content of 34.02% water content, 0.35% ash content, 14.64% protein content, 4.05% fat content, and 46.73% carbohydrate content. This nutritional content has met the Indonesian National Standard for nugget products, namely a maximum water content of 60%, a minimum protein content of 12%, and a maximum fat content of 20% [28]. The results of the organoleptic test showed that all respondents liked the selected vegetable nugget products based on the parameters of taste, aroma, color, and texture.

V. CONCLUSIONS

The results of the conjoint analysis show that the order of attributes that can influence consumer preferences for vegetable nugget product design are nugget shape, nugget flavor (taste and aroma), nugget weight per piece (size), packaging material, and packaging design. The order of attribute levels is animal pieces, dominant vegetables, weight 20-25 grams (large), vacuum plastic, and varied designs. The configuration of vegetable nugget product design that suits consumer preferences based on the highest-ranking results is the configuration of stimulus card number 3 with the composition of the vegetable nugget product design configuration in the form of animal pieces, flavor (taste and aroma) that is dominant in vegetables, nugget weight per piece of 20-25 grams (large), vacuum plastic packaging material and simple or simple packaging design. The selected design has the following nutritional content: 34.02% water content, 0.35% ash content, 14.64% protein content, 4.05% fat content, and 46.73% carbohydrate content.

VI. AUTHOR'S CONTRIBUTION

Conceptualization: Endang Retno Wedowati, Diana Puspitasari and Fungki Sri Rejeki.
Methodology: Endang Retno Wedowati and Tri Rahayuningsih.
Investigation: Diana Puspitasari, Fungki Sri Rejeki and Johan Paing Heru Waskito.
Discussion of results: Endang Retno Wedowati, Diana Puspitasari and Fungki Sri Rejeki.
Writing – Original Draft: Endang Retno Wedowati and Tri Rahayuningsih.
Writing – Review and Editing: Endang Retno Wedowati, Diana Puspitasari and Fungki Sri Rejeki.
Resources: Endang Retno Wedowati, Tri Rahayuningsih and Johan Paing Heru Waskito.
Supervision: Fungki Sri Rejeki and Johan Paing Heru Waskito.
Approval of the final text: Endang Retno Wedowati, Diana Puspitasari, Fungki Sri Rejeki, Tri Rahayuningsih and Johan Paing Heru Waskito.

VII. ACKNOWLEDGMENTS

Gratitude is expressed to Universitas Wijaya Kusuma Surabaya, which has provided funding for this activity through the Internal Research Grant Program with contract number 8/LPPM/UWKS/III/2024.

VIII. REFERENCES

[1] J. D. Frutos and D. Borenstein, "A framework to support customer-company interaction in mass customization environments," Comput. Ind., vol. 54, pp. 115–135, 2004.

[2] R. Akkerman and D. P. Van Donk, "Product mix variability with correlated demand in two-stage food manufacturing with intermediate storage," Int. J. Prod. Econ., vol. 121, no. 2, pp. 313–322, 2009, doi: 10.1016/j.ijpe.2006.11.021.

[3] R. I. McIntosh, J. Matthews, G. Mullineux, and A. J. Medland, "Late customisation: issues of mass customisation in the food industry," Int. J. Prod. Res., vol. 48, no. 6, pp. 1557–1574, Mar. 2010, doi: http://dx.doi.org/10.1080/00207543.2012.693963.

[4] A. N. Utama and G. Anjani, "Substitusi isolat protein kedelai pada daging analog kacang merah (Phaseolus vulgaris L.)," J. Nutr. Coll., vol. 5, no. 4, p. 402, 2016, [Online]. Available: http://ejournal-s1.undip.ac.id/index.php/jnc

[5] M. Astawan, Sehat dengan Hidangan Kacang dan Biji-bijian, First. Jakarta: Penebar Swadaya, 2009.

[6] Akantu et al., "Preferensi Konsumen Terhadap Produk Nugget Ayam di Kecamatan Kota Selatan Kota Gorontalo Consumer Preferences for Chicken Nugget Products in Kota Selatan District, Gorontalo City," Jambura J. Trop. Livest. Stud. vol. 1, no. 1, pp. 16–24, 2023.

[7] A. P. K. Ikhsanu, L. A. Manafe, and M. A. Masyhuri, "Preferensi Konsumen dalam Membeli Produk Frozen Food," J. Akunt. Bisnis dan Ekon., vol. 9, no. 2, pp. 3435–3444, 2023, doi: 10.33197/jabe.vol9.iss2.2023.1122.

[8] C. R. Rahardjo, "Faktor yang menjadi preferensi konsumen dalam membeli produk frozen food," PERFORMA J. Manaj. dan Start-Up Bisnis, vol. 1, no. 1, pp. 32–43, 2016.

[9] E. R. Wedowati, M. L. Singgih, and I. K. Gunarta, "A study of consumer preferences customized product design," in MATEC Web of Conferences 204, 2018, vol. 01002, pp. 1–7. doi: https://doi.org/10.1051/matecconf/201820401002.

[10] E. R. Wedowati, M. L. Singgih, and I. K. Gunarta, "Determination of modules in pleasurable design to fulfil customer requirements and provide a customized product in the food industry," Designs, vol. 4, no. 7, pp. 1–21, 2020, doi: 10.3390/designs4010007.

[11] E. R. Wedowati, M. L. Singgih, and I. K. Gunarta, "Product value analysis on customized product based on pleasurable design and time-driven activity-based costing in food industry," Cogent Bus. Manag., vol. 7, no. 1, pp. 1–22, 2020, doi: 10.1080/23311975.2020.1823581.

[12] T. Seifert et al., "Multivariate risk analysis of an intensified modular hydroformylation process," Chem. Eng. Process. Process Intensif., vol. 95, pp. 124–134, 2015, doi: 10.1016/j.cep.2015.05.010.

[13] J. Espejel, C. Fandos, and C. Flavián, "The role of intrinsic and extrinsic quality attributes on consumer behaviour for traditional food products," 2007, doi: 10.1108/09604520710835000.

[14] R. Iop, S.C.F.; Teixeira, E.; Deliza, "Consumer research : extrinsic variables in food studies," Br. Food J., vol. 108, no. 11, pp. 894–903, 2006.

[15] M. Hersleth, E. Monteleone, A. Segtnan, and T. Næs, "Effects of evoked meal contexts on consumers ' responses to intrinsic and extrinsic product attributes in dry-cured ham," FOOD Qual. Prefer., vol. 40, pp. 191–198, 2015, doi: 10.1016/j.foodqual.2014.10.002.

[16] P. Y. Lee, K. Lusk, M. Mirosa, and I. Oey, "An attribute prioritization-based segmentation of the Chinese consumer market for fruit juice," FOOD Qual. Prefer., vol. 46, pp. 1–8, 2015, doi: 10.1016/j.foodqual.2015.06.016.

[17] M. C. D. Verain, S. J. Sijtsema, and G. Antonides, "Consumer segmentation based on food-category attribute importance : The relation with healthiness and sustainability perceptions," Food Qual. Prefer., vol. 48, pp. 99–106, 2016, doi: 10.1016/j.foodqual.2015.08.012.

[18] T. Nishimura et al., "Phytosterols in onion contribute to a sensation of lingering of aroma , a koku attribute," Food Chem., vol. 192, pp. 724–728, 2016, doi: 10.1016/j.foodchem.2015.06.075.

[19] J. P. H. Waskito, E. R. Wedowati, F. S. Rejeki, and E. Wahyuningtyas, "Food product design with Wijaya Kusuma character based on pleasurable design," Int. J. Eng. Sci. Inf. Technol., vol. 2, no. 1, pp. 1–8, 2021, doi: 10.52088/ijesty.v2i1.193.

[20] P. Kotler and K. L. Keller, Marketing Management, 15th Globa. London: Pearson Education, Inc., 2016.

[21] C. H. Wang and C. W. Shih, "Integrating conjoint analysis with quality function deployment to carry out customer-driven concept development for ultrabooks," Comput. Stand. Interfaces, vol. 36, no. 1, pp. 89–96, 2013, doi: 10.1016/j.csi.2013.07.010.

[22] C. H. Wang, "Integrating Kansei engineering with conjoint analysis to fulfil market segmentation and product customisation for digital cameras," Int. J. Prod. Res., vol. 53, no. 8, pp. 2427–2438, 2015, doi: 10.1080/00207543.2014.974840.

[23] S. S. Nielsen, Food Analysis Laboratory Manual, Third Edit. Switzerland: Springer Nature, 2019. doi: 10.1007/978-3-319-44127-6.

[24] P. R. D. McCullough, "A User's Guide to Conjoint Analysis," Marketing research magazine, vol. 14, no. 2, pp. 18–23, 2002.

[25] A. Mulyadi and E. Fauziyah, "Preferensi Konsumen Dalam Pembelian Mi Instan Di Kabupaten Bangkalan," Agriekonomika, vol. 3, no. 1, pp. 65–80, 2014.

[26] S. De Pelsmaeker, J. J. Schouteten, S. Lagast, K. Dewettinck, and X. Gellynck, "Is taste the key driver for consumer preference? A conjoint analysis study," Food Qual. Prefer., vol. 62, pp. 323–331, 2017, doi: 10.1016/j.foodqual.2017.02.018.

[27] W. Bangun, Teori Ekonomi Mikro, IV. Bandung: PT Refika Aditama, 2015.

[28] Anonymous, “Petunjuk Teknis Skema Sertifikasi Produk Naget Ayam,” Peraturan Badan Standardisasi Nasional Republik Indonesia Nomor 6 Tahun 2019 Tentang Skema Penilaian Kesesuaian Terhadap Standar Nasional Indonesia Sektor Pangan. Badan Standarisasi Nasional Republik Indonesia, Jakarta, pp. 1097–11110, 2019.