The Utilization of The Kano Model for Development of Edible Spoon

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Abstract. The use of plastic in food packaging and cutlery is one of the significant factors that cause environmental pollution. The alternative solution that can be given to reduce the use of plastic is to create edible spoons. The features and attributes required for the spoon are essential factors in the process of product development. Therefore, this study aimed to analyze the level of consumer acceptance and satisfaction regarding the features and attributes of the product by using the Kano method. This analysis involves distributing questionnaires, validity and reliability tests, and dividing requirements into specific categories. The requirements distributed in the questionnaire are various dimensions of product quality that need to be analyzed in product development. The results of the Kano questionnaire showed that of the 17 requirements, there were five essential attributes: having a BPOM certificate, hygienic packaging, a list of nutritional contents on the package, the good nutritional content on the edible spoon, and a product that is not easy to stale. These five attributes are the ones that should be considered in developing edible spoon products.

1. Introduction

Plastic waste is one of the world's most serious concerns; around 18 million pounds of plastic debris enter the oceans each year from coastal locations. 40% of all plastic produced is used in food-related applications, such as packaging and cutlery. Globally, only about 20% of plastic is recycled [1]. While attempts are being made to recycle plastic trash, many forms of plastic are incompatible with recycling. Cutlery is one sort of plastic debris that is frequently discovered. Several academic researchers worldwide are investigating alternate solutions dubbed "edible cutleries" to tackle this rising challenge [2,3]. The notion of an idea was initially developed in India in 2010 as a commercial product by a business named Bakey's. Since 2016, the product has been improved, and the company can now produce up to 50,000 edible spoon products per day. The company has been asked to make 25 million pieces of its products all over the world [4].

Edible spoons are made using simple, preservative-free, and natural sources such as carbohydrate-based ingredients such as sorghum, rice flour, and wheat flour. Even though the prospect of making this product is high and feasible for the market, it is necessary to understand customer behavior and expectations in order to examine the product's strengths and flaws. Consumer purchasing decisions are impacted by a variety of factors, including culinary features, quality, and packaging [5]. As a result, a survey will be conducted to ascertain the product characteristics of those who may purchase these products. The Kano model approach has been proved to be an effective method for the development of the new product. The Kano model is a way to group product characteristics based on how well the product meets customer needs [6]. It can also be used to understand the quality and customer satisfaction attributes at the attribute level from the customer's point of view [7]. In this study, the Kano approach was utilized to obtain information on the important attributes that give a significant influence on the edible spoon development.

1.1 Objectives

The objective of this study was to analyze the level of consumer acceptance and satisfaction regarding the features and attributes that are important for the development of edible spoon products by using the Kano method.

2. Literature Review

Edible dinnerware is a renewed notion. Since the 1400s, it has been created in England in the shape of the bread bowl. Then, this revitalized design began to get international interest and resulted in the production of this eco-friendly cutlery [8]. The edible spoon is made from natural ingredients such as grains [9]. Edible spoons are manufactured from a variety of grains, including sorghum, rice, and wheat. After blending the ingredients until smooth, they will be kneaded with hot water and fashioned into a spoon. The created dough is

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then baked to provide a crispy, firm, and moisture-free texture. The product can be flavored with various flavors, such as vanilla or strawberry, to give it a sweet taste, or it can be seasoned with salt and pepper to give it a savory flavor [10]. Bakeys, a firm specializing in edible cutlery located in India, has developed an edible spoon manufactured from cereals such as sorghum. It has a long shelf life due to its low water content [9].

The Kano model was created by Prof. Noriaki Kano in 1984. This model was formulated to categorize and prioritize consumer needs and provide guidance for manufacturers to develop a product [11]. There are six categories in the Kano model such as:

a. Must be.
Must-be requirements are basic requirements, these requirements represent the minimum criteria that must be met by a product. If this is not met, the customer will be dissatisfied or will not be interested in a product. Even if these requirements were fully met, they would not result in an additional level of customer satisfaction above the neutral level.

b. One-dimensional
If a product has functional features that meet a type of need, consumers will be more attracted to the product. If these types of requirements are met, it will be a strong factor to attract consumers' attention. Therefore, these requirements must be prioritized in product development.

c. Attractive
The attractive curve shows the area where you will be more satisfied with a product that is more functional but will not feel dissatisfied if a product is less functional. These types of requirements are not stated or expected directly by consumers. Therefore, in the absence of a certain attribute, it will not cause dissatisfaction by consumers. Attributes like this are just like extras/additions that would please consumers if any.

d. Indifferent
The indifferent category indicates that the respondent cannot state that certain requirements can increase or decrease the quality of the product. This category shows that **consumer**`s are not satisfied with a feature but also are not dissatisfied with a feature.

e. Reverse
The reverse category shows requirements that are not desired by consumers, if the product has these features, the level of customer satisfaction will decrease. This can happen if a feature/attribute of a product goes against what customers expect/want.

f. Questionable
The questionable category indicates that the respondent may not understand or have other reasons (Respondents answered that they will feel satisfied when a requirement is met or not).

3. Methods

3.1 Kano Questionnaire

The methods used in this study involved the use of Kano approach [12]. This method can be used to understand the level of customer satisfaction with the attributes of the product. In this study, a simple random sampling approach was used to obtain the respondents. The minimum respondent needed in this questionnaire was determined following the Bernoulli method:

$$N = \frac{z\left(\frac{\alpha}{2}\right) x\ p\ x\ q}{e^2} \quad (1)$$

Where n is the sample size, z is normal distribution standard value, p is probability being rejected, q is probability being accepted (1-p), and e is margin or error. Assuming the level of accuracy (α) is 5 %, the z value obtained from distribution normal table is 1.96. The probability of the questionnaire is correct or rejected was 0.5 for each value. With the margin error of 10%, the respondents needed in this questionnaire was:

$$N = \frac{1.96 \times 0.5 \times 0.5}{0.01} = 96.04 \quad (2)$$

Based on the calculation, the minimum respondent needed for Kano questionnaire is 97. In this research, we gathered 145 respondents, therefore, the sample size was adequate for the questionnaire. To run the Kano model analysis method, the first step is to make a questionnaire in a quantitative way which will be distributed to respondents with paired questions such as the level of consumer satisfaction if the product has a feature and if the product does not have a feature. The first question is called functional form and the second is dysfunctional form, and the answers that will be chosen on the questionnaire are: (1) I like it, (2) I expect it, (3) Neutral, (4) Tolerable, and (5) Dislike. Several attributes of edible spoons have been asked in the questionnaire (Table 1).

Table 1. Criteria and sub criteria of the attributes

No.	Criteria	Sub Criteria
1	Performance	Food additives
		Price as competitive as plastic cutlery
2	Features	BPOM registration
		Halal certification
		Nutritional content list on the packaging
3	Reliability	Hygienic packaging
		Contain fiber
		Good Nutritional quality
		Variety of taste
		Smoothness of product
		Crispy texture
4	Durability	Longer shelf life
5	Serviceability	Available in the modern market
6	Aesthetic	Bright color
7	Perceived quality	Produce with high technology

3.2 Kano Evaluation

After the data has been collected, the next step is to evaluate the data using the Kano evaluation table (Table 2). The interpretation of data is based on the answer given by the respondent and classified according to the table. The abbreviations used in the evaluation table represent the characteristics of one-dimensional (O), attractive (A), must-be (M), indifferent (I), questionable (Q), and reverse (R).

Table 2. Kano Evaluation

Customer Requirement		Dysfunctional				
		Like it	Expect it	Neutral	Tolerable	Dislike it
Functional	Like it	Q	A	A	A	O
	Expect it	R	I	I	I	M
	Neutral	R	I	I	I	M
	Tolerable	R	I	I	I	M
	Dislike it	R	R	R	R	Q

Notes: A: Attractive; M: Must-be; O: One-dimensional; R: Reverse; Q: Questionable; I: Indifferent

The next stage is to establish the product feature category based on the frequency of responses once the data has been categorized into tables. In general, data collecting findings were assessed considering current information. The findings collected can be communicated, however, provided the inquiries are in-depth or thorough. As a result, Berger et al. (1993) recommend utilizing Blauth's formula to classify data, namely, if the value (O + A + M) > (I + R + Q), the result of O, A, M with the highest number of respondents were chosen. If the value (O + A + M) < (I + R + Q), the I, R, Q with the highest number of respondents were utilized. Furthermore, if both needs have the same frequency results, the categorization that has the most impact on the product should be picked. M > O > A > I is the order in which they should be prioritized.

The final step in analyzing using the Kano model is to consider the level of satisfaction (IBT / If Better Than) and the level of disappointment (IWT / If Worse Than) of the consumer. Mazler and Hinterhuber (1998) stated that the value of consumer IBT and IWT levels only ranges from -1 to 1. If the value is 0 it means that the feature does not affect consumers, and if the results have a value of 1 or close to 1, these attributes will affect consumers more. On the other hand, if the disappointment value approaches -1, consumer disappointment will be more substantial. The following is the formula for calculating the IBT and IWT values:

$$IBT = \frac{A+O}{A+O+M+I} \quad (3)$$

$$IWT = -\frac{M+O}{A+O+M+I} \quad (4)$$

4. Results and Discussion

Characteristics of respondents is one of the supporting factors to determine whether the respondent's data collection can represent a number of populations that will become the target consumers. Characteristics of respondents such as gender, age, and occupation were asked on the questionnaire and shown in Figure 1, Figure 2, and Figure 3.

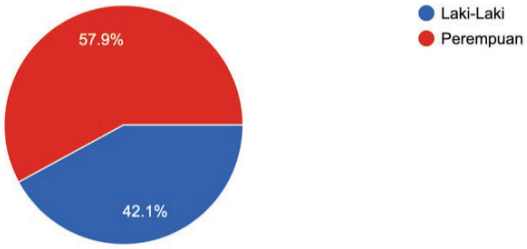

Fig. 1. Gender of respondents

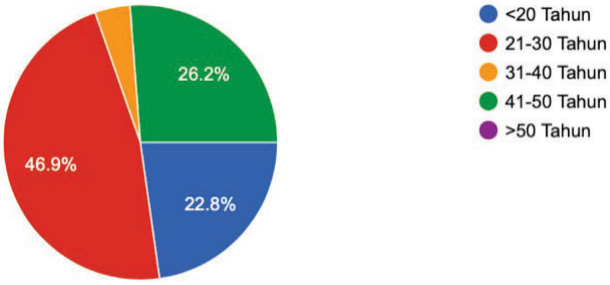

Fig. 2. Age of respondents

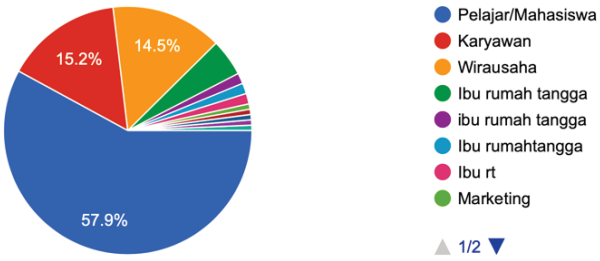

Fig. 3. Occupation of respondents

The result of data tabulation from the questionnaire was shown in table 3. The data were obtained and tabulated from 145 people that fill out the questionnaire. Based on the results obtained, several attributes were considered important for the development of the edible spoon, namely attributes in the category must be, one-dimensional, and attractive. Product durability is categorized as a must-be, where respondents want the product not easily damaged and to have a longer shelf life. Other features such as products without preservatives, with a good level of smoothness, crunchy texture, and produced with advanced processing technology were considered as an attractive category.

For one-dimensional attributes, there was a product that is registered in BPOM, has a hygienic packaging, has good nutritional content, and has a nutrition list on the packaging. These attributes are the features that consumers want in the edible spoon.

Table 3. Category of attributes based on Kano analysis

Criteria	Attributes	A	O	M	I	R	Q	Total	Category
Product performance	1	**47**	25	10	58	2	3	145	**A**
	2	46	4	3	**79**	10	3	145	**I**
Features	3	48	**44**	15	38	-	-	145	**O**
	4	24	14	3	**96**	6	2	145	**I**
	5	54	**48**	11	32	-	-	145	**O**
Reliability	6	11	**117**	11	6	-	-	145	**O**
	7	48	14	1	**80**	1	1	145	**I**
	8	41	**74**	5	22	2	1	145	**O**
	9	45	10	6	**68**	12	4	145	**I**
	10	**47**	32	14	49	2	1	145	**A**
	11	**57**	27	2	58	-	1	145	**A**
Durability	12	3	54	**34**	45	6	3	145	**M**
Service	13	41	15	1	**80**	1	7	145	**I**
Aesthetics	14	38	14	2	**82**	6	3	145	**I**
Quality Impression	15	**63**	15	1	60	-	6	145	**A**

Notes:

1 : Product does not contain preservatives
2 : Product costs the equivalent of a plastic spoon
3 : Product has a BPOM registered
4 : Product has a halal certificate
5 : Product has a list of nutrition content on the packaging
6 : Product has a hygienic packaging
7 : Product contains fiber
8 : Product has a good nutritional content
9 : Product has different flavors
10 : Product has a good level of tenderness (soft)
11 : Product has a crunchy texture
12 : Product is not easily damaged (stale)
13 : Product is available in the modern market
14 : Product has a bright color
15 : Product is manufactured using modern machine technology

After the data has been categorized, the scores in each category that have been collected, calculated the value of IBT (If better than) and IWT (If worse than). The IBT value varies between 0 and 1, if the value is closer to 1, it means that the feature will affect consumers more. And vice versa if the number is closer to 0 then it will not affect consumers. The IWT value varies between 0 and -1, the closer the value is to -1, the higher the level of consumer disappointment (Mazler and Hinterhuber, 1998). After calculating the IBT and IWT values, these values will be entered into a Cartesian diagram matrix (Figure 1) which is divided into 4 parts, namely attractive, must-be, one-dimensional, and indifferent. Table 4 is the result of the satisfaction coefficient that has been calculated based on the results of the questionnaire.

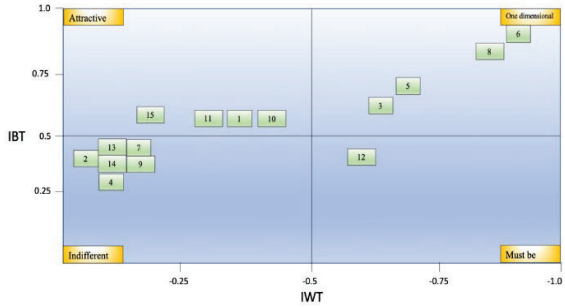

Fig. 4. Cartesian Diagram of Customer Satisfaction Coefficient

Table 4. IBT and IWT coefficient value of the attributes

Criteria	Requirements	Category	IBT	IWT
Product performance	The product does not contain preservatives	**A**	0.514	-0.368

	Product costs the equivalent of a plastic spoon	**I**	0.379	-0.073
Features	Product has BPOM certificate	**O**	0.634	-0.608
	Product have halal certificate	**I**	0.277	-0.143
	Product has a list of nutrition content on the packaging	**O**	0.703	-0.648
Reliability	Product has a hygienic packaging	**O**	0.883	-0.955
	Product contains fiber	**I**	0.434	-0.156
	Product has a good nutritional content	**O**	0.81	-0.767
	Products have different flavors	**I**	0.426	-0.167
	Product has a good level of tenderness (soft)	**A**	0.556	-0.474
	Product has a crunchy texture	**A**	0.583	-0.333
Durability	Product is not easily damaged (stale)	**M**	0.419	-0.633
Service	Product is available in the modern market	**I**	0.409	-0.165
Aesthetics	Product has a bright color	**I**	0.382	-0.154
Quality Impression	This product is manufactured using modern machine technology	**A**	0.561	-0.211

There is one attribute that is categorized as a must-be, namely the product is not easily changed or stale. This requirement has an IBT value of 0.419 and an IWT of -0.633. With a large enough IWT value, it must be ensured that these requirements can be met in product development so that the product can last a long time by guaranteeing its quality. The other four sub-criteria are classified as attractive requirements, with a large IBT value and a relatively small IWT. This means that in product development, these attributes or features can be applied to the product so that the product has added value in the eyes of consumers. The last is the indifferent category, where there are six requirements classified in that category. In this category, the IBT and IWT values can be said to be relatively small, so there is no significant difference in the eyes of consumers if the requirements are met or not.

At the product development stage, it is necessary to adjust the criteria desired by potential consumers. After distributing the questionnaires and the data has been analyzed, it can be seen what features and attributes are desired by consumers. The hygienic packaging, product registered in BPOM, good nutritional content, and nutrition list on the packaging, are the attribute that is categorized as one-dimensional. According to BPOM [13], food processing carried out from raw materials to food distribution must meet the Good Manufacturing Practices (GMP) requirements, which include the production process environment, production equipment, water used, storage areas, and distribution methods. Therefore, with the BPOM registration, it is guaranteed that the product and the packaging used already fulfill the standard quality.

The fulfillment of products that have a crunchy texture and are not easily damaged/changed (stale) can be fulfilled automatically because edible spoon products are processed using thermal treatment by using an oven so that the water content value decreases. The reduction of water content could prolong the shelf life, and affect the visual, taste, and texture of the food material [14]. A good level of smoothness is categorized as attractive. The potential consumers will be more interested in buying if these requirements are met. However, edible spoons cannot be realized with a soft texture, because their use is to lift solid and liquid food. Edible spoons without the addition of additives are the attribute categorized as attractive, which the condition could be fulfilled by reduction of water content through the heating process in the oven [15]. The reduction of water content in the product is associated with long shelf life.

5. Conclusion

In the process of the development of edible spoon, it is very important to understand the consumer voices and suggestions. Based on the Kano approach, various requirements must be prioritized at the development stage of edible spoon products, such as products that have a BPOM registered, products that have a list of nutritional content on the packaging, products that have hygienic packaging, products that have good nutritional content, and products which doesn't get easily stale.

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