Consumer Analysis of Commercial Plant-Based Jerky

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Abstract. The demand for plant-based meats is growing globally, with the global market estimated at USD 1.6 billion in 2019 and projected to reach USD 3.5 billion by 2026. Taking advantage of these opportunities, a food company based in Bandung, West Java, Indonesia develops plant-based products that can be consumed by both vegetarians and vegans. The growth of companies in the food sector is quite high. Competition between companies in the food sector is becoming increasingly tight, so the business units involved must try to determine the best strategy in providing quality and service according to demand. This study aimed to determine the consumer satisfaction of commercial plant-based jerky produced by a food company in Bandung, West Java, Indonesia using the Customer Satisfaction Index (CSI) method, identify its important attributes, and map the important of each attribute using Importance Performance Analysis (IPA). Variables and attributes used are: 1) quality of product (vegan jerky colour, aroma, texture, taste, shelf life, vegan jerky shape & size), 2) packaging products (appearance, material/type, practicality), 3) product price. Total respondents are 100 consumers with convenience sampling technique. This study uses probability sampling with simple random sampling technique and tested on 124 respondents. The customer satisfaction level of vegan jerky based on CSI are as follow: original onion variant 86.8%, spicy onion variant 85.3%, original non-onion variant 83.8%, and spicy non-onion variant 84.9%. Based on IPA, there were 5 attributes that needed improving: aroma, taste, texture, shelf life, and price.

1. Introduction
The vegetarian diet has increased rapidly every year. This is recorded from 4.3 million people in the Asia Pacific region, as many as 36% of consumers have implemented a low meat diet or a meatless diet. In 2020, consumer demand for plant-based meat products increased by 7.4% compared to the previous year [1]. The demand for plant-based meats is growing globally, with the global market estimated at USD 1.6 billion in 2019 and projected to reach USD 3.5 billion by 2026, resulting in an estimated annual growth rate of 12.0% [2]. Several companies in Europe and the United States currently produce plant-based meat, which has characteristics resembling the structure and taste of meat. Asian countries will also become a potential market in the near future due to the increasing interest in plant-based meat [3].

The high demand for plant-based food products can be an opportunity for business people to prepare and create alternative plant-based meat products. Taking advantage of these opportunities, a food company based in Bandung, West Java, Indonesia (afterwards called as PT. XYZ in this paper) develops plant-based products that can be consumed by both vegetarians and vegans. The ready-to-eat vegan (plant-based) jerky product is one of the alternative plant-based meat products being marketed by the company [4]. The company produces vegan jerky using plant-based meat products, then it is cut and
added with spices. The plant based-meat that has been cut is cooked with spices for 30 minutes and stored at room temperature for 24 hours, then dried in an oven at 150°C for 6 hours and soaked with spices for 30 minutes and stored at room temperature for 24 hours, then dried using an oven at 150°C for 6 hours. The spices added are galangal, onion, garlic, ginger, coriander, salt, pepper, palm sugar, tamarind, candlenut, chili [5].

Micro, Small and Medium Enterprises (MSMEs) in the food and beverage sector that have been registered in 2012 are 42 businesses or 40% of the total MSMEs. In 2015 it increased very rapidly (530%) to 266 MSMEs [6]. The increasing culinary and food business in Bandung, the products offered are also more numerous and varied. Consumers will be more critical in making purchasing decisions. Competition between companies in the food sector is becoming increasingly tight, so the business units involved must try to determine the best strategy in providing quality and service according to demand. For this reason, it is necessary to analyze consumer responses to vegan jerky products that have been circulating in the market in order to determine the level of consumer satisfaction with the products offered. This analysis was conducted to obtain an assessment from consumers to the company in order to improve product attributes that affect quality and consumer satisfaction [7].

2. Methods
2.1. Data Collection
The object of this research is the customer of the vegan jerky product PT. XYZ who has consumed the product. Determination of respondents based on simple random sampling technique, where each individual or member of the population has an equal and fair probability of being selected. Determination of the number of samples is determined so that the sample can be representative of the population and have accuracy and precision. Determination of the number of samples is calculated by the Slovin formula [8].

Analysis of consumer satisfaction on attributes of vegan jerky products uses the Customer Satisfaction Index (CSI) was processed with Microsoft Excel 2007. For the result of recommendations attribute improvement, Importance Performance Analysis (IPA) uses SPSS 16.0 software. The research questionnaire contains 10 attributes of vegan jerky, namely vegan jerky color, aroma, texture, taste, shelf life, vegan jerky shape & size, packaging appearance, packaging material/type, packaging practicality, and product price [9]. Respondents were asked to provide an assessment of the importance of attributes or consumer expectations and attribute performance. The scale used in this questionnaire is the Likert scale, for assessing the importance of attributes with 1 = very unimportant and 5 = very important, while product performance assessment with 1 = very dissatisfied and 5 = very satisfied [10].

2.2. Data Analysis
Respondents used in the validity and reliability test amounted to 30 people, while the analysis of consumer satisfaction used 124 respondents. The validity test in this study aims to test whether the questions in the questionnaire have measured the same aspects. The validity test was carried out by measuring the correlation between the variables/items (questions) with the total score of the variables and processed using SPSS 16.0. The questionnaire is declared valid if \( r_{\text{count}} > r_{\text{table}} \), if the questionnaire is not valid, the questionnaire will be redesigned by eliminating several invalid questions [11]. In the reliability test, the questionnaire declared reliable if the Cronbach’s alpha values \( \geq 0.700 \) which means that the answers of respondents to a statement remain consistent or stable over time. Data from reliability testing was processed using the SPSS 15.0 software program[12].

2.2.1. Customer Satisfacion Index (CSI). The CSI value states the level of consumer satisfaction with the product by comparing the level of importance of the product attributes. The results of the CSI calculation are in [13] the form of a percentage that shows customer satisfaction [9]. The first step in determining the CSI value is to calculate the Mean Importance Score (MIS) and Mean Satisfaction Score (MSS). Next, calculate the Weight Factor (WF) which is the percentage of the MIS per
indicator/attribute to the total MIS. Third, calculating the Weight Score (WS) which is the multiplication between WF per attribute and the average value of satisfaction level (MSS). CSI values obtained by using the following equation: 

\[ \text{CSI} = \left( \frac{\text{Total WS}}{\text{highest scale (5)}} \right) \times 100\% \] [10].

2.2.2. Importance Performance Analysis (IPA). The IPA value is obtained by using a series of product attributes or the average value of the importance and performance of each attribute [14]. The results of calculating the IPA value of each attribute will be positioned in the importance-performance matrix based on the average score [15]. An example of Importance-performance matrix shown in Figure 1.

![Importance-Performance Matrix](image)

**Figure 1.** Importance-Performance Matrix

2.2.3. Focused Group Disscussion (FGD). Focus Group Discussion is a data collection technique with a qualitative approach in a study. FGD were conducted with the aim of giving opinions about a certain discussion by a group of people to give their opinion about a certain discussion [16]. The FGD was held virtually with 8 discussion members who were Food Technology Bina Nusantara students. The discussion focused on the sensory quality of vegan jerky to obtain participants' perceptions of taste, aroma, texture, shape and size in the sample. There were 3 samples, namely the vegan jerky produced by PT. XYZ, competitor vegan jerky, and beef jerky.

3. Result and Discussions

In validity test using 30 initial respondents with a significance level of 5% and degrees of freedom (df = N-2, 30-2 = 28) has an R_{table} value of 0.36. From the calculation results, the ten attributes on the questionnaire can be declared valid because they have a calculated R value that is greater than the table R_{value} [11]. The results of the reliability test get a value of 0.88 shown in Table 1. This value is included in the high reliability category with a range of 0.70-0.90 then the attributes contained in the questionnaire are declared reliable and can be used in further data collection [17].

| No | Attributes     | R_{value} | Cronbach’s Alpha |
|----|----------------|-----------|-----------------|
| 1  | Vegan jerky colour | 0.82      | 0.86            |
| 2  | Aroma          | 0.61      | 0.88            |
| 3  | Texture        | 0.56      | 0.88            |
| 4  | Taste          | 0.54      | 0.88            |
| 5  | Shelf life     | 0.80      | 0.86            |
In this study, data processing using the CSI method was carried out on 4 variants of XYZ company's vegan jerky. The vegan jerky variants tested were the original onion, spicy onion, original non-onion, and spicy non-onion variant. The total respondents for the original onion variant = 32 respondents, the spicy onion variant = 32 respondents, the original non-onion variant = 30 respondents, and the non-onion spicy variant = 30 respondents. Attributes that have the highest average value of importance are attributes that are very influential on a product that consumers want to buy. Consumers will pay greater attention to the attributes they perceive to give them satisfaction [18].

### Table 2. Mean Importance Score and Mean Satisfaction Score of Vegan Jerky PT. XYZ

| No | Attributes                  | Mean Importance Score | Mean Satisfaction Score |
|----|-----------------------------|-----------------------|-------------------------|
|    |                             | P1       | P2       | P3       | P4       | P1       | P2       | P3       | P4       |
| 1  | Vegan jerky colour          | 3.91     | 4.22     | 4.43     | 4.33     | 4.34     | 4.31     | 4.10     | 4.17     |
| 2  | Aroma                       | 4.41     | 4.66     | 4.37     | 4.20     | 4.31     | 4.19     | 4.10     | 4.07     |
| 3  | Texture                     | 4.75     | 4.81     | 4.67     | 4.67     | 4.44     | 3.97     | 4.00     | 4.27     |
| 4  | Taste                       | 4.88     | 4.94     | 4.73     | 4.80     | 4.38     | 4.34     | 4.00     | 4.03     |
| 5  | Shelf life                  | 4.31     | 4.69     | 4.53     | 4.63     | 4.28     | 4.16     | 4.37     | 4.37     |
| 6  | Vegan jerky shape & size    | 3.91     | 4.19     | 4.23     | 4.23     | 4.19     | 4.25     | 3.93     | 4.37     |
| 7  | Packaging appearance        | 4.03     | 4.28     | 4.03     | 4.23     | 4.25     | 4.28     | 4.20     | 4.17     |
| 8  | Packaging material/type     | 4.22     | 4.44     | 4.53     | 4.33     | 4.34     | 4.50     | 4.27     | 4.33     |
| 9  | Packaging practicality      | 4.41     | 4.53     | 4.50     | 4.37     | 4.59     | 4.63     | 4.53     | 4.50     |
| 10 | Product price               | 4.38     | 4.56     | 4.53     | 4.47     | 4.25     | 4.06     | 3.93     | 4.23     |
|    | Average                     | 4.32     | 4.53     | 4.46     | 4.43     | 4.34     | 4.27     | 4.14     | 4.25     |

### Table 3. Weight Factor and Weigh Score of Vegan Jerky PT. XYZ

| No  | Attributes                  | Weight Factor (%) | Weight Score |
|-----|-----------------------------|-------------------|--------------|
|     |                             | P1       | P2       | P3       | P4       | P1       | P2       | P3       | P4       |
| 1   | Vegan jerky colour          | 9.0      | 9.3      | 9.9      | 9.8      | 0.39     | 0.40     | 0.41     | 0.41     |
| 2   | Aroma                       | 10.2     | 10.3     | 9.8      | 9.5      | 0.44     | 0.43     | 0.40     | 0.39     |
| 3   | Texture                     | 11.0     | 10.6     | 10.5     | 10.5     | 0.49     | 0.42     | 0.42     | 0.45     |
| 4   | Taste                       | 11.3     | 10.9     | 10.6     | 10.8     | 0.49     | 0.47     | 0.43     | 0.44     |
| 5   | Shelf life                  | 10.0     | 10.3     | 10.2     | 10.5     | 0.43     | 0.43     | 0.44     | 0.46     |
| 6   | Vegan jerky shape & size    | 9.0      | 9.2      | 9.5      | 9.6      | 0.38     | 0.39     | 0.37     | 0.42     |
| 7   | Packaging appearance        | 9.3      | 9.4      | 9.1      | 9.6      | 0.40     | 0.41     | 0.38     | 0.40     |
| 8   | Packaging material/type     | 9.8      | 9.8      | 10.2     | 9.8      | 0.42     | 0.44     | 0.43     | 0.42     |
| 9   | Packaging practicality      | 10.2     | 10.0     | 10.1     | 9.9      | 0.47     | 0.46     | 0.46     | 0.44     |
| 10  | Product price               | 10.1     | 10.1     | 10.2     | 10.1     | 0.43     | 0.41     | 0.40     | 0.43     |
|     | Average                     | 4.34     | 4.27     | 4.14     | 4.25     |

P1 in the table represents the original onion variant of vegan jerky, P2 is the spicy onion variant of vegan jerky, P3 is the non-onion original variant of vegan jerky, and P4 is the non-onion spicy variant of vegan jerky. CSI P1 = (4.34/5) X 100% = 86.82%. After the calculation, the CSI value for the original onion variant is 86.82%, the spicy onion variant is 85.32%, the non-onion original variant is 83.85%, etc.
and the non-onion spicy variant is 84.98%. Based on the results of the CSI, it shows that overall of the 10 attributes, vegan beef jerky has been included in the satisfactory category. This is in accordance with the criteria for the CSI value scale according to [10] that if the CSI value is in the range of 81% - 100%, it is included in the very satisfied category. However, the level of customer satisfaction needs to be increased again to close to 100% so that all attributes provide the highest satisfaction value for consumers.

Mapping of attributes of vegan jerky based on priority was done using a Cartesian diagram or importance-performance matrix [15]. The Cartesian diagram aims to find out in more detail of the vegan jerky product attributes that need to be improved and the attributes maintained by PT. XYZ. The Cartesian diagram is divided into 4 quadrants, namely quadrant A (concentrate here), B (maintain), C (low priority), and D (excessive). Before mapping the product attributes on the diagram, first determine the average value of X (performance) and Y (expectations) of each attribute [19].

![Figure 2. Importance-performance Matrix of Original Onion Variant Vegan Jerky PT. XYZ](image)

The attributes included in quadrant A in the original onion variant are aroma and price attributes. This indicates that the aroma and price attributes are considered important by consumers, but in reality their performance is not as expected. Quadrant A is an area that contains attributes that have a low level of satisfaction, so companies need to prioritize the attributes in this quadrant to immediately make improvements in order to increase customer satisfaction [15]. The aroma of jerky products is very distinctive with the aroma of spices used such as coriander, galangal, garlic, shallots, pepper, and brown sugar. The process of aroma formation occurs when the ingredients are mixed, until they become spices and dried beef jerky, the aroma will be more distinctive [20]. Attributes that should be maintained by the company are the attributes of taste, texture, and practicality of packaging. The attributes that have low priority are shape and size attributes, packaging appearance, and shelf life of vegan jerky. While the attributes included in quadrant D are the attributes of the material/type of packaging and the color of vegan jerky.
In the spicy onion variant, the attributes included in quadrant A and require improvement are aroma, texture, shelf life, and product price. Shelf life is the time span of a product from the production stage to before the product has decreased in quality/damaged and is unfit for consumption. In general, the decrease in quality/damage to the product can be seen from the sensory and nutritional parameters. During the shelf life, the product must contain the nutritional content as stated on the packaging, maintain the appearance, smell, texture, taste, function, and the product must be safe for consumption. The shelf life value is calculated from the time the product is produced/packaged [21]. In general, the shelf life of beef jerky on the market is 3-6 months, the shelf life of vegan jerky produced by PT. XYZ is 6 months. Quadrant B is an area that contains attributes that are considered important by consumers and these attributes are considered to be in accordance with consumer expectations [15]. The level of customer satisfaction is relatively higher in this quadrant, so the quality of the attributes needs to be maintained by the company [9]. Attributes that are included in quadrant B are taste and attributes included in quadrant C are vegan jerky shape and size. Meanwhile, the attributes included in quadrant D are vegan jerky color, packaging appearance, packaging materials/types and packaging practicality.

There are 3 attributes that included in quadrant A (concentrate here) namely taste, texture, and product price. Texture of food is related to the structure of the food that is felt in the mouth. Texture also affects the quality of the food product. A good beef jerky texture is semi-wet and not too dry so the texture is soft, there are no white and greenish spots on the surface [22]. The attributes of packaging
material/type, shelf life, and packaging practicality on the original non-onion variant have satisfied consumers with a good level of performance. Quadrant C is an area that contains attributes that are considered less important for consumers and product performance (product quality) is considered unsatisfactory. The attributes in this quadrant do not need to be prioritized and can be ignored by the company, but it’s possible that the attributes in quadrant C in the future can become attributes that are considered important by consumers, so companies can also consider this [9]. Attributes included in quadrant C are vegan jerky color, aroma, and vegan jerky shape & size. Meanwhile, the attributes included in quadrant D are packaging appearance.

![Figure 5. Importance-performance Matrix of Spicy Non-onion Variant Vegan Jerky Products](image)

In the spicy non-onion variant of vegan jerky products, there are attributes of taste and product price, these two attributes have not been able to meet consumer satisfaction. Taste is one of the most important aspects of a food product. Taste can also determine whether the food product is acceptable or not by consumers. The taste of food is influenced by several factors, namely chemical compounds, temperature, concentration and interactions with other flavor components. The taste of good jerky is sweet and savory with special spices [22]. Price is an amount of money that contains the uses needed to obtain a number of combinations of goods and services that are exchanged in order to obtain ownership rights. Price indicators/attributes can be expressed as financial sacrifices given by consumers to specifications in the form of product quality. The assessment of price indicators is seen from the compatibility between consumer sacrifices and the value of the product received after making a purchase, therefore consumers will start to make perceptions for the product or service to be expensive or not [23]. Texture and shelf life attributes are included in quadrant B. Attributes included in quadrant C are vegan jerky color, aroma, and packaging appearance. Meanwhile, vegan jerky shape & size, packaging materials/types, and packaging practicality attributes are included in quadrant D. The level of consumer expectations on the attributes in quadrant D has been exceeded, so the company can prioritize attributes whose performance level is still low. Improved performance on these attributes will only lead to a waste of resources [15].

The appearance of the packaging must be able to attract attention visually, emotionally and rationally. A good packaging design display will provide an added value to the product. The main key to a good packaging display is that the packaging looks simple, functional and can create a positive emotional response that indirectly says: "buy me" [24]. Attributes of packaging appearance on jerky products produced by PT. XYZ has exceeded consumer expectations, so there is no need for improvement.

There were 3 questions discussed in the FGD. Analysis of the question "Which attributes most influence the decision to buy jerky product?" From the results of the discussion, the taste and texture attributes of jerky products are the attributes that most influence purchasing decisions. Collecting data and information through FGD through the question "Describe the attributes of the three samples given?" summarized and presented in table 4.
Population growth and rising average income mean that global demand for livestock products will increase between 2010 and 2050. It is estimated that increasing population, urbanization, industrialization, education and increasing incomes will cause more demands for meat consumption in whole, like shredded. This is because the company cuts plant products, but not the shape and size. The shape and size of the company’s product we need. The results were poorer and less attractive than the competitor’s vegan jerky products.

Table 4. Focus Group Discussion Results of Vegan Jerky, Competitors Vegan Jerky, Beef Jerky

| No | Attributes       | PT. XYZ Vegan Jerky | Competitor Vegan Jerky | Beef Jerky                  |
|----|------------------|----------------------|-------------------------|-----------------------------|
| 1  | Vegan jerky colour | Pale brown          | Dark brown              | Dark brown and shiny         |
| 2  | Aroma            | Sugary/caramel       | The pungent smell of shitake mushrooms that smells like jengkol | Sugary/caramel and meat     |
| 3  | Texture          | Soft and fibrous     | Too soft and easy to chew | A little tough              |
| 4  | Taste            | Sweet and salty      | Not tasty and bland, dominant taste of shitake mushrooms | Savory, sweet and a little salty |
| 5  | Vegan jerky shape&size | Not uniform, too small, crushed | Uniform shape and right size | Thin sheets and the right size |

The third question in the Focus Group Discussion (FGD) is “Which sample is the most preferred if you pay attention to each attribute?” From the results of the discussion, all members have the same opinion about the preferred color of beef jerky, which is dark brown. The pale brown color of jerky products is considered less attractive, so the company needs to improve the color of the product to be darker. Companies can add palm sugar to get a dark brown color. The higher the level of addition of palm sugar, the color of the beef jerky will be darker due to the reaction between sugar and heat during frying. The reaction that occurs is a Maillard reaction in which the carbonyl group of reducing sugar reacts with the amino group of meat protein and amino acids non-enzymatically, and the reaction results in a dark brown color [25]. The FGD participants didn’t like the smell that was too strong as in competitor’s vegan jerky products. Meanwhile, the most preferred aroma by FGD participants was the aroma of beef jerky samples. Participants thought that PT. XYZ has a sugary/caramel aroma, but there is no distinctive smell of jerky. According to [25], the higher the level of adding palm sugar, the weaker the flavor of meat will be. Companies can add meat aroma essence to vegan jerky products if needed. The results of the discussion regarding the FGD participants' favorite taste attributes were samples of beef jerky because there was a delicious savory taste. Companies may revisit the seasoning formulation of the non-onion variant of vegan jerky products. [26] stated that the formulation of a good jerky seasoning was brown sugar (30%), galangal (2.5%), coriander (2%), onion (5%), garlic (1.5%), salt (2%), pepper (0.2%).

The FGD participants agreed that they preferred beef jerky with a texture that was not too soft. As for the shape and size attributes, discussion members preferred jerky with a uniform size and in the form of sheets. A good form of beef jerky according to [27] is slab-shaped. Participants liked the texture of the company’s products, but not the shape and size. The shape and size of the company's product were not uniform and too small, so there were some participants who received samples that were crushed (not whole, like shredded). This is because the company cuts plant-based meat manually using a knife and has not set a standard size. The recommendation from the author is to improve the process of cutting plant-based meat using automatic tools (not manual).
2030 by 72% [28,29]. Environmental pollution from animal protein production varies according to the type of animal and the livestock system used [30]. Meat production is also responsible for increasing Greenhouse Gas (GHG) emissions. The contribution of livestock to the three main greenhouse gas emissions, carbon dioxide, methane and nitrous oxide, is 9%, 39% and 65%, respectively [31]. As much as 40% of the total grain and soybean produced and 75% of the total soybean is used for animal feed. From the aspect of land about 70% of the total land available on earth, 30% is devoted to animal production. The rapid expansion of livestock production due to increased demand for meat has put more pressure on available natural resources and is considered a key factor in deforestation [32]. Reducing animal protein consumption will benefit biodiversity, land and water use, and climate [33]. One way to reduce animal protein consumption is to replace meat with plant-based alternatives.

4. Conclusion
In this study it can be concluded that the level of consumer satisfaction with the product of vegan jerky PT. XYZ is in the very satisfied category. Important attributes that affect the level of customer satisfaction are the attributes of beef jerky color, beef jerky aroma, beef jerky texture, beef jerky taste, shelf life, shape and size of beef jerky, packaging appearance, packaging material/type, practicality of packaging, and product prices considered by respondents based on validity tests and reliability.

Based on the attribute mapping on the Cartesian diagram, the attributes in quadrant A that require improvement in the original onion variant of vegan jerky are aroma and product prices. In the spicy onion variant, the attributes that need improvement are aroma, texture, shelf life, and price. In the original non-onion variant of vegan jerky, the attributes that need to be improved are taste, texture, and product price. In the non-onion spicy variant, the attributes that need to be improved are taste and product price attributes. The recommendation for the company is to improve the taste quality by reviewing the existing seasoning formulations. Improving the production process by using better cutting tools and reducing prices by reducing the quality of packaging whose performance is considered excessive by consumers.

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