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Sustainability of Packaged UHT Cow's Milk Products Using the Multidimensional Scaling (MDS) Method

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ABSTRACT

Product positioning is how a product is defined by consumers in terms of the attributes of competitors or the place where the product is distinguished in the minds of consumers compared to other products. This study aims to analyze the sustainability of packaged UHT cow's milk products in the market using the Multidimensional Scaling (MDS) non-metrik method. This research was conducted in Makassar City, South Sulawesi, specifically at shopping centers frequently visited by consumers, namely Lotte Mart and Satu Sama, from May to July 2024. The sampling technique used was accidental sampling, where anyone who happened to meet the researcher while purchasing UHT cow's milk and was deemed suitable as a data source was selected. The total number of respondents obtained during the study was 65. The analysis results show that Indomilk UHT and Frisian Flag UHT have superior positions in terms of storage temperature, packaging design, ease of use, and ease of storage, located in quadrant I. Meanwhile, Ultra Milk UHT and Diamond Milk UHT compete closely in terms of product innovation and discounts, located in quadrant III. These findings indicate that each brand has certain competitive advantages that can be leveraged for product development and more effective marketing strategies. To achieve product sustainability, the development of packaged UHT cow's milk products needs to focus on attributes valued by consumers, thus allowing for increased competitive advantage.

Keywords: *Multidimensional scaling, packaged cow's milk, product positioning, sustainability*

Introduction

Animal husbandry involves raising livestock to gain benefits, such as producing high-quality cow's milk in consistent quantities (Wawrzyniak, 2023). Dairy farming plays a crucial role in the food industry and the economy, as cow's milk is one of the most important and frequently consumed food products (Headey *et al*., 2024). In general, milk is considered a source of animal protein essential for human health and growth due to its high nutritional content. Almost all the components found in milk, including proteins, fats, carbohydrates, minerals, and vitamins, are necessary for humans. Milk is a food with complete and balanced natural nutrition, containing an ideal nutritional ratio that is essential for humans (Silva and Smetana, 2022). Some of the major components of dry milk include fats, carbohydrates, proteins, vitamins, and minerals. Fat is a significant component of milk, playing an important role due to its economic value, high nutritional content, and its impact on the milk's odor, taste, and other qualities.

Dairy products have unique characteristics that make them a highly nutritious food source and play an important role in meeting the nutritional needs of society. Physically, milk has a white to yellowish color, a liquid to semi-thick texture, and viscosity influenced by fat content and temperature. Chemically, milk is rich in protein, fat, lactose, as well as essential vitamins and minerals such as calcium and vitamin D (Wozniak *et al*., 2022). The characteristics of dairy products are determined by the perception of milk among Indonesian people. Drinking milk has various effects on the body, both positive and negative, depending on individual conditions and the amount consumed. Additionally, some people believe that drinking milk can lead to obesity, so they choose to avoid it. Consumer perception of a product is a key factor that influences purchasing decisions. This perception is shaped by aspects, including product quality and price (Dwijayanti and Mutmainnah, 2022). Consumer considerations when purchasing packaged cow's milk are not only based on brand or price but also on several key factors, such as taste, discounts, innovation, and storage temperature.

A delicious taste that matches consumer preferences can increase brand loyalty. More affordable prices through promotions or discounts attract consumers. The use of technology, such as leak-proof packaging or freshness indicators, can enhance consumer trust in the product. Product packaging is a key factor in improving and developing products in the market, and consumers have expressed a willingness to pay a premium price for innovative milk packaging (Merlino *et al*., 2020). Similarly, UHT milk is more practical as it can be stored at room temperature before being opened. The product's durability at certain temperatures also influences purchasing decisions, especially for consumers who need flexibility in storage.

Consumer perception of a product with a specific brand can drive their choice to stick with that product, making it challenging to switch to another one (Yılmaz and Altunay, 2023a). Purchase interest is typically divided into two categories, i.e, the product itself or the brand, often viewed as a fully planned purchase (Alyahya *et al*., 2023). People from various social or environmental backgrounds will have differing opinions, evaluations, attitudes, needs, and preferences, which means that the stages of perception and purchase intent will be influenced by multiple factors (Wan *et al*., 2024). When consumers perceive service quality positively, such as friendly, polite, and efficient service, they tend to feel satisfied. Thus, consumer satisfaction is typically assessed after they have used the products or services (Prassida *et al*., 2024). Consequently, a perception of superior or positive service quality can lead to repeat purchases and foster emotional attachment to brands, along with rational preferences, ultimately resulting in high consumer loyalty (Isa *et al*., 2016). Product attributes will ultimately shape consumer attitudes, which can be either positive or negative (Banovic *et al*., 2022). These attitudes can significantly influence a person's purchasing decisions (Cabeza-Ramírez *et al*., 2022). Consumer trust is related to the belief that a product possesses valuable attributes (Pal *et al*., 2022).

Sustainability in the food industry has become a growing global concern, particularly as public awareness of the impact of consumed products increases (Khan *et al*., 2024). One crucial sector in this context is the packaged cow's milk industry, which encounters several sustainability-related challenges, including effects on consumer satisfaction (Costa *et al*., 2023). It is essential to assess the sustainability of packaged cow's milk products with a comprehensive approach, taking into account various attributes such as ease of use, price, taste, and brand. The Multidimensional Scaling (MDS) method provides an innovative approach to sustainability analysis by enabling the comparison of different attributes of dairy products. MDS is a statistical technique used to assess the distance or similarity between objects in a multidimensional space (Martínez *et al*., 2024). In the context of sustainability analysis, MDS can aid in visualizing and comparing various aspects of the sustainability of packaged cow's milk products more intuitively. By identifying and analyzing different attributes, MDS allows stakeholders to understand how various dairy products compare to one another in terms of sustainability.

This study focuses on the sustainability of packaged UHT cow's milk products, which have rarely been the primary subject of sustainability research. Most previous studies have primarily discussed sustainability in fresh milk production or the livestock industry in general. MDS is typically used in perception analysis or multivariate data mapping, but its application in assessing the sustainability of packaged UHT cow's milk products is a relatively new approach. The aim of this research is to apply the MDS method to analyze the sustainability of packaged UHT cow's milk products, focusing on attributes such as ease of use, price, taste, and brand, meanwhile, the results of this study are expected to contribute to the development of a sustainable dairy industry in Indonesia. By comparing various brands of packaged UHT cow's milk products, this research not only maps the sustainability position of each brand based on attributes such as ease of use, price, taste, and brand image, but also provides information that can be used by consumers to make purchasing decisions. For producers, the findings of this study serve as a foundation for evaluation and innovation to enhance the competitiveness of their products in the market.

Materials and Methods

Research location and data collection

This research was conducted in Makassar City, South Sulawesi, specifically at the Lotte Mart and Satu Sama shopping centers, from May to July 2024. The respondents in this study are consumers (housewives) who purchase UHT cow's milk. The sampling technique used is accidental sampling, where anyone who happens to meet the researcher while buying UHT cow's milk and is considered suitable as a data source will be selected as a respondent. UHT cow's milk was chosen as the object of study because it is a popular choice for many groups, including children, teenagers, and adults. The total number of respondents obtained during the study was 65 people. Although the number is relatively small, the sample was carefully selected using the accidental sampling technique in shopping centers frequently visited by consumers, such as Lotte Mart and Satu Sama. The respondents selected were housewives, who are the main decision-makers in purchasing milk products for their families. This makes the respondents a representation of various age groups within households, from children to adults. The decision to have a limited sample size is also reinforced by the fact that the variety of products offered in the market, such as various brands of UHT cow's milk and flavor variants that

appeal to different groups, provides a sufficient picture of consumer preferences. Thus, although the sample size is not large, the data obtained can be considered representative to illustrate consumer trends in choosing UHT cow's milk packaging based on sustainability and other product attributes.

The data were collected from the purchase of packaged UHT cow's milk brands, i.e, Indomilk, Frisian Flag, Ultra Milk, and Diamond Milk. These packaged milk brands are available in various packaging sizes, from small (single-serving) to large (family-sized). Additionally, many producers offer UHT cow's milk in various flavors (chocolate, strawberry, vanilla, etc.), making it more appealing to children and teenagers.

Research area

Quantitative descriptive approach of the research to obtain variables such as ease of use, price, taste, and brand. Variables such as ease of use, price, taste, and brand are chosen because they directly influence consumers' purchasing decisions. The type of relationship between the indicator and the variable is reflective (Table 1).

Table 1. Variables and indicators

Variable	Indicator
Ease of use	Product
	Ease of storage
	Ease of product
	Ease of packaging and design
Price	Price feasibility
	Product quality matches the price
	Availability of a discount or price reduction
Taste	Freshness
	Storage temperature
	Better taste than other milk products
Brand	Product innovation
	Certified and compliant with SNI standards
	Milk origin

The research instrument used in this study is a questionnaire to understand consumer perceptions of packaged cow's milk. The type of questionnaire employs a Likert Scale, which is used to facilitate respondents in answering the statements made by the researcher in the questionnaire. Respondents can choose a score that matches their opinion, whether they strongly agree or strongly disagree. The following table 2 is the 4 (four) rating categories used in the study with the Likert Scale:

Table 2. Category level of consumer perception of packaged UHT cow's milk products

Scale	Category
4	Strongly agree
3	Agree
2	Disagree
1	Strongly disagree

Data Analysis

The data has been analyzed using Multidimensional Scaling (MDS), a non-metric method used to map respondents' perceptions and preferences. The MDS method is a multivariate technique that can be used to determine the position of an object based on similarity assessments (Bibal *et al*., 2021). The MDS is related to creating a map to depict the position of one object relative to another based on the similarities of the objects under study, and is used to establish the interdependence or mutual dependence between variables or data. The purpose of MDS is to find a configuration such that the distances between points correspond to the dissimilarities between objects (Hare, 1999). In this research, the MDS analysis is used to determine the advantages of packaged cow's milk products based on the specified research attributes.

The steps of MDS analysis are as follows:

1. Formulating the problem
   In this case, mapping will be carried out to determine the position of four (4) packaged cow's milk products based on consumer perceptions in the city of Makassar.
2. Data preparation
   Inputting the data derived from consumer preferences. The data must be in the form of a distance matrix or similarity matrix, where each element of the matrix reflects the relationship between pairs of objects or variables to be analyzed. The distance or similarity measurement method used depends on the research context.
3. Selecting the procedure
   The type of procedure used is non-metric because the input data above uses ranking (ordinal) data. The nearest (smallest) object pairs are assumed to be the main competitors, and the farthest (largest) object pairs are assumed to be the most distant competitors.
4. Determining the number of dimensions
   There are several criteria or guidelines to obtain a suitable MDS model so that the results are valid and can be used for interpretation. The fit of MDS solution is typically assessed using the STRESS (Standardized Residual Sum of Squares) measure (Ramachandran and Tsokos, 2021). STRESS is used to measure how well the MDS mapping results represent

the relationships between data in a lower-dimensional space compared to the original dimensional space. A smaller STRESS value indicates a more accurate mapping result, while a larger value indicates higher discrepancies. STRESS is a measure of lack of fit; the higher the STRESS value, the less suitable the model. Therefore, it can be concluded that if the STRESS value is high, the data may not be appropriate for Multidimensional Scaling (MDS) analysis, using the formula:

$$\text{STRESS} = \sqrt{\frac{(d_{i\,j} - \hat{d}_{i\,j})^2}{(d_{i\,j} - \bar{d}_{i\,j})^2}}$$

$\bar{d}_{i\,j}$ = Average distance in the map

$\hat{d}_{i\,j}$ = Derived distance or similarity data

$d_{i\,j}$ = Distance data provided by respondents

For interpretation, the principle is that the lower the STRESS, the better the resulting MDS model. This involves assessing validity and reliability. For the stress formula, there are guidelines for identifying a good model based on the stress value using standard criteria. The standards used for determining the STRESS value are presented in Table 3. Therefore, the final step is to test the accuracy of the model by examining the STRESS value and the index of fit (R^2), as it can be considered acceptable if the index of fit (R^2) or RSQ > 60%.

Table 3. Category level of Goodness of Fit

Stress (%)	Goodness of Fit
>20	Poor
10-20	Good enough
5-10	Good
2,5-5	Very good
<2,5	Excellent

Results and Discussion

UHT (Ultra High Temperature) packaged cow's milk is one of the most widely consumed types of milk due to its practicality and longer shelf life compared to fresh milk. The popularity of UHT milk continues to rise because of its ease of storage and use, especially for families who need milk products with a longer shelf life. Additionally, UHT milk is available in various flavors, with added nutritional content, and in packaging sizes suitable for different consumer segments, from children to adults.

Housewives play a key role in determining household consumption products, including the purchase of UHT packaged cow's milk. Their purchasing decisions are influenced by various factors, both in terms of product quality and economic and family health considerations. Positioning analysis using the MDS is to determine the position of packaged UHT cow's milk products according to consumer perceptions by housewives. In the initial calculation, the average consumer perception obtained from each attribute is determined, and based on this, the STRESS and RSQ values for packaged cow's milk products are obtained, as shown in Table 4.

Table 4. Fit Model MDS

For Matrix	
Stress = 0,193	RSQ = 0,939

Based on MDS analysis, the STRESS value indicates a reasonably good goodness-of-fit criterion, demonstrating that the MDS analysis has appropriate reliability and validity in determining the best UHT cow's milk packaging. To ensure that UHT packaged cow's milk meets good criteria for consumers, a comprehensive strategy is needed, including product quality improvement and packaging innovation. Product quality can be enhanced by offering variants such as low-fat milk, lactose-free milk, or milk with added nutrients like calcium and probiotics. Innovation can be achieved through the development of attractive and functional packaging with an informative design, hygienic materials, and environmentally friendly features (Dekker *et al*., 2019). The same finding is stated in the study by (Rizqiansyah *et al*., 2023) which mentions that the proposed marketing strategy for comic-themed undershirts has a STRESS value of 0.15, indicating that it falls into the "good enough" criteria. The proposed marketing strategy for comic-themed undershirts falls into the "fairly good" category because it has advantages in several aspects. However, there are still some shortcomings that need improvement, such as implementation effectiveness, market competitiveness, or relevance to the target consumers. Meanwhile, the calculated RSQ value is more than 0.60, specifically 0.939 or 93.9%, which means the mapped data is acceptable. Furthermore, by using the MDS analysis, the coordinates of the points for the four packaged cow milk products and the coordinates of the points for the attributes or indicators used were obtained. This facilitates the interpretation of the results. Generally, the number of dimensions used is two, as shown in Table 5.

Table 5. Coordinates of packaged UHT cow's milk products

Products	Dimensions	
	1 (X)	2 (Y)
Ultra Milk UHT	0.0767	-0.7714
Diamond Milk UHT	0.7330	-1.6041
Indomilk UHT	-0.1508	0.8244
Frisian Flag UHT	-0.2157	0.6217

Table 6. Coordinates the attributes of packaged UHT cow's milk products

Atribute	Code	Dimensions	
		1 (X)	2 (Y)
Product	$X_{1.1}$	-1.9020	-0.1623
Ease of storage	$X_{1.2}$	-0.1321	1.1660
Ease of product	$X_{1.3}$	-0.2730	0.4391
Ease of packaging and design	$X_{1.4}$	-0.8045	0.1064
Price feasibility	$X_{2.1}$	2.4492	1.2734
Product quality matches the price	$X_{2.2}$	-0.5533	-0.7696
Availability of a discount or price reduction	$X_{2.3}$	3.1237	-0.9050
Freshness	$X_{3.1}$	0.3650	0.2366
Storage temperature	$X_{3.2}$	-0.6220	0.0465
Better taste than other milk products	$X_{3.3}$	0.0020	0.0520
Product innovation	$X_{4.1}$	0.4405	-0.2583
Certified and compliant with SNI standards	$X_{4.2}$	-1.2211	-0.1956
Milk origin	$X_{4.3}$	-1.3155	-0.0997

Based on the coordinates obtained from Tables 5 and 6, the position of each milk product can be visualized on a Spatial Map or Perceptual Mapping, as shown in Figures 1 and 2: The Figure 1 illustrates the position of packaged UHT cow's milk products along with their attributes in a certain dimension and the distance between the positions of these products based on consumer perception when selecting packaged cow milk. Each brand of packaged milk holds a distinct position in the perceptual map based on specific attributes of variable such as product, price, taste, and brand. The dimensions used in this mapping represent the most influential factors in consumer purchasing decisions. The distance between one product and another indicates the degree of similarity or difference in consumer perception. If two milk brands are positioned close to each other, it means consumers perceive them as having similar characteristics. Conversely, if their positions are far apart, it suggests that consumers view these products as significantly different. Therefore, this perceptual mapping provides insights into how packaged cow's milk is positioned in the market based on consumer perception, which can be utilized to develop more targeted marketing strategies.

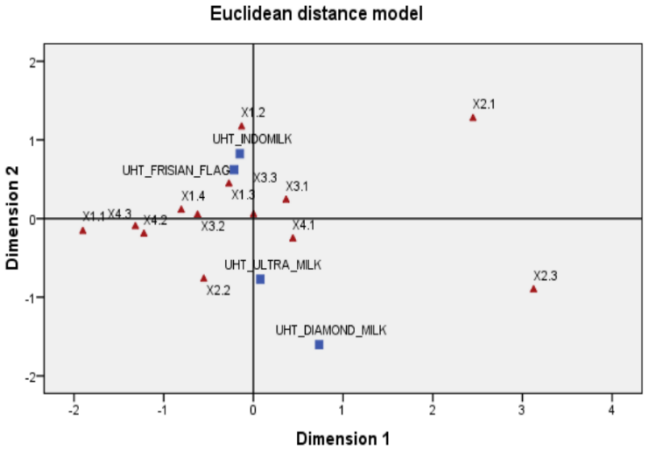

Figure 1. Results of the two-dimensional scaling of packaged cow's milk UHT products

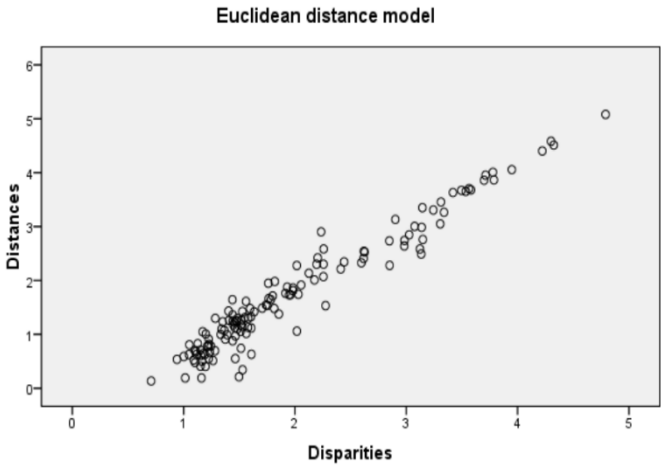

Figure 2. Two-dimensional map of respondent consistency

The results from the MDS analysis indicate that Ultra Milk UHT is similar to Diamond Milk UHT, as they are located close to each other and within the same quadrant, making Diamond Milk UHT the closest competitor to Ultra Milk UHT, and vice versa. This similarity is evident in their shared strengths, such as discounts and product innovation. Ultra Milk UHT and Diamond Milk UHT often offer discounts in supermarkets and e-commerce platforms such as Shopee, Tokopedia, and Indomaret, with promotions like "buy 2, get 1 free" or bundled discounts with other products. In terms of innovation, Ultra Milk UHT provides an On The Go (200ml) packaging, which is practical for active consumers, while Diamond Milk UHT offers economical 1L packaging, making it more suitable for families. Indomilk UHT also shows similarity to Frisian Flag UHT, as they are close to each other and within the same quadrant, making Indomilk UHT the closest competitor to Frisian Flag UHT, and vice versa. This is marked by the proximity of points that symbolize the similarities and strengths of the attributes possessed by both products.

From Figure 2, it can be seen that the Euclidean distance is used as a measure of dissimilarity, meaning that the larger the Euclidean distance between two objects, the greater their dissimilarity or the less similar the objects are Winsberg and Carroll, 1989). The figure above represents a collection of coordinates from 65 respondents. It can be seen that the coordinate points form a cluster with close distances, indicating a grouping. The cluster of plots (points) in the image demonstrates that respondents have similar attitudes in choosing packaged cow's milk products based on the attributes in this study. Meanwhile, some other points indicate dissimilarity among respondents in perceiving packaged cow's milk products. The shape of the plots in this image is spread out and slightly clustered, illustrating that some respondents have different perceptions.

The results have shown that the positions of the four packaged cow's milk products are shown according to consumer perceptions, namely ease of use, price, taste, and brand (Figure 1). The graph is presented in the form of a two-dimensional image (X-axis and Y-axis), and the graph is divided into four quadrants as follows:

- Quadrant I (top left) consists of Indomilk UHT and Frisian Flag UHT. The results of the analysis indicate that these two milk products compete on indicators such as ease of storage, ease of use, packaging, design convenience, and storage temperature. Indomilk UHT and Frisian Flag UHT do not compete in terms of product availability, SNI certification, and milk origin because both already have a wide distribution network, meet the same standards, and use raw material sources that are not significantly different. Therefore, competition is more focused on other aspects such as packaging, ease of use, and marketing strategy. This is in line with the opinion of (Akin, 2024), who stated that this encourages companies to implement various marketing strategies to enhance their competitiveness. One area of competition in the food business is packaged liquid milk products, which include various brands with different characteristics to attract consumers. This competition is influenced by several key factors, such as price, product innovation, marketing strategies, distribution, and consumer preferences regarding health benefits and ease of consumption. These products are highly favored because their packaging is easy to carry anywhere, and they are healthy for consumption. The intense competition in the packaged liquid milk product market presents a unique challenge for companies.
- Quadrant II (top right), the results of the analysis indicate that there are no products competing or having similarities in the attributes of price fairness, freshness, and better taste compared to other milk products. Consumers tend to switch to cheaper products when they are presented with options at lower prices for products of perceived similar quality. This behavior indicates that price plays a crucial role in market competition dynamics, where a price reduction by one

producer can influence consumer purchasing decisions and drive brand switching. Thus, price is not only a determining factor in consumer preferences but also serves as a competitive strategy for producers to attract and retain customers amid industry competition. This is in line with (Arlt *et al*., 2024) opinion, which states that in terms of price attributes, price-sensitive consumers tend to switch to products that are cheaper.

- Quadrant III (bottom right) consists of Ultra Milk UHT and Diamond Milk UHT. The results of the MDS analysis indicate that these two milk products compete on the attributes of discounts or price reductions and product innovation. According to Chaeruddin and Syafaruddin (2021), in addition to product quality, product price also affects consumers. Consumer perception of whether milk is expensive or cheap is relative; therefore, companies must continuously monitor competitors' prices to ensure that their prices are not significantly higher than those of competitors. Producers must also continuously innovate their milk products to create clear differences from similar products, aiming to attract consumer interest and analyze consumer attitudes toward milk that offers discounts or price reductions.
- Quadrant IV (bottom left), the analysis results indicate that there are no competing products or having similarities in product availability, quality relative to price, certification, compliance with SNI standards, and milk origin. This is because all respondents consider these attributes before consuming milk products, resulting in no competition or similarity in attributes. This aligns with the opinion of (Domínguez Díaz *et al*., 2020), the labeling, health motivation, and consumers' attitudes towards functional food products could have an influence on consumers' purchase decisions. Unstable claims ensure a high level of consumer protection by allowing them to make better informed food choices.

Overall, the plot shows two groups with similarities but different from other groups. These two groups are:

- Group 1: Indomilk UHT and Frisian Flag UHT products with attributes of ease of storage, ease of use, packaging and design convenience, and storage temperature (at room temperature before opening, but must be refrigerated after opening.
- Group 2: Ultra Milk UHT and Diamond Milk UHT products with attributes of discounts or price reductions and product innovation.

In product positioning, efforts are needed to satisfy consumers and develop long-term relationships by strengthening brand positioning. One tool for strengthening brand positioning is perceptual mapping. Positioning is a form of communication strategy to enter the consumer's mind (Yılmaz and Altunay, 2023b), so that the offered product and brand convey a certain meaning (Sohn, 2022), which in various aspects reflects superiority over the product or brand in associative relationships (Manjunath *et al*., 2024). Thus, positioning is related to how producers position their products or brands among competitors (Rua & Santos, 2022) and how they position their products with the brand in the minds of consumers or customers (Alzate *et al*., 2022).

The perceptual mapping in this study indicates that consumers choose packaged cow's milk products according to the product positioning. This shows that no milk product is superior because each milk product has similarities with another milk product. This is evident in Figure 1, which shows that Indomilk UHT and Frisian Flag UHT have significant competition as they are located in the same quadrant, competing on the indicators of ease of storage, product use, storage temperature, packaging, and design. Similarly, Ultra Milk UHT and Diamond Milk UHT also compete on product innovation and discounts as they are located in the same quadrant, competing on the indicators of discounts, price reductions, and product innovation.

Conclusion

Indomilk UHT and Frisian Flag UHT have the highest attribute scores regarding storage temperature, packaging, and design. The positions of Indomilk UHT and Frisian Flag UHT are in quadrant I with dimensions (-0.1508, 0.8244) and (-0.2157, 0.6217). The attributes that support the superiority of Indomilk UHT and Frisian Flag UHT are ease of use (-0.2730, 0.4391) and ease of storage (-0.1321, 1.1660). The superiority of Indomilk UHT and Frisian Flag UHT creates competition. Meanwhile, Ultra Milk UHT and Diamond Milk UHT compete in quadrant III, marked by their close positioning. Ultra Milk UHT is located at (0.0767, -0.7714), and Diamond Milk UHT is at (0.7330, -1.6041). This competition involves product innovation attributes and discounts. To ensure the sustainability of this packaged milk product, it is necessary to develop products focusing on attributes valued by consumers, enabling the creation or improvement of superior product.

Conflict of interest

No potential conflict of interest relevant to this article was reported. All authors have agreed with the contents of the manuscript.

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