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### **Evaluating sensory and brand tests through an aggregation method for election and a multi-attribute decision-making method**

### **Evaluación de pruebas sensoriales y de marca mediante un método de agregación para elección y un método de toma de decisiones multi-atributo**

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### **Resumen**

Dentro de mercados cada vez más competitivos, las empresas necesitan implementar estrategias para permanecer y, si es posible, crecer su participación de mercado. Sin embargo, en estos mercados, las empresas enfrentan situaciones complejas, principalmente por la cantidad de productos ofrecidos y la diversidad de estos. Una de las posibles estrategias que implementan las empresas para permanecer y crecer en los mercados es el diseño de nuevos productos (NPD). No obstante, NPD es una tarea de alto riesgo e incertidumbre. Estudios relacionados con NPD muestran que entre el 24 y el 55% de los nuevos productos fallan en el mercado. Las empresas del sector alimentario, que desarrollan nuevos productos, operan en mercados dinámicos y competitivos que incluyen las tendencias de la demanda y producción de alimentos agrícolas, y al mismo tiempo, las preferencias y deseos de los consumidores, canales de comercialización, vida de anaquel, entre otros. Así, este trabajo tiene como objetivo presentar una evaluación de pruebas sensoriales y de marca realizadas a seis suplementos de fibra comercializados a través de un método de agregación para elección y un método de toma de decisiones multiatributo, esto para ayudar en el proceso de diseño de un nuevo suplemento de fibra a base de berenjena. En las pruebas participaron 87 personas, de 19 a 45 años, como panelistas no entrenados. Cada panelista evaluó seis muestras codificadas de los suplementos de fibra utilizando seis atributos hedónicos. Posteriormente, evaluaron estos suplementos a través de tres atributos no hedónicos conociendo los nombres del suplemento. Para cada prueba, cada panelista hizo un ordenamiento global de los suplementos. Al final, se obtuvieron dos conjuntos de datos de 87 registros que se analizaron mediante estadística descriptiva, el conteo de Borda y el método UTASTAR. Utilizando los ordenamientos globales realizados por los panelistas, se obtuvo que la marca líder de los

suplementos de fibra en el mercado fue la más preferida. El atributo hedónico más importante fue el sabor y el no hedónico fue el contenido de fibra. Cinco de los 87 panelistas fueron inconsistentes con sus evaluaciones de suplementos de fibras comerciales en las valoraciones de los atributos y el ordenamiento global creado por ellos. Utilizar diferentes métodos para analizar pruebas sensoriales y de marca permite tener diferentes puntos de vista asociados a las preferencias de los consumidores. Usar el conteo de Borda permite considerar todas las posiciones en los ordenamientos de cada muestra porque es un método de agregación. Por otro lado, con UTASTAR es posible detectar inconsistencias en la evaluación de las muestras cuando los panelistas brindan un ordenamiento global de estas. Estos enfoques pueden respaldar los resultados obtenidos con métodos estadísticos clásicos, como ANDEVA y Análisis Conjunto. Por la orientación de este trabajo, la industria de alimentos es una de las áreas donde puede aplicarse el proceso aquí presentado, sin embargo, puede ser utilizado para cualquier empresa donde se diseñen y desarrollen nuevos productos.

**Palabras clave:** Análisis de marca, análisis sensorial, método de agregación, método multi-atributo.

### **Abstract**

Within increasingly competitive markets, companies need to implement strategies to remain and, if possible, increase their market share. However, companies face complex situations in these markets, mainly due to the number of products and their diversity. One of the possible strategies that companies implement to stay and grow in the markets is the design of new products (NPD). Nonetheless, NPD is high risk and uncertain endeavor. NPD-related studies show that 24-55% of new products fail on the market. Companies in the food sector that develop new products operate in dynamic and competitive markets, which include trends in demand and production of agricultural food, and at the same time the preferences and desires of consumers, marketing channels, shelf life, among others. Thus, this work aims to present an evaluation of sensory and brand tests carried out on six marketed fiber supplements through an aggregation method for election and a multi-attribute decision-making method in order to aid in the design process of a new fiber supplement based on eggplant. In such tests, 87 people aged 19-45 participated as untrained panelists. Each panelist evaluated six coded samples of the fiber supplements using six hedonic attributes. Subsequently, they evaluated these supplements through three non-hedonic attributes knowing the names of the supplements. For each test, each panelist ranked the supplements globally. In the end, two data sets of 87 records were obtained, which were analyzed using descriptive statistics, the Borda count, and the UTASTAR method. Using the panelists' global rankings, the leading brand of fiber supplements on the market was the most preferred. The most important hedonic attribute was taste, and the non-hedonic attribute was fiber content. Five of the 87 panelists were inconsistent with their evaluations of the commercial fiber supplements in the attribute evaluations and the global ranking. Using different methods to analyze sensory and brand tests allows different points of view associated with consumer preferences. Using the Borda count allows considering all the positions in each sample's rankings since it is an aggregation method. On the other hand, with UTASTAR, it is possible to detect inconsistencies in evaluating the samples when panelists provide a global ordering. These approaches can support the results obtained with classical statistical methods, such as ANOVA and Conjoin Analysis. Due to this work's orientation, the food industry is one area where this article's process can be applied. However, it can be used for any company where new products are designed and developed.

**Keywords:** Aggregation method, brand analysis, multi-attribute method, sensory analysis.

## I. Introduction

Inside an increasingly competitive market, companies need to implement strategies to survive in a highly competitive global market and increase their market share to maximize their profit (Dekimpe & Hanssens, 2018; Radović-Marković, Salamzadeh, & Vujičić, 2019). However, in these markets, companies face complex situations due to globalization. New technologies have become a crucial business factor and a significant competitive advantage, mainly to the number of products offered and their diversity in the market. Companies implement possible strategies to remain and grow, including new marketing approaches, supply chain optimization, new product design, and new strategic alliances and fusions with other companies (Abedrabbo Ode & Cornuel, 2020).

One of the strategies to operate successfully in this external uncertainty climate is the design of new products (NPD). In order to do so, they need to be innovative and more competitive when designing these new products, including the needs and preferences of consumers. Unfortunately, new product design is of high risk and uncertain task. Studies related to NPD show that 24-55% of the products fail in the market (Adams, 2004; Barczak, Griffin, & Kahn, 2009; Cooper & Kleinschmidt, 1993). It coincides with the results of Victory et al. (2021), where 25% of new stock-keeping units (SKUs) of consumer-packaged goods, introduced between 2002 and 2009 in the USA, failed in the first year, and around 40% in the second one. Therefore, the decision process related to the NPD is complex.

It is a diverse one, and it's present in all NPD-related sectors. But this complexity is almost different in the food sector, where companies operate in competitive and dynamic markets. It is even if demand and production trends are increasing worldwide and entering a new era

of scarcity of resources and more significant volatility risks. In Mexico, for instance, it is estimated that 35% of food is lost or wasted (CEC, 2019) and mainly occurs in the upstream stage's food supply chain. Pre-harvest activities are susceptible to the events in both production and consumption stages and vice versa. CEC (2017) noted that it is necessary to explore and instrument food loss and waste initiatives into the industrial, commercial, and institutional sector operations.

For these and other reasons, some farmers are trying to add value to their products, i.e., venturing into the design of new products. But sometimes, farmers do it empirically without a methodology focused on a purpose. It is the case of the horticultural sector in Sinaloa, Mexico, which faces the challenges mentioned above related to competitive and dynamic markets. Sinaloa producers simply lack diversification and NPD culture based on knowledge to generate a high value-added economy. Hence, this economy is at a low level. Sinaloa is in the Northwest of Mexico and is one of the national leaders in agri-food production. It is estimated in Sinaloa that only 15% of 11 million tons of agri-food products obtain added value through the agri-industry. Also, only around 30% of Sinaloa's horticultural farms add value to their fresh products in the packaging presentation. Due to a greater extent, most Sinaloa producers are not professionals in NPD's field and are using empirical methods that had been passed down for generations, thus resulting in limited knowledge and little or no industrialization. It has occurred with some Eggplant's producers in Sinaloa.

Eggplant (*Solanum melongena* L.), also known as aubergine, brinjal, or Guinea, is an agronomically and economically important non-tuberous species of the nightshade Solanaceae family. Eggplant has been cultivated for centuries in Asia, Africa,

Europe, and the Near East (Weese & Bohs, 2010). It is a vegetable consumed for its low calories and 33 nutrients. It comprises 92.3% water, 3% total dietary fiber, 0.98% protein, 25 kcal of energy, and vitamins and minerals: B-6, B12, K, calcium, potassium, magnesium, and phosphorus (USDA, 2018). There are different varieties of eggplant such as purple, white, and mixed colors with shapes ranging from oval to elongated. The choice of variety to produce depends on diverse factors like availability, price, climatic conditions, time of planting, insect or disease resistance/tolerance, market requirements, etc. Eggplant can be grown in a wide altitude range: from the sub-tropical plains to the temperate (mountain) climatic conditions. The variety and sowing dates should be selected to fit the climatic conditions. Eggplant requires warm climatic conditions over a 6-month growing period to give a good crop of good-quality fruit. The optimum average monthly temperature range is 21° to 30°C, with a maximum of 35°C and a minimum of 18°C (Alam et al., 2003; Ellis & Amraibure, 2020).

According to the Food and Agriculture Organization of the United Nations, around 50 million tons of cultivated eggplant are produced on more than 1,800,000 ha worldwide. China and India are the world's largest eggplant producers (28 and 13mt per year, respectively). It is commonly sold in American, European, and Australian markets (FAOSTAT, 2014, 2015). In this context, Mexico was the 12<sup>th</sup> global producer of eggplant in 2020 (SIAP, 2020) and the third global exporter of it in 2019, behind China and Netherlands (ITC, 2021). In Mexico, eggplant is produced mainly in Sinaloa state with 93.4%, Nayarit with 2.1%, San Luis Potosi with 1.6%, and another five states (SIAP, 2020). It is known 100g of eggplant consist of 92.3% water, 3% total dietary fiber, 0.98% protein, 25 kcal of energy, and around 30 nutrients such as vitamins and minerals: B-

6, B12, K, calcium, potassium, magnesium, and phosphorus USDA (2019). This vegetable does not mature after being cut from a plant and interrupts its maturity process in an irreversible form. Eggplant has a short shelf life even if it is cut in a non-maturity stage; thus, it needs to be harvested and packaged in the field to reduce damages by handling and exposition to high temperatures.

To design a new product based on eggplant, it is important to know consumers' preferences and needs to reduce its failure rate. As pointed out by Dijksterhuis (2016), the main problem of the high failure rate of new products is the non-understanding of consumer motivation and consumer choice. Thus behavioral science should be used more effectively to tackle this problem. Therefore, this work aims to present an evaluation of sensory and brand tests carried out on six marketed fiber supplements to design a new eggplant fiber supplement. Borda's count and the multi-attribute method UTASTAR (Siskos & Yannacopoulos, 1985) were used. The sensory and brand evaluations test was part of a proposed methodology for NPD where two market studies were carried out. This work was done on an important farm of Sinaloa, México, which produces and markets eggplant. It was founded in 2003; it has 30 permanent employees and around 400 temporary employees for cutting work and packaging vegetables. The farm has between 15% and 19% eggplant market share in the port of Nogales, Arizona. Owners of the company wish to increase market share and diversify their eggplant products, either fresh or processed. Additionally, they wish to open new domestic markets for processed eggplant.

## II. Materials and Methods

To address the exposed situation on the farm, a proposed approach for New Product Design was followed:

**Stage 1. Obtaining a list of possible products to be designed.** It included the analysis of the company's contexts, both internal as external, design and performing a market study of possible products that, in general, the company could design. The output of this stage was a list of possible products to be designed.

**Stage 2. Selecting the product to be designed.** Here, a decision-maker's elicitation concerning the product to be designed based on the obtained list on stage 1. The output was the selection of a product to be designed.

**Stage 3. Performing a market study of the selected product.** In this stage, another market study about products related to the selected product by the decision-maker was performed. The outputs of this stage, among others, were favorite flavors, potential additives (antioxidants, vitamins, minerals, etc.), price range that consumers would be willing to pay for a fiber supplement, type of packaging, net content, a list of the most prominent products related to the selected product on stage 2, a list of the most important attributes of these products, and a list of possible panelists for sensory and brand tests.

To obtain the most prominent products, the questionnaire included the following question: *From the list below, identify up to three dietary fiber supplements that are of your choice. Then sort these three products in your order of preference, assigning 1 to the most preferred, 2 to the next, and 3 to the least preferred. You can add a product in case it is not listed before proceeding to order.*

- \_\_\_ Active Fiber (Herbalife)
- \_\_\_ Fibra de oro
- \_\_\_ Fiber N plus (Omnilife)
- \_\_\_ Metamucil

- \_\_\_ Piñalinaza
- \_\_\_ Xotzil

Likewise, to obtain the list of the most important attributes of these products, the questionnaire included the following question related to the most preferred fiber supplement:

*What is the main reason you consume that fiber? Distribute 100 points among the different attributes you consider when choosing to buy and/or consume a fiber supplement. Assign a higher number of points to the product attribute that is the most important in choosing the dietary supplement you consume. If any attribute is not relevant to you, give it 0 points.*

- \_\_\_ Fiber content (percentage of fiber provided)
- \_\_\_ Presentation (powder, granulated, liquid).
- \_\_\_ Solubility (easy to dissolve in water, liquefied juice, etc.).
- \_\_\_ Feeling on the palate (slimy, sticky, watery).
- \_\_\_ Rapidity of the effect (the consumption of the product achieves the result you expect).
- \_\_\_ Taste
- \_\_\_ Odor
- \_\_\_ Aftertaste (residual taste that remains at the end of taking the fiber).
- \_\_\_ Color
- \_\_\_ Price

**Stage 4. Designing and performing sensory and brand tests.** It includes designing and applying sensory and brand evaluation tests about the most preferred products in the market. They were designed and performed to know the most preferred consumer attributes of the six most demanded commercial fiber food supplements in Sinaloa, Mexico, from different plant origins and content. The type of sensory evaluation was sensory affective (hedonic).

Each panelist evaluated six coded samples of fiber food supplements using six hedonic attributes: color, odor, solubility, taste, palate sensation, and aftertaste. The attributes were valued with different ordinal scales. When the panelists valued each fiber supplement, first, they used the color and odor attributes. They put water into the fiber's recipient to soluble it and mark a value in the solubility attribute. Subsequently, the panelists valued the fiber

supplement with the rest of the attributes. In the end, each panelist provided a global ranking of the supplements. The materials and supplies per panelist included six coded recipients with 3g of fiber, one piece of white bread, six disposable spoons, three disposable napkins, one disposable cup with natural water, one empty disposable cup, one evaluation sheet and one pencil. Table 1 shows part of the sensory evaluation sheet provided to each panelist.

**Table 1.** Partial sensory evaluation sheet provided to the panelist.

Preference order	Code	Color	Odor	Solubility	Taste	Palate's sensation	Aftertaste
	<b>517</b>	I like very much I like it I neither like not dislike I don't not like I do not like it all	I like it a lot I like it I neither like not dislike I do not like it at all I like it a lot	Dissolves very easily Dissolves easily Effortless soluble Hard to dissolve Very hard to dissolve	I like very much I like it I neither like not dislike I don't not like I do not like it all	Very unpleasant Unpleasant Indifferent Pleasant Very pleasant	Very intense Intense Indifferent Light Very light
	<b>963</b>	I like very much I like it I neither like not dislike I don't not like I do not like it all	I like it a lot I like it I do not like it at all I like it a lot	Dissolves very easily Dissolves easily Effortless soluble Hard to dissolve Very hard to dissolve	I like very much I like it I neither like not dislike I don't not like I do not like it all	Very unpleasant Unpleasant Indifferent Pleasant Very pleasant	Very intense Intense Indifferent Light Very light

Source: Own elaboration.

On the other hand, an experimental brand test was carried out with the same panelists to obtain the preferences regarding the non-sensory attributes of fiber food supplements. They evaluated these supplements through three non-hedonic attributes knowing the supplement's names through a set the attributes. In this test, the panelists had full information about the fiber's brands instead of the sensory evaluation, where the panelists were not aware of the brands they were

evaluating. To assess the supplements, panelists used ordinal scales. In the end, each panelist provided a global ranking of the supplements. For this test, per panelist, the materials and supplies included one booklet with photos and fiber features, one evaluation sheet, and one pencil. The outputs were two datasets with the evaluations of both tests. Table 2 shows part of the brand's evaluation sheet provided to each panelist.

**Table 2.** Partial brand evaluation sheet was provided to the panelist.

Order of preference	Brand	Fiber Content	Price	Presentation
	Fibra de oro	Almost does not have Low Adequate Hight Very high	Very accessible Accessible More or less accessible Expensive Very expensive	Very inconvenient Undesirable Appropriate Pretty convenient Very convenient
	Active Fiber	Almost does not have Low Adequate Hight Very high	Very accessible Accessible More or less accessible Expensive Very expensive	Very inconvenient Undesirable Appropriate Pretty convenient Very convenient

Source: Own elaboration.

**Stage 5. Analyzing the results of sensory and brand tests.** In this stage, the obtained records were analyzed using Borda's count, the UTASTAR method, descriptive statistics, and Conjoin Analysis. Recently, Borda's count was used to analyze the choice of a suitable location for the centralized renewable hydrogen production (Mostafaeipour & Jooyandeh, 2017). Here, Borda's count was used to obtain two global rankings of the supplements, one for each test. In Borda's count, the positions obtained by each supplement in the rankings provided via the panelists were used to generate such a global ranking. This method computes the times a product was found in each panelist's ranking and multiplies these times by a linear weight associated with each ranking position. Table 3 shows a Borda's count instance of 3 products valued by 50 panelists, where Product 3 is the winner  $Borda(\text{Product3}) = 10 \times 3 + 35 \times 2 + 5 \times 1 = 105$ .

**Table 3.** Borda's count of 3 products valued by 50 panelists.

Position in the ranking	Position weight	Product 1	Product 2	Product 3
1	3	15	10	10
2	2	20	25	35
3	1	15	15	5
<b>Sum</b>		<b>100</b>	<b>95</b>	<b>105</b>

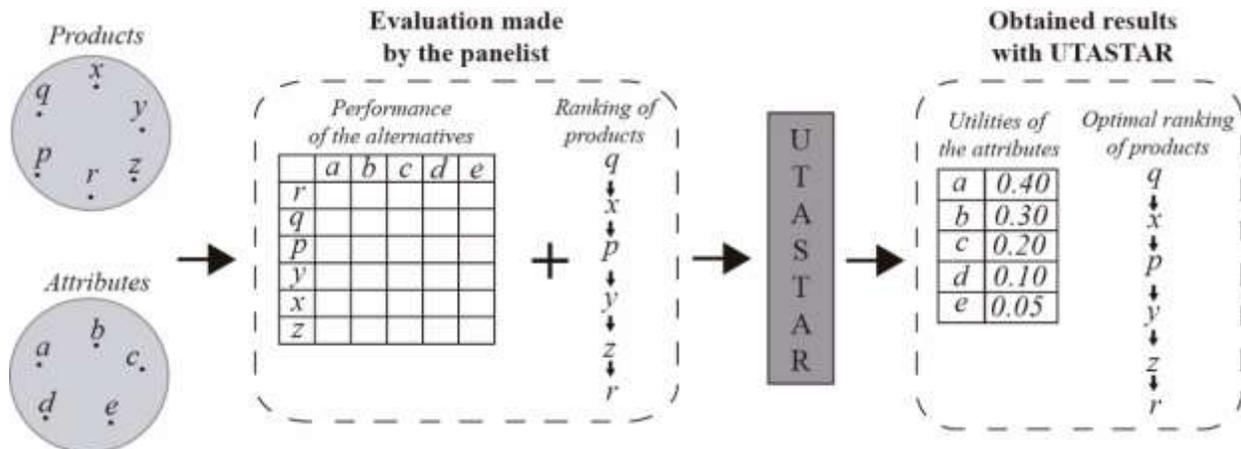
Source: Own elaboration.

Moreover, Borda's count was used to obtain global rankings of the attributes of the sensory and brand evaluation tests. Microsoft Excel 365 Pro Plus was used to implement this counting.

On the other hand, UTASTAR is an ordinal regression method for building additive value functions. Given a set of products and attributes, a consumer values the products using these attributes and ranks the products. It allowed determining the order of the product's attributes for each consumer, in which a utility function is estimated for each consumer distinctly. This utility function is as consistent as possible with a ranking of products provided by the consumer. Based on the relative importance of the attributes, the

utility model is derived, which is called preference disaggregation analysis. Recently, UTASTAR was used to perform a study to identify the key criteria of sustainable development and select the optimal project for current and future projects (Ghannadpour & Moradimanesh, 2020).

Thus, for each panelist of the sensory test, UTASTAR was used to obtain the importance of each attribute used to evaluate the set of samples of fiber supplements and an optimal ranking of such supplements. Figure 1 shows the procedure of UTASTAR to obtain the utilities of the attributes and the optimal ranking of products.



**Figure 1.** The procedure of the UTASTAR method. Source: Own elaboration.

UTASTAR is implemented in Diviz software (Bigaret & Meyer, 2015). It is used to design, execute, and share complex MCDA algorithms and experiments by implementing different Multicriteria Decision Analysis methods. Diviz is a three-part software application consisting of a client program, an XMCDAs web service component, and a server. In order to use it, the user downloads the client software. The client connects to the server, which distributes the calculations to dedicated web services expressly, and finally, results are sent to the client program.

Since datasets from the sensory and brand evaluations were initially captured in Microsoft Excel, they were transformed into the XMCDAs format (XML-Multi-Criteria Decision Analysis) used by Diviz software. Subsequently, a workflow was designed in Diviz software, adding components necessary to use the UTASTAR. Figure 2 shows the workflow used to obtain the value functions of each food supplement. Once the workflow was defined, it was processed on the remote Decision Desk server. See (Bigaret & Meyer, 2015), know how to use Diviz software.

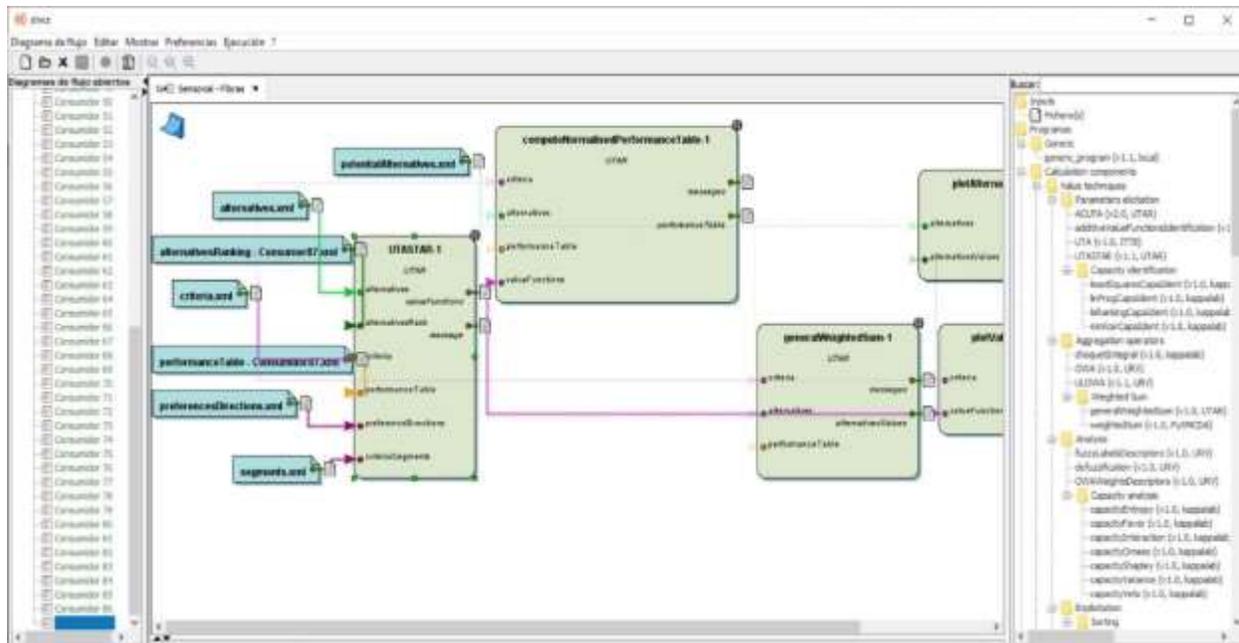


Figure 2. The Workflow of UTASTAR in Diviz software. Source: Own elaboration.

Also, statistics analysis was included to describe which included counting, averages, and Conjoint Analysis. The statistical analysis software programs included Microsoft Excel 365 Pro Plus and IBM SPSS Statistics 22.

**Stage 6. Defining the profile of the new product.** In this stage, a new product's characterization was obtained. It was based on the results of market studies, sensory and brand tests, the decision-maker's preferences, and its elicitation about the possible new product.

### III. Results and Discussion

The results and discussion of this work are presented below:

**Stage 1. Obtaining a list of possible products to be designed.** After applying the first market study, a list of new possible products based on eggplant was obtained: dehydrated eggplant as a snack, eggplant marmalade, eggplant water as a diuretic, eggplant flour for bakery, eggplant food supplement, eggplant medallions for hamburgers, and eggplant tea. Likewise, the

market study allowed the decision-maker to have a broader vision about the new products that he could later design. It is important because individuals generate alternatives thinking and making a list of possible alternatives. However, due to the complex process of generating alternatives with no guidance, such lists tend to contain alternatives considered in similar past decisions, possibly modified to address the current situation (Keeney, 2012).

On the other hand, the new market study about fiber food supplements allowed to identify the participant's preferences of flavors, brands, presentation of the products, price, socioeconomic and academic levels, and fiber food supplements.

**Stage 2. Selecting the product to be designed.** From the list of possible products, the decision-maker selected the fiber food supplement. His decision was based on the farm's needs, the information obtained from the market studies, the characteristics and capacity of a pilot plant in the farm, and the fiber food supplement's production costs.

Literature reports that, traditionally, decision-makers tend to identify alternatives that easily come to mind; however, they leave out alternative solutions that are more likely to be successful and effective given the decision-maker's problem, objectives, interests, needs, and preferences (Keeney, 1992).. This process is outside the scope of the article.

**Stage 3. Performing a market study of the selected product.** From the market study, the following preferences related to fiber supplements were obtained: orange as the favorite flavor, antioxidants as additive, price range between \$151.00 and MXN 250.00, which consumers would be willing to pay for a fiber supplement, plastic packaging, and net content of 250 g.

Also, the following ranking was obtained considering the most preferred fiber supplements: Metamucil > Active Fiber > Piñalinaza > Fiber N Plus > Xotzil > Fibra de Oro, where > denotes strictly preferred. Likewise, from the most preferred attributes on these products, the following ranking was derived: Fiber Content > Price > Quick effect > Taste > Solubility > Presentation > palate's sensation > Aftertaste > Odor > Color.

Finally, from this study, the authors obtained a list of 87 responders who accepted untrained panelists for the sensory and brands

tests. They were potential and habitual consumers of the fiber food supplement.

**Stage 4. Designing and performing sensory and brand tests.** Two evaluation designs and sensory and brand evaluation tests were performed with information from the previous stage. The sensory evaluation test included the six fiber food supplements: Metamucil, Active Fiber, Piñalinaza, Fiber N Plus, Xotzil, and Fibra de Oro using the hedonic attributes Taste, Solubility, Palate's sensation, Aftertaste, Odor, and Color. The Quick effect attribute was not included in the design due to the impracticality of its evaluation.

The non-inclusion of labels, brands, or pictures of the supplements in the sensory evaluation test allowed us to minimize the cognitive biases of the panelists. For instance, in Parker et al. (2021), evaluations of vice foods with product-level organic labels were lower than vice foods with ingredient-level organic labels. Nevertheless, the brand evaluation test included the booklet with photos and fiber features, but these cognitive biases were not detected. On the other hand, this last test incorporated the main non-hedonic attributes obtained in the market study: Fiber Content, Price, and Presentation. Table 5 shows the information included in the booklet.

**Table 5.** Information included in the booklet for the brand evaluation test.

Supplement	Presentation (Net content)	Fiber content	Price (MXN)
Metamucil	425 g	40.66 g	\$ 297.00
Piñalinaza	470 g	25.74 g	\$ 55.00
Fiber N Plus	450 g	46.70 g	\$ 415.00
Active Fiber	210 g	71.43 g	\$ 450.00
Xotzil	620 g	28.64 g	\$ 154.00
Fibra de Oro	340 g	18.50 g	\$ 193.00

Source: Own elaboration.

The outputs of this stage were two datasets with 87 evaluations of the fiber supplements.

### Stage 5. Analyzing the results of sensory and brand tests.

#### 5.1 Sensory evaluation test

Using Borda's count on the set of rankings emitted by panelists in the sensory evaluation

test, the following global ranking was generated: Metamucil  $\succ$  Fiber N Plus  $\succ$  Active Fiber  $\succ$  Piñalinaza  $\succ$  Fibra de Oro  $\succ$  Xotzil, where  $\succ$  denotes strictly preferred. Table 4 shows the obtained results with Borda's count, which allowed to derive the ranking:

**Table 4.** Borda's count of rankings provided by panelists in the sensory evaluation.

Rank	Position's weights	Metamucil	Piñalinaza	Fibra de Oro	Xotzil	Fiber N	Active Fiber
1	6	36	5	4	6	25	11
2	5	18	14	11	6	21	21
3	4	14	15	13	10	13	23
4	3	7	23	25	11	9	11
5	2	5	17	22	24	9	12
6	1	7	13	12	30	10	9
<b>Sum</b>		<b>400</b>	<b>276</b>	<b>262</b>	<b>217</b>	<b>362</b>	<b>329</b>

Source: Own elaboration.

Similarly, the set of rankings generated by UTASTAR in the sensory evaluation test was used to generate a global ranking through Borda's count. From these results, the following global ranking was derived:

Metamucil  $\succ$  Fiber N Plus  $\succ$  Active Fiber  $\succ$  Piñalinaza.  $\succ$  Fibra de Oro  $\succ$  Xotzil. Table 5 shows the results generated with Borda's count.

**Table 5.** Borda's count of the optimal rankings generated by UTASTAR in the sensory evaluation,

Rank	Position's weights	Metamucil	Piñalinaza	Fibra de Oro	Xotzil	Fiber N	Active Fiber
1	6	40	5	4	4	26	16
2	5	23	20	17	10	18	12
3	4	9	16	12	8	19	22
4	3	7	25	25	14	7	18
5	2	5	13	20	24	9	12
6	1	3	8	9	27	8	7
<b>Sum</b>		<b>425</b>	<b>303</b>	<b>281</b>	<b>223</b>	<b>369</b>	<b>329</b>

Source: Own elaboration.

Because the evaluation sheet was designed for the UTASTAR method, the sensory attributes that evaluated fiber food supplements could not be used in a Conjoint Analysis. However, it was used with the 87 rankings of the evaluation sheets. The estimated utilities of each fiber food supplement were Metamucil = -1.061, Fiber

N Plus = -0.625, Active Fiber = -0.245, Piñalinaza = 0.364, Fibra de Oro = 0.525, Xotzil = 1.042, a Constant = 3.464. The utility values were in the range [-1,1], with -1 being more preferred and 1 less preferred. Thus, the following ranking can be derived: Metamucil  $\succ$  Fiber N Plus  $\succ$  Active Fiber  $\succ$  Piñalinaza  $\succ$  Fibra de Oro  $\succ$  Xotzil.

Considering the global rankings obtained with the Borda count, UTASTAR, and Conjoint Analysis methods, it is noted that they were equals, i.e., Metamucil  $\succ$  Fiber N Plus  $\succ$  Active Fiber  $\succ$  Piñalinaza  $\succ$  Fibra de Oro  $\succ$  Xotzil. It could indicate at least two interpretations: *a)* panelists' evaluations were consistent, and *b)* given a set of data without inconsistencies, these methods, used as in this study, lead to similar results. For authors of this work, an inconsistency is when: *i)* in the evaluation of two products A and B, product A has, in general, better performance in the attributes than product B, but in the ranking provided by the panelist, B is better than A;

*ii)* given three products A, B, and C, if  $A \succ B$  and  $B \succ C$ , in the ranking provided by the panelist  $C \succ A$ , where  $\succ$  denotes strictly preferred.

On the other hand, taking into account the global ranking obtained in the market study: Metamucil  $\succ$  Active Fiber  $\succ$  Piñalinaza  $\succ$  Fiber N Plus  $\succ$  Xotzil  $\succ$  Fibra de Oro, Metamucil is notable as the most preferred food supplement, and the rest had different positions. It is important to recall that panelists did not know the name of the fiber supplements. Table 5 shows a summary of the obtained results in the sensory evaluation.

**Table 5.** Summary of the global rankings obtained in the sensory evaluation with different methods and the market study.

Rank	Borda's count (panelists' rankings)	Borda's count (UTASTAR's rankings)	Conjoint analysis (panelists' rankings)	Market study
1	Metamucil	Metamucil	Metamucil	Metamucil
2	Fiber N Plus	Fiber N Plus	Fiber N Plus	Active Fiber
3	Active Fiber	Active Fiber	Active Fiber	Piñalinaza
4	Piñalinaza	Piñalinaza	Piñalinaza	Fiber N Plus
5	Fibra de oro	Fibra de oro	Fibra de oro	Xotzil
6	Xotzil	Xotzil	Xotzil	Fibra de oro

Source: Own elaboration.

The importance of the attributes used to evaluate the fiber food supplements was determined with UTASTAR. Here, for each panelist, the value functions of each attribute were obtained. Table 6 shows that, on average, the taste attribute had the highest

valuation within the set of attributes, which indicates that it is the attribute of greater importance. The following ranking was derived from the value functions' averages: taste  $\succ$  color  $\succ$  palate's sensation  $\succ$  odor  $\succ$  solubility  $\succ$  aftertaste.

**Table 6.** Descriptive statistics of the UTASTAR's value functions of each attribute.

Attribute	N	Mean	Standard Error of the Mean	Standard Deviation	Variance	Coefficient of variation
Color	87	0.1978	0.0209	0.1945	0.0378	98.34
Odor	87	0.1358	0.0183	0.1703	0.0290	125.42
Aftertaste	87	0.1241	0.0160	0.1492	0.0223	120.17
Taste	87	0.2327	0.0251	0.2340	0.0548	100.57
palate's sensation	87	0.1773	0.0251	0.2340	0.0548	132.00
Solubility	87	0.1323	0.0210	0.1961	0.0385	148.23

Source: Own elaboration.

Using Borda's count to generate a global order using the rankings obtained with UTASTAR, the following ranking was derived: taste  $\succ$  color  $\succ$  palate's sensation  $\succ$  odor  $\succ$  aftertaste  $\succ$  solubility. It differs from ranking generated with the value functions' averages in switching aftertaste and solubility attributes. Due to Borda's count using the number of times, a supplement was found on each ranking position, and it assumes linear weights of such positions. On the other hand, the average is a compensatory method, i.e.; it compensates for the bad performance of a given attribute with the good performance of such attribute in different evaluation sheets.

Moreover, if non-sensory attributes are removed from the obtained ranking in the market study, this is Fiber Content, Price, and Presentation; and assuming that the

transitivity property is maintained, the ranking of the sensory attributes was as follows: Taste  $\succ$  Solubility  $\succ$  palate's sensation  $\succ$  Aftertaste  $\succ$  Odor  $\succ$  Color. It matches only in the first and third positions with the rankings previously presented with UTASTAR: Taste and palate's sensation. However, the rest of the attributes changed their positions. The most extreme case was presented with the color attribute, wherein the rankings obtained from the UTASTAR were in the second position. In contrast, in the market research ranking, it was in the sixth and last position. This situation and the other differences in rankings could be because, during the sensory evaluation, the panelists perceived the attributes differently, compared to when they were only questioned in the market study. Table 7 shows a summary of the attribute's ranking.

**Table 7.** Summary of the attributes rankings obtained in the sensory evaluation with different methods and the market study.

Rank	Average (UTASTAR's value functions)	Borda's count (UTASTAR's rankings)	Market study
1	taste	taste	Taste
2	color	color	Solubility
3	palate's sensation	palate's sensation	palate's sensation
4	odor	odor	Aftertaste
5	solubility	aftertaste	Odor
6	aftertaste	solubility	Color

Source: Own elaboration.

## 5.2 Brand evaluation test

Using the 87 evaluations and rankings of the brands of fiber food products, UTASTAR was used to obtain rankings of the brands and the attributes' value functions. Table 8 shows, among others, the averages of the rankings of the brands obtained with UTASTAR, where the lower the average value, the higher preference, and the higher the average value,

the lower the preference. Nevertheless, Table 7 exhibits five missing evaluations. It is because the UTASTAR method could not obtain the ranking of these evaluations. The evaluations non-considered were from panelists 32, 36, 38, 45, and 71. This situation was due to inconsistencies between evaluating the attributes in each of the brands and their ranking.

**Table 8.** Descriptive statistics of brand rankings obtained with UTASTAR.

Brand	Total	N	Missing	Mean	Standard Error of the Mean	Standard Deviation	Variance	Coefficient of Variation
Active Fiber	87	82	5	2.963	0.170	1.543	2.381	52.07
Fiber N Plus	87	82	5	3.305	0.173	1.569	2.461	47.47
Fibra de Oro	87	82	5	4.366	0.149	1.347	1.815	30.86
Metamucil	87	82	5	2.720	0.146	1.327	1.76	48.78
Piñalinaza	87	82	5	2.549	0.175	1.580	2.498	62.01
Xotzil	87	82	5	3.146	0.158	1.433	2.052	45.53

Source: Own elaboration.

To illustrate these situations, let us analyze the inconsistencies of panelist 32 presented in Table 9. From that table, and for this example, only the three most preferred products in the ranking are considered: Fiber N Plus, Active Fiber, and Metamucil.

**Table 9.** An instance of a brand evaluation with inconsistencies of panelist 32.

Brand	Content (Max)	Price (Min)	Presentation (Max)	Ranking
Fiber N Plus	4	3	3	1
Active Fiber	5	4	3	2
Metamucil	4	2	3	3
Xotzil	3	1	3	4
Fibra de Oro	2	2	3	5
Piñalinaza	3	1	3	6

Source: Own elaboration.

Table 9 shows that Presentation is not an attribute that allows discrimination of the fiber food supplements. Therefore, this attribute is removed to use only the Content and Price attributes, as presented in Table 10.

**Table 9.** Top 3 of the most preferred products.

Brand	Content (Max)	Price (Min)	Ranking
Fiber N Plus	4	3	1
Active Fiber	5	4	2
Metamucil	4	2	3

Source: Own elaboration.

From Table 10, it can be deduced that panelist 32 was inconsistent with data assigned in the evaluation of each attribute and the ranking. Using a lexicographic ordering method and assuming that the Content attribute is the most important, the ranking should be Active Fiber  $\succ$  Metamucil  $\succ$  Fiber N Plus. However, this ranking does not match the ranking provided by panelist 32, Fiber N Plus  $\succ$  Active Fiber  $\succ$  Metamucil. On the other hand, if it is assumed that Price is the most important attribute, and using the same lexicographic ordering method, the ranking should be Metamucil  $\succ$  Fiber N Plus  $\succ$  Active Fiber, which does not match the ranking of the products provided by the panelist. Likewise, note that Metamucil and Fiber N Plus have the same Content attribute value, but Metamucil with better value in Price than Fiber N Plus; nevertheless, the panelist placed the latter in the first place and Metamucil in third.

Thus, Borda's count was used to obtain the global ranking from the 82 rankings provided by the panelists in the brand evaluation tests. The following ranking was derived from this: Metamucil  $\succ$  Piñalinaza  $\succ$  Fiber N Plus  $\succ$  Active Fiber  $\succ$  Xotzil  $\succ$  Fibra de Oro, where  $\succ$  denotes strictly preferred. If 87 panelists had been considered, the ranking would have been the same. Table 11 shows the Borda count for the 82 rankings provided by the panelists.

**Table 11.** Borda's count of rankings provided by 82 panelists in the brand evaluation tests.

Rank	Position's weights	Metamucil	Piñalinaza	Fibra de Oro	Xotzil	Fiber N	Active Fiber
1	6	28	19	2	7	8	17
2	5	27	13	3	15	18	9
3	4	16	11	12	12	17	14
4	3	7	14	17	17	12	14
5	2	3	11	18	20	18	11
6	1	1	14	30	11	9	17
<b>Sum</b>		<b>395</b>	<b>301</b>	<b>192</b>	<b>267</b>	<b>287</b>	<b>284</b>

Source: Own elaboration.

As before, the Conjoint Analysis made with the brand evaluation test was only with rankings provided by the 82 panelists. The estimated utilities of each fiber food supplement were Metamucil = 0.039, Fiber N Plus = -0.124, Active Fiber = 0.035, Piñalinaza = 0.380, Fibra de Oro = -0.352, Xotzil = 0.022. The utility values were in the range [-1,1], with 1 being more preferred and -1 less preferred. Thus, the following ranking

can be derived: Piñalinaza  $\succ$  Metamucil  $\succ$  Active Fiber  $\succ$  Xotzil  $\succ$  Fiber N Plus  $\succ$  Fibra de Oro. The following ranking would have been considered if 87 panelists had been considered: Metamucil  $\succ$  Piñalinaza  $\succ$  Fiber N Plus  $\succ$  Active Fiber  $\succ$  Xotzil  $\succ$  Fibra de Oro. Table 12 shows a summary of the obtained rankings in the brand evaluation with 87 and 82 panelists.

**Table 12.** Summary of the rankings obtained in the brand evaluation with different methods.

Rank	Borda's count (Rankings' panelists)*	Conjoint analysis (Rankings' panelists)*	Borda's count (Rankings' panelists)**	Conjoint analysis (Rankings' panelists)**	Average of value functions UTASTAR**	Borda's count of rankings UTASTAR**
1	Metamucil	Metamucil	Metamucil	Piñalinaza	Piñalinaza	Piñalinaza
2	Piñalinaza	Piñalinaza	Piñalinaza	Metamucil	Metamucil	Metamucil
3	Fiber N Plus	Fiber N Plus	Fiber N Plus	Active Fiber	Active Fiber	Active Fiber
4	Active Fiber	Active Fiber	Active Fiber	Xotzil	Xotzil	Xotzil
5	Xotzil	Xotzil	Xotzil	Fiber N Plus	Fiber N Plus	Fiber N Plus
6	Fibra de oro	Fibra de oro	Fibra de Oro	Fibra de Oro	Fibra de oro	Fibra de Oro

Notes:

\* Rankings including 87 panelists,

\*\* Rankings including 82 panelists.

Source: Own elaboration.

In Table 12, the Borda's count rankings and the Conjoint Analysis, using the rankings issued by the 87 panelists, were the same. These rankings also coincide with the one obtained with Borda's count, using the

rankings of 82 panelists. The latter is because the difference between the total values of each product was low, as presented in Table 13.

**Table 13.** Differences between the rankings obtained with Borda's count for rankings provided by 87 and 82 panelists.

Rank	Fiber supplement	Values of Borda's count (Rankings' panelists)*	Values of Borda's count (Rankings' panelists)**	Difference	Difference between ranks *	Difference between ranks **
1	Metamucil	419	395	24	*	*
2	Piñalinaza	314	301	13	105	94
3	Fiber N Plus	305	287	18	9	14
4	Active Fiber	300	284	16	5	3
5	Xotzil	289	267	22	11	17
6	Fibra de Oro	204	192	12	85	75

Notes:

\* Values of 87 panelists,

\*\* Values of 82 panelists.

Source: Own elaboration.

Again, in Table 12, the obtained rankings with Conjoint analysis, the Average of value functions UTASTAR, and Borda's count of UTASTAR for 82 panelists were the same. But when these rankings were compared with the rankings of 87 panelists, they were different. As said before, Borda's count only uses the positions of the supplements in the rankings; and Conjoint analysis, for instance, estimates the utilities assigned by panelists to the different attributes that make up the product. These utilities assigned to the relevant aspects of the product are obtained by decomposing the global assessments made by such panelists. Meanwhile, UTASTAR uses ordinal regressions for building additive value functions considering both the evaluations of the products through the attributes and the rankings issued by the panelists. Borda's results do not mean the Rank reversal Type II presence, which occurs when a non-optimal element is replaced by a worse one, and the best element changes its position in the ranking.

Consumer theory indicates that individuals act rationally and will always choose one good over another if the utility obtained with the first is greater than that obtained with the second. If the set of goods A is better because greater satisfaction is obtained than goods B. If the individual prefers the set of goods A over the set B and the latter is better than

goods C, then the consumer continues to choose the set of goods A (Méndez, 2011). However, when carrying out the trademark evaluation process, there were some inconsistencies when carrying out the evaluation and preference ranking of the brands, which shows that consumer behavior is not always rational. It is complex to know what the person prefers when not prioritizing her preferences. In this regard, the decision theory will consider that said person does not choose rationally by not complying with the assumption of transitivity.

Although it was not explicitly and systematically evaluated, based on the results obtained, the authors consider that the attitudes of the panelists were not affected by the images of the fiber supplements presented in the brochure for the evaluation of brands, i.e., the panelists they used the information to evaluate the brands. In this regard, Zhou, Zeng & Li (2021) observed that consumer attitudes were significantly affected by the interaction between the product category and the type of image. For example, they consider that an abstract image is more likely to motivate consumers to adopt a positive attitude than a specific image in hedonic products. In this study, Piñalinaza, Fibra de Oro, and Xotzil have concrete images on their packaging, and Metamucil, Fiber N Plus, and Active Fiber have abstract images.

On the other hand, a ranking of the attributes from the brand evaluation test was obtained using the average with the value functions of UTASTAR. In this case, only evaluations of the 82 panelists were considered. Statistics

information from the value functions is presented in Table 14. The ranking of the brand's attributes derived from such table was: Content  $\succ$  Price  $\succ$  Presentation.

**Table 14.** Statistical information of the attributes' value functions obtained with UTASTAR.

Attribute	N	Mean	Standard Error of the Mean	Standard Deviation	Variance	Coefficient of variation
Content	82	0.4282	0.0345	0.3123	0.0975	72.93
Price	82	0.3374	0.0302	0.2734	0.0748	81.04
Presentation	82	0.2227	0.0289	0.2615	0.0684	117.39

Source: Own elaboration.

Similarly, Borda's count was used to obtain the global ranking of the brand attributes. This ranking was equal to the derived with mean of Table 14: Content  $\succ$  Price  $\succ$  Presentation. Table 15 shows the results obtained with Borda's count.

**Table 15.** Borda's count of rankings obtained with UTASTAR.

Rank	Position's weights			
	Content	Price	Presentation	
1	42	34	22	3
2	27	38	33	2
3	13	10	27	1
<b>Sum</b>	<b>395</b>	<b>301</b>	<b>192</b>	

Source: Own elaboration.

**Stage 6. Defining the profile of the new product.** Based on the results of the stages, the characterization of the new fiber food supplement base on eggplant could be orange flavor, since, in the market study, this flavor was the most preferred. In addition, in the market study and the sensory evaluation, Metamucil (Orange flavor) was the one who ranked first in the ordering of products in the different analysis methods (average, Borda count, Joint Analysis, and UTASTAR).

Since potential eggplant fiber supplement consumers chose antioxidants as a nutrient

that could be added to this product. It is suggested to emphasize the nutritional properties of eggplant fiber, which has around 156% dietary fiber, 54% calcium, and 78% iron of the daily requirements for every 100 g of eggplant fiber. These data were provided by the owner of the horticultural company from a laboratory analysis of eggplant fiber samples, done by a center for research in food.

Regarding the net content of the new product, it is suggested that it be 250 g, as preferred by respondents from the market study. However, the possibility of a net content that is in the range of 425 to 470 grams should be considered, since the first three best-evaluated brands, in general, are in that range: Metamucil (425 g), Piñalinaza (470 g) and Fiber N Plus (450 g). The latter would allow it to compete with a similar presentation to the competition and reduce packaging costs and inventory space. Regarding the latter, the product could be packed in a resealable bag such as the Piñalinaza presentation, which reduces inventory space; however, it is suggested that it be a plastic container packaging, as preferred by the respondents.

Considering that the respondents in the market study indicated to be willing to pay

between \$151.00 and \$250.00MXN for an eggplant fiber food supplement and that Metamucil was the most preferred product in the evaluation of brands with a price of \$ 297.00, the price of the eggplant supplement could be in that price range mentioned or close to the price of Metamucil. The latter assumes that this new product is close to the attributes of this brand. However, it is necessary to carry out an economic feasibility study, which includes the costs of making the product, marketing costs, and expected profits.

Based on the above, various options could be presented to a group of consumers to carry out a Choice-based Conjoint Analysis, in which different profiles of the new product would be presented. Depending on the choice-based conjoint analysis results, a discriminative sensory assessment is recommended, which requires between 20 and 100 panelists with minimal training. This evaluation is product-oriented and is used to determine differences between the products under evaluation, the new eggplant fiber product, and others on the market. Specifically, if the product tastes orange, it could be contrasted with Metamucil orange flavor. In addition to taste, the attributes odor, color, sensation on the palate, aftertaste, and solubility are hedonically evaluated in this test. Here, it is necessary to consider the results obtained in this study with UTASTAR and Borda's count regarding the importance of the attributes to focus on the most important. It is part of the contribution of this work and verifying consumers' preferences from a multi-attribute approach.

#### **IV. Conclusions**

In this work, an approach was presented for the new product design problem. An application was performed with this approach to design a fiber supplement based on eggplant. The paper focused on the sensory

and brand evaluation tests of this approach. Data gathered from these tests were analyzed using Borda's count, Conjoint Analysis, Average, and UTASTAR methods. Several results were presented for each test. The results suggest that the approach could be a good way to aid in designing a new product. Good practice in that process could be using the UTASTAR method to detect inconsistencies of the panelists because it is known that Conjoint Analysis or Average cannot detect them. However, similar results than UTASTAR were obtained with such methods because data were free of discrepancies. Extensive testing is necessary to know if Conjoint Analysis, Average, and UTASTAR methods can obtain similar results. It can be performed in future work.

Results obtained with Borda's count method suggest an easy way to use ordinal data and consider all positions of the rankings to get a global ranking. Also, due to the provided rankings containing the same products or alternatives, rank reversal Type II is unlikely to occur.

Finally, the classical consumer theory indicates that individuals act rationally and always choose one good or another if the utility obtained with the first is greater than obtained with the second. However, when carrying out the brand evaluation test, some inconsistencies in the evaluation and preference order in the brand, which shows that consumer behavior is not always rational.

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## VI. References

- Abedrabbo Ode, G., & Cornuel, E. (2020). "Big corporations: Market saturation and Massive Diversification".
- Adams, M. (2004). Findings from the PDMA research foundation CPAS benchmarking. PDMA Foundation.
- Alam, S., Rashid, M., Rouf, F., Jhala, R., Patel, J., Satpathy, S., Cork, A. (2003). Development of an integrated pest management strategy for eggplant fruit and shoot borer in South Asia: AVRDC-WorldVegetableCente.
- Barczak, G., Griffin, A., & Kahn, K. B. (2009). Perspective: trends and drivers of success in NPD practices: results of the 2003 PDMA best practices study. *Journal of Product Innovation Management*, 26(1), 3-23.
- Bigaret, S., & Meyer, P. (2015). "Supporting the MCDA Process with the diviz workbench". In R. Bisdorff, L. C. Dias, P. Meyer, V. Mousseau, & M. Pirlot (Eds.), *Evaluation and Decision Models with Multiple Criteria: Case Studies* (pp. 619–638). Berlin, Heidelberg: Springer Berlin Heidelberg. [https://doi.org/10.1007/978-3-662-46816-6\\_21](https://doi.org/10.1007/978-3-662-46816-6_21).
- CEC. (2017). Characterization and Management of Food Loss and Waste in North America. Retrieved from <http://www3.cec.org/islandora/en/item/11772-characterization-and-management-food-loss-and-waste-in-north-america-en.pdf>
- CEC. (2019). Quantifying Food Loss and Waste and Its Impacts. Montreal, Quebec. Retrieved from <http://www3.cec.org/islandora/en/item/11813-technical-report-quantifying-food-loss-and-waste-and-its-impacts-en.pdf>.
- Cooper, R. G., & Kleinschmidt, E. J. (1993). New product success in the chemical industry', *Industrial Marketing Management*.
- Dekimpe, M. G., & Hanssens, D. M. (2018). Sustained spending and persistent response: A new look at long-term marketing profitability LONG-TERM IMPACT OF MARKETING: A Compendium (pp. 143-186): World Scientific.
- Dijksterhuis, G. (2016). New product failure: Five potential sources discussed. *Trends in food science & technology*, 50, 243-248 <https://doi.org/10.1016/j.tifs.2016.01.016>.
- Ellis, E. O., & Amraibure, O. (2020). Antioxidant Activity of Some Whole Fruit Cultivars of Raw and Processed (Boiled) Egg Plant (*Solanum melongena*). *South Asian Research Journal of Natural Products*, 18-25.
- FAOSTAT. (2014). Base de datos estadístico. from <http://www.fao.org/faostat/en/#search/eggplant>
- FAOSTAT. (2015). Statistical Database. from <http://www.fao.org>
- Ghannadpour, S. F., & Moradimanesh, R. (2020). Utility Function Estimation of Sustainable Project Selection using a Hybrid Approach of SBSC, ANP and UTASTAR (Case Study: SAIPA Co.). *Quarterly Journal of Transportation Engineering*, 12(2), 189-211.
- ITC (International Trade Center) (2021). Trade statistics for international business development. [https://www.trademap.org/Country\\_S](https://www.trademap.org/Country_S)

- [elProduct\\_TS.aspx?nvpm=1%7c%7c%7c%7c%7c07%7c%7c%7c2%7c1%7c1%7c2%7c2%7c1%7c2%7c1%7c1%7c1](#).
- Keeney, R.L (1992). Value-focused thinking: a path to creative decision analysis: Harvard University Press, Cambridge
  - Keeney, R. L. (2012). Value-focused brainstorming. *Decision Analysis*, 9(4), 303-313.
  - Méndez, M. J. S. (2011). *Economía en la empresa* (4ta. ed.).
  - Mostafaepour, A., & Jooyandeh, E. (2017). Prioritizing the locations for hydrogen production using a hybrid wind-solar system: A case study. *Advances in Energy Research*, 5(2), 107.
  - Parker, J. R., Paul, I., Hamilton, R., Rodriguez-Vila, O., & Bharadwaj, S. G. (2021). How Product Type and Organic Label Structure Combine to Influence Consumers' Evaluations of Organic Foods. *Journal of Public Policy & Marketing*, 40(3), 419-428 <https://doi.org/10.1177/0743915620922873>.
  - Radović-Marković, M., Salamzadeh, A., & Vujičić, S. (2019). Selection of organization models and creation of competences of the employed people for the sake of competitiveness growth in global business environment. *International Review*, (1-2), 64-71.
  - SIAP (Servicio de Información Agroalimentaria y Pesquera) (2020). *Panorama Agroalimentario 2020*. Secretaría de Agricultura y Desarrollo Rural. México.
  - Siskos, Y., & Yannacopoulos, D. (1985). UTASTAR: "An ordinal regression method for building additive value functions". *Investigação Operacional*, 5(1), (1985) pp. 39–53.
  - USDA. (2018). Food Composition Databases. Retrieved from <https://ndb.nal.usda.gov/ndb/foods/show/2962?fg=&manu=&facet=&format=&count=&max=50&offset=&sort=default&order=as>
  - USDA (2019). Eggplant, raw. Retrieved August 2, 2020, from <https://fdc.nal.usda.gov/fdc-app.html#/food-details/169228/nutrients>.
  - Victory, K., Nenycz-Thiel, M., Dawes, J., Tanusondjaja, A., & Corsi, A. M. (2021). How common is new product failure and when does it vary?. *Marketing Letters*, 32(1), 17-32. <https://doi.org/10.1007/s11002-021-09555-x>
  - Weese, T. L., & Bohs, L. (2010). Eggplant origins: out of Africa, into the Orient. *Taxon*, 59(1), 49-56.
  - Zhou, Z., Zheng, L., & Li, X. (2021). Abstract or concrete? The influence of image type on consumer attitudes. *International Journal of Consumer Studies*, 45(5), 1132-1146.