

Intrinsic and extrinsic attributes influencing the selection of dehydrated fruits and vegetables in Mexico

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Abstract

For dehydrated products to access new markets and for their production to generate economic development opportunities in rural production units, it is necessary to understand consumer demands. The objective was to analyze consumer behavior and identify the main attributes that lead consumers to make the decision to purchase dehydrated fruits and vegetables in Mexico in 2023. A survey was administered to 704 households nationwide and analyzed using Pearson correlation, cluster analysis and the analytic hierarchy process (AHP). It was identified that the most valued attributes were flavor (46.28%), being a national product (40.13%), biodegradable packaging (38.04%), and supporting environmental conservation (35.42%). In addition, four groups of consumers were identified who differed in the attributes valued when purchasing dehydrated products; however, flavor was the most important across all groups. Companies that produce dehydrated fruit and vegetable products can create generic promotion strategies that highlight the attributes of health, environmental care, product quality and social responsibility.

Keywords:

conservation, demand, analytic hierarchical process.



Introduction

The consumption of dehydrated fruits and vegetables has become popular among people seeking foods that are low in calories, high in fiber content, free of chemical additives, with nutritional and organoleptic properties, attractive in appearance and ready for immediate consumption (Anigstein, 2019; Moreno-Colom and Boràs-Català, 2021).

In addition to the above, the consumption of dehydrated foods is associated with the benefits that these products bring to human health, as they are foods with high nutritional value and are supplements in the diet (Vega *et al.*, 2006). This is mainly because the consumption of fruits and vegetables influences the reduction of the risk of developing cardiovascular diseases, some types of cancer, diabetes mellitus, overweight, and obesity, which are the main causes of death worldwide (Mora *et al.*, 2023).

Therefore, dehydrated foods are an alternative to expand the consumption of fruits and vegetables among a high percentage of the population (Tarancón *et al.*, 2020). The preferences for, and the decision to purchase a food, depend on various factors that influence the quality perceived by consumers; among them are the intrinsic attributes, which are the physical, organoleptic, or nutritional factors of the products, such as variety, flavor, smell, color and nutrients, among others.

There are also extrinsic attributes, which are characteristics by which a product can be differentiated, without being physically part of them, such as price, brand, packaging, and environmental and sociocultural connotations, among others (Torres *et al.*, 2025). In addition, Siró *et al.* (2008) mention other factors, such as consumers' socioeconomic characteristics, opinions, attitudes, objectives, the sociocultural environment, and the level of information consumers possess.

According to Tabares and Lochmuller (2013), the factors that lead consumers to make choices that meet their nutritional, social, environmental and emotional needs must be analyzed. There is research that has determined the attributes of dehydrated products, such as tubers, fruits, and vegetables (López *et al.*, 2019; Da Silva *et al.*, 2019; Sánchez-Toledano *et al.*, 2024, Monaco *et al.*, 2024), where the authors point out that intrinsic and extrinsic attributes must be considered in business and commercial strategies.

From the above, the following questions arise: What attributes of dehydrated products are valued by consumers, and what should the cooperative consider making its products? What aspects should be considered in the design of commercial strategies? To respond, the objective was to analyze consumer behavior and identify the main attributes that lead consumers to make the decision to buy dehydrated fruits and vegetables in Mexico.

Materials and methods

Information collection

A questionnaire was administered to consumers of dehydrated products nationwide from July to September 2023. The questionnaire included 36 multiple-choice questions, organized into three sections: 1) sociodemographic characteristics and consumption habits; 2) product knowledge; and 3) important attributes when buying dehydrated foods.

The confidence level of the instrument was evaluated using Cronbach's alpha reliability coefficient, yielding a value of 0.944 (Al-Makhroumi *et al.*, 2022). The survey was created on the Google Apps server via Drive® and pilot tests were conducted to ensure question clarity and minimize errors (n=25). Once validated, the survey was distributed online.

Sample estimation

The sample size was estimated using finite population sampling. The formula was that used by Rodríguez (2003):

$$n = \frac{N * Z_{\alpha/2}^2 * p * q}{d^2(N - 1) + Z_{\alpha/2}^2 * p * q}$$

Where: N= 35 219 141 households in Mexico in 2022 (INEGI, 2023); Z= confidence level (99%) 2.57; p= probability of success 0.5; q= probability of failure 0.5; d= maximum error (5%). The sample size was 661; however, during the application of the survey, 704 valid surveys were recorded, which were considered for analysis.

The selection of respondents was carried out with convenience sampling, justified by the participants' willingness to answer.

Analysis of information

The degree of correlation between the variables was calculated using Pearson correlation (Hernández *et al.*, 2018). Consumption habits were assessed with a five-point Likert scale: not at all (1); rarely (2); occasionally (3); almost always (4); and always (5). The descriptive statistical analysis was carried out using the methodology of Gould (1988). The scores of the statements were calculated, evaluating for each individual i, a total score (Pi), adding the scores assigned to each of the items j (Pi,j):

$$P_i = \sum_{j=1}^{10} P_{i,j}$$

Then, the mean, standard deviation, and variance were calculated.

A cluster analysis was performed using the K-means method as the clustering technique and Euclidean square distance as a measure of similarity. Finally, through the analytic hierarchical process (AHP) consumer preferences were identified and the relative importance of the attributes they consider when purchasing dehydrated products was estimated. The information obtained from the survey was concentrated in Excel 2016 spreadsheets, and the statistical analyses were performed using SPSS software, version 27.

Results and discussion

Sociodemographic characteristics and consumption habits

Age and income showed a positive relationship (Table 1), indicating that the older people are, the greater the economic possibility to purchase food that satisfies specific preferences and needs. The level of education and income had a positive relationship, indicating that when schooling and income are high, consumption preferences may differ from those of people with lower levels of education and income.

Table 1. Pearson correlation between significant variables.

		Income level ¹	Sex ²	Age ³	Education level ⁴	Household members ⁵	Consume dehydrated products ⁶
1	Pearson correlation	1	0.094*	0.483**	0.47**	-0.209**	-0.079*
	Sig. (2-tailed)		0.013	0	0	0	0.037
2	Pearson correlation	0.094*	1	0.053	-0.008	0.141**	0.124**
	Sig. (2-tailed)	0.013		0.16	0.836	0	0.001
3	Pearson correlation	0.483**	0.53	1	0.205**	-0.13**	-0.135**
	Sig. (2-tailed)	0	0.16		0	0.001	0

		Income level ¹	Sex ²	Age ³	Education level ⁴	Household members ⁵	Consume dehydrated products ⁶
4	Pearson correlation	0.47**	-0.008	0.205**	1	-0.125**	-0.104**
	Sig. (2-tailed)	0	0.836	0		0.001	0.006
5	Pearson correlation	-0.209**	0.141**	0.13**	0.125**	1	-0.019
	Sig. (2-tailed)	0	0	0.001	0.001		0.62
6	Pearson correlation	-0.079*	0.124**	-0.135**	0.134**	-0.019	1
	Sig. (2-tailed)	0.037	0.001	0	0.006	0.62	

Asterisks indicate significance (* = $p \leq 0.05$, ** = $p \leq 0.01$).

The relationship between sociodemographic variables in purchasing decisions is consistent with studies conducted in Italy (Massaglia *et al.*, 2019); Bulgaria and Moldova (Pocol *et al.*, 2020) and Romania (Barbu *et al.*, 2023), where per capita income was a relevant variable when deciding what to buy.

The relationship between the consumption of dehydrated products and income and education was negative, indicating a lower probability of purchasing these products when the consumer has a higher level of schooling and income. Miramontes-Escobar *et al.* (2020) highlighted that consumers with higher incomes follow a low-carbohydrate, high-protein diet and consume more fresh fruits and vegetables. In addition, an educated consumer is a more rational and freer being when making purchases (Castillejo *et al.*, 2011), which makes them prefer fresh fruits and vegetables over dehydrated ones.

In this regard, Yuting and Liang (2020) noted that consumers with a strong health motivation prefer to eat dried fruits occasionally as a snack rather than change their eating routine in the long term. Additionally, Monaco *et al.* (2024) pointed out that intrinsic attributes, such as color and texture, affect the preference of dehydrated products over consumer perceptions, which is based on the value associated with the product and the preservation of its nutrients, giving greater preference to fresh fruits and vegetables.

In a study conducted in Mexico (Sánchez-Toledano *et al.*, 2024) on consumers' perceptions of dehydrated fruits and vegetables, the authors mentioned that the country has a wide variety of fruits and vegetables at affordable prices year-round, and that the trend is to consume them fresh. In turn, dehydrated foods are considered as 'snacks' or ingredients for preparing dishes, so their acquisition is occasional. Mexicans prefer to buy these products in large and open-air markets, in supermarkets, traditional stores, and online, since this depends on the prices of the products, the convenience of the location, and the consumer's familiarity with the use of technology.

Consumption habits

In consumption habits, there is concern for health and food, evidenced by scores in the consumption of fruits and vegetables (Table 2). According to Mora *et al.* (2023), consuming fruits and vegetables is synonymous with good eating habits, better health, and disease prevention.

Table 2. Scale of consumption habits.

Habits	Mean	Standard deviation	Variance
Eating and health habits			
Fruit and vegetable consumption	4.25	0.87	0.75
I care about my diet and my health	4.22	0.75	0.56

Habits	Mean	Standard deviation	Variance
I moderate consumption of high fats and sugars	3.63	0.92	0.84
Social and leisure habits			
In my free time, I usually go to bars and restaurants	3.23	1.17	1.37
I usually read, listen to, or watch the news daily	3.92	0.95	0.9
I usually go to cultural events (concerts and theater)	3.45	0.98	0.96
I usually eat away from home	3.32	1.01	1.03
I usually smoke or drink an alcoholic beverage	3.47	1.21	1.46
Sustainability and the environment			
I care about the environment	4.44	0.73	0.54
I recycle garbage in suitable containers	3.98	0.96	0.93
I like to have contact with nature	4.4	0.74	0.55
Interest in physical activity			
I like to do outdoor activities	4.28	0.83	0.69
I do physical exercise	3.62	0.96	0.93
Interest in food product innovation			
Interest in learning about and trying beneficial health products	4.37	0.75	0.56
Interest in buying products that help rural people and indigenous communities	4.33	0.77	0.6
Interest in trying new products	3.9	0.88	0.78
Not at all= 1; rarely= 2; occasionally= 3; almost always= 4; always= 5.			

The results indicate concern for sustainability and the environment (Table 2), associated with the benefits perceived by consumers when purchasing products whose production and composition involve elements that help the planet, such as saving natural resources and raw materials (Arroyave-Ramírez and Arrubla-Zapata, 2018).

There was also interest in food innovation that benefits health, rural people and indigenous communities. These attributes in dehydrated foods can trigger product quality and market acceptance, where consumers prioritize quality over quantity and seek products with a clear history and origin (Gutiérrez and Martín, 1998; Matiz, 2025).

Consumers segments for dehydrated products

Four groups of consumers were identified: group one (31.68% of the sample), consisting of men aged 20 and 24, with a monthly income of less than \$5 000.00 and between \$5 001.00 and \$10 000.00, with a university education and households of four to six members. The consumption of dehydrated foods consisted of aromatic herbs, seeds, chilis and teas.

Group two (16.62%), made up mostly of women, with a monthly income of more than \$30 000.00, aged between 35 and 39, with postgraduate degrees, and households of one to three people. The consumption of dehydrated foods consisted of aromatic herbs and flour.

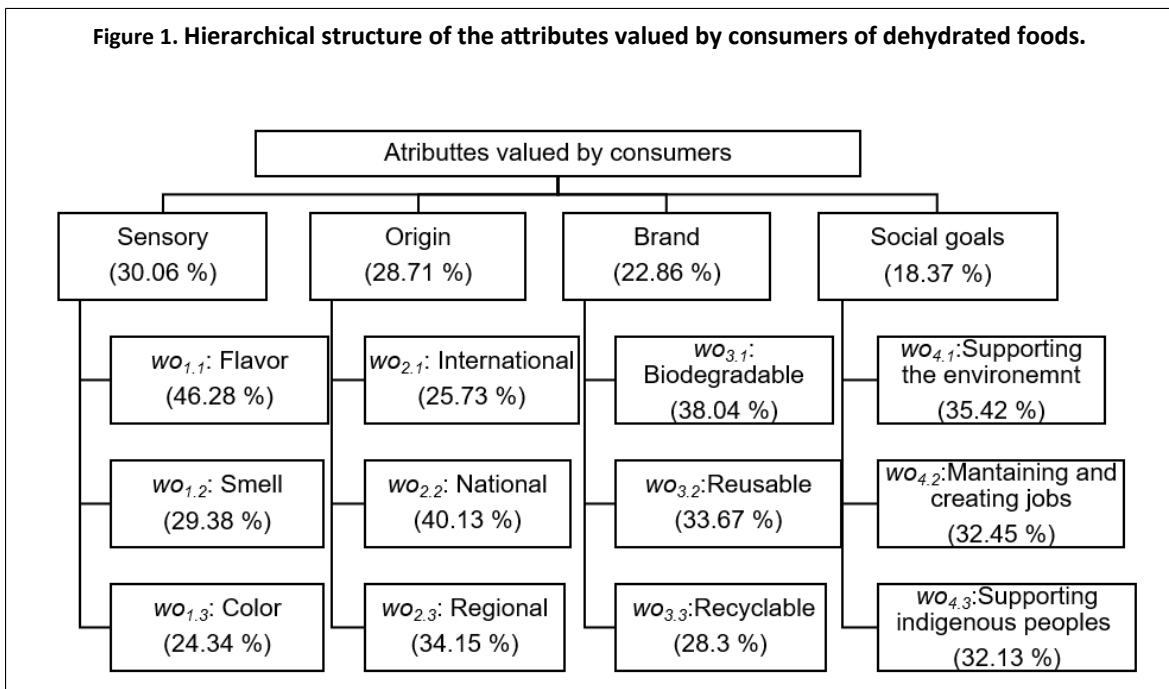
Group three (14.77%), made up of men with incomes between \$10 001.00 and \$15 000.00, aged 25 to 29, with a university education and households made up of one to three people. They consume dehydrated seeds, chilis, aromatic herbs and flours.

Group four (36.93%), mainly made up of men with incomes between \$15 001.00 and \$20 000.00 and between \$20 001.00 and \$30 000.00, aged 35 to 39 years, with postgraduate degrees, and households of one to three people. They consume dehydrated foods such as aromatic herbs, fruits, seeds, and flour.

Attributes valued by consumers when buying dehydrated foods

Sensory attributes were the most important, followed by origin, brand and social goals (Figure 1). Consumers had a greater preference for flavor (46.28%) and it is an attribute that determines the acceptance of dehydrated foods in the market. The origin had a significant influence, and this is due to the reliability of national products.

The preference for the national over the regional could be due to the limited availability of local brands. To take advantage of these attributes, companies that produce dehydrated foods must create brands with an emotional connection, which stimulates consumer engagement and loyalty (Carroll and Ahuvia, 2006; Anggraeni and Rachmanita, 2015; Ríos *et al.*, 2025).



Consumers of dehydrated foods preferred biodegradable packaging, highlighting a commitment to sustainability, as it is made of materials designed to decompose naturally by the action of microorganisms (Rivera *et al.*, 2019). This result is similar to that of Estrada-Domínguez *et al.* (2020), who found that brand and ecolabeling are factors that positively influence the purchase of products, as they do not represent damage to the environment.

In their study, Acosta-Medina *et al.* (2023) point out that, in the long term, biopackaging can have more economical results by reducing waste disposal costs and complying with environmental standards, in addition to consumers being willing to pay more for products with biodegradable packaging.

Mohd-Suki (2016) mentions that if consumers know about the environmental impact caused by products, they tend to increase their purchases towards those that cause less harm. Currently, there is a concern for the care of the environment, which is why there is a growth in the use of biodegradable and eco-friendly packaging that supports the conservation of the environment, as it is made of recycled materials, reducing the emission of pollutants and using limited resources and energy (Acosta-Medina *et al.*, 2023; Salinas y Vélchez, 2024).

In the social sphere, the three attributes showed similar importance (Figure 1), and a growing awareness of social responsibility was observed; therefore, products must demonstrate a solid commitment in this area, as it is an element that affects consumer acceptance (Barragán-Hernández *et al.*, 2021). One of the factors that determines responsible purchasing is information about social responsibility issues and the image that the company projects on the subject (Leyva-Hernández *et al.*, 2024).

In the assessment of attributes by consumer segments (Table 3), it was observed that group one prioritized the social aspect, whereas the other groups prioritized environmental care. Groups one and three exhibited equal preferences between national and regional origin. Group four balanced their preferences between support for the environment and indigenous peoples.

Table 3. Attributes valued by consumers based on group segmentation.

Attribute	Percentage (%)			
	Group 1	Group 2	Group 3	Group 4
Sensory				
Smell	27.62c	31.16a	30.6a	29.63b
Color	23.65c	23.6c	24.94b	25.01a
Flavor	48.74a	45.25a	44.46a	45.35a
Origin				
International	24.57a	28.71a	25.12a	25.54a
National	39.16b	39.06c	38.7b	41.89a
Regional	36.26a	32.12b	36.19a	32.47b
Packaging				
Biodegradable	37.9b	41.04a	37.97b	36.82c
Recyclable	29.16a	27.96a	27.49a	28a
Reusable	32.94b	31b	34.54a	35.17a
Social goals				
Maintaining and creating jobs	30.4c	31.37c	34.95a	33.75b
Supporting indigenous peoples	32.57b	32.55b	30.32c	32.23a
Supporting the environment	37.03a	36.08a	33.72b	34.01a

Se destacó la necesidad de estrategias diferenciadas en cada grupo de consumidores, esta acción abre la puerta para explorar el potencial de influir en la creación de nuevos alimentos deshidratados que generen un impacto económico en pequeños productores.

Conclusiones

Los resultados de este estudio muestran que una variable sociodemográfica decisiva en la adquisición de productos deshidratados de frutas y verduras es el ingreso. Se distinguen cuatro segmentos de consumidores en frutas y verduras deshidratadas, los cuales están diferenciados por rangos de edad, nivel de ingreso, nivel educativo, tamaño de hogar y el tipo de productos deshidratados que adquieren.

Los atributos mejor valorados son el sabor, que sea un producto nacional, con empaque biodegradable. Los cuatro segmentos de consumidores de productos deshidratados tienen preferencias diferentes en lo ambiental, social, económico y sensorial. Por lo tanto, las estrategias de promoción deben estar diferenciadas para cada tipo de consumidor y destacar los atributos de salud, cuidado ambiental, calidad del producto y responsabilidad social.

Una de las limitaciones del estudio fue que contempló un sondeo general para productos deshidratados de frutas y verduras, por lo que la información obtenida solo da nociones generales sobre las características sociodemográficas de los consumidores y los atributos intrínsecos y extrínsecos asociados a ellos.

En futuras investigaciones se recomienda realizar estudios sobre productos específicos de frutas y verduras deshidratadas, que considere segmentos de consumidores y aspectos particulares del producto. Se sugiere hacer análisis comparativos entre regiones del país, para ello se puede aplicar el instrumento de medición considerando consumidores diferenciados por poder adquisitivo, nivel de estudios, edad, entre otras.

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