

VALIDATION OF SENSORY TESTS FOR THEIR APPLICATION IN CONSUMER INSIGHTS

VALIDAÇÃO DE TESTES SENSORIAIS PARA SUA APLICAÇÃO EM INSIGHTS DO CONSUMIDOR

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ABSTRACT: Rapid sensory methodologies such as Check-All-That-Apply (CATA) and Conjoint Analysis are useful tools for understanding consumer preferences, but their reliability compared to traditional methods is still questionable. This study compares these approaches applied to bakery products with pseudocereals, specifically amaranth, evaluated by consumers in Brazil and Mexico. Depending on the pandemic restrictions, the analyses were conducted through conceptual or taste evaluations. The results indicated that the combination of CATA and Conjoint Analysis with traditional tests, such as preference, contributed to the development of new products and the acquisition of consumer insights. In Brazil, consumers have rectangular, yellow, chocolate or organic amaranth bars, while in Mexico they prefer similar bars but with honey or chocolate flavors. The study reinforces the potential of rapid food innovations and product adaptation to different markets.

Keywords: Amaranth. Check-all-that-apply. Pseudocereals.

1

RESUMO: Metodologias sensoriais rápidas, como Check-All-That-Apply (CATA) e Análise Conjunta, são ferramentas úteis para compreender as preferências do consumidor, mas sua confiabilidade em comparação com os métodos tradicionais ainda é questionável. Este estudo compara essas abordagens aplicadas a produtos de panificação com pseudocereais, especificamente amaranto, avaliados por consumidores no Brasil e no México. Dependendo das restrições da pandemia, as análises foram conduzidas por meio de avaliações conceituais ou de sabor. Os resultados indicaram que a combinação de CATA e Análise Conjunta com testes tradicionais, como de preferência, contribuiu para o desenvolvimento de novos produtos e para a obtenção de insights sobre o consumidor. No Brasil, os consumidores têm preferência por barras retangulares de amaranto amarelo, chocolate ou orgânico, enquanto no México preferem barras semelhantes, porém com sabores de mel ou chocolate. O estudo reforça o potencial de inovações rápidas em alimentos e adaptação de produtos a diferentes mercados.

Palavras-chave: Amaranth. Check-all-that-apply. Pseudocereals.

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INTRODUCTION

Sensory analysis is a scientific methodology that seeks to measure, interpret and understand consumer responses to sensory stimuli of products, such as taste, odor, texture and appearance (Rinaldi et al, 2024). This analysis involves a set of techniques and tests applied to collect data that reflect consumers' perceptions, preferences and acceptance of a product. In the food sector, sensory analysis is essential for the development of new products, quality control and adjustment of product formulations, thus allowing industries to adopt them to better meet consumer expectations and preferences (Rodrigues, 2019).

Performing a traditional sensory analysis involves several essential steps, starting with the formation of a panel of evaluators, that is, a group of consumers trained to evaluate the sensory characteristics of the product. This process begins with the search (recruitment) of candidates, followed by individual interviews to assess their sensory abilities and a screening based on the results obtained in the sensory methodologies applied during the test, which can be discriminative or descriptive (Reinbach et al., 2014; Ares et al., 2010). After this selection, the candidates undergo specific training for the products that will be evaluated. The final step involves the application of the definitive tests, where the necessary sensory data is collected. This process, which can take three to six months, must be renewed annually to ensure the quality and accuracy of the results, as suggested by Alves (2021).

With the growing demand for greater agility in the search for results, especially in industry and research, the need to optimize sensory methods has become evident. To meet this demand, “rapid” sensory methodologies have been developed, thus enabling a reduction in execution time. These techniques have gained even more recognition during the pandemic, when the need for fast and accessible results has increased (Hunaefid & Farhanz, 2021). Recent studies carried out in Brazil and Mexico have applied these rapid methodologies, with the aim of validating their effectiveness and viability in the Latin American context (Iwamura et al., 2022; Ortega-Heras et al., 2019). However, these methods still face resistance regarding credibility, especially due to the application of complex statistical methods and the need for a change of mindset in relation to conventional approaches (Ávila, 2021). A methodology that is increasingly being adopted due to its practicality and speed is CATA (Check All That Apply), which allows consumers to indicate all the sensory characteristics perceived in a sample or product from a predefined list (Heussen et al., 2023; Alexi et al., 2018; Ares & Jaeger, 2015). This method is particularly interesting for the sensory characterization of consumers, because it

does not require specific training, choosing only the terms that best represent their perception of the product (Ávila, 2021; Varela & Ares, 2014).

In addition to CATA, the Conjoint Analysis test is another technique used to assess the acceptance and impact of different prototype alternatives. This method helps to measure consumer preferences and the level of acceptance, being useful in the validation of new products (Jaeger et al., 2015). The application of rapid methodologies, such as CATA and Conjoint Analysis, allows to reduce the time to obtain results, facilitating agility in decisions about the development of sensory products.

To validate the application of rapid methodologies in sensory research, a study focused on consumers in Brazil and Mexico collected significant data to support more efficient decisions in sensory projects. Amaranth was chosen for this study due to its history of consumption in the Americas, with archaeological records of up to 10 thousand years. Evidence suggests that its origin is in Central and South America, with traces dating back to approximately 4000 BC in Tehuacán, Mexico (Ochoa, 2022).

Materials and methods

Sampling

The conceptual study was conducted in two countries, Brazil and Mexico, with a population of 104 and 135 respondents, respectively. The questionnaire used was applied online through the FIZZ by Biosystemes© program and published on the researchers' social networks.

MÉTODOS

CATA (CHECK ALL THAT APPLY)

In this study, a list of attributes was developed based on the ingredients used in amaranth bars found in the Mexican market. These attributes (as shown in Figure 1) were used to develop prototypes, which consist of various combinations of these attributes, to evaluate the main characteristics of food bars containing amaranth.

FORMA

☐ Circular
 ☐ Rectangular

COR

☐ Amarela
 ☐ Verde

INGREDIENTES

☐ Chia
 ☐ Mel
 ☐ Cacau
 ☐ Passas
 ☐ Amendoim
 ☐ Chocolate
 ☐ Aveia
 ☐ Frutos secos
 ☐ Gergilim
 ☐ Agave

Figure 1. Presentation of the list of attributes

Conjoint analysis

Using the Conjoint Analysis technique, 20 distinct conceptual prototypes of amaranth bars were developed, based on the ingredients indicated on the labels of various commercial brands (see Table 1). These prototypes were then compared with the consumer preference profile.

Table 1. List of evaluated prototypes

Type	Shape	Color	Ingredient
Profile 1	Circular	Yellow	Oat
Profile 2	Circular	Yellow	Dried fruits
Profile 3	Circular	Green	Sesame
Profile 4	Rectangular	Yellow	Honey
Profile 5	Circular	Yellow	Chia
Profile 6	Rectangular	Green	Chia
Profile 7	Rectangular	Green	Peanut
Profile 8	Rectangular	Yellow	Sesame
Profile 9	Rectangular	Green	Cocoa

Profile 10	Rectangular	Green	Oat
Profile 11	Circular	Green	Raisins
Profile 12	Circular	Green	Agave
Profile 13	Rectangular	Yellow	Agave
Profile 14	Circular	Yellow	Peanut
Profile 15	Rectangular	Yellow	Raisins
Profile 16	Rectangular	Green	Dried fruits
Profile 17	Circular	Green	Honey
Profile 18	Rectangular	Yellow	Chocolate
Profile 19	Circular	Green	Chocolate
Profile 20	Circular	Yellow	Cocoa

The questionnaire adopted was entirely conceptual, presented without images, and comprised three stages: consent to participate in the research, obtained through the Free and Informed Consent Form (FICF); collection of demographic information; and conceptual evaluation, which involved selecting, from a list of ingredients, the options that the participant considered essential in an amaranth bar (as indicated in Table 2). Subsequently, the interviewees were asked to evaluate, conceptually, each prototype, using a 9-point scale, in which 1 represents "I disliked it very much", 5 "I neither liked nor disliked it" and 9 "I liked it very much".

Table 2. Ingredientes e características a considerar para uma barra de amaranto

Ingredientes	Forma	Color	Fonte
Oat	Circular	Green	Traditional
Cocoa	Rectangular	Yellow	Organic
Chia			
Honey			
Agave			
Peanut			
Raisin			
Sesame			
Dried fruits			

Chocolate

Statistical analysis

ANOVA analysis of variance at a significance level of 5% and preference mapping were performed on the sensory data using XLStat and Fizz Calculations software.

Results and discussion

The samples examined are listed in Table 1, describing their characteristics regarding shape, color and ingredients used in the composition. Table 2 highlights the main properties that represent the bars containing amaranth.

CATA

Based on the selection of ingredients indicated by CATA, the preparation of an ideal amaranth bar for the Mexican population is relatively straightforward: a rectangular bar, yellow in color, containing honey and nuts. On the other hand, for Brazil, the variety of ingredients is greater, resulting in a rectangular bar, also yellow, containing nuts, oats, honey, cocoa, chocolate and raisins (as shown in Table 3). Cereal bars are in line with the growing search by consumers for healthier options, as they offer a combination of several components essential for health. The aspects of texture, flavor and physical characteristics are carefully adjusted through an appropriate selection of ingredients, which complement each other harmoniously. This care is observed because cereal bars are developed to provide a pleasant sensory experience, while providing the nutrients necessary for a balanced and healthy diet (Ferreira et al., 2019).

6

Table 3. Selection of ingredients needed for an ideal amaranth bar

Characteristic	Mexican population (%)	Brazilian population (%)
Circular	19	9
Rectangular	87	96
Green	1	8
Yellow	95	89
Agave	11	13
Sesame	28	35

Oat	23	63
Peanut	48	47
Cocoa	30	61
Chía	20	46
Chocolate	47	56
Dried fruits	57	67
Honey	81	63
Risins	39	50
Organic	44	48

Mexican population n=135, Brazilian population n=104.

Texture plays a key role, as a crunchy and chewy consistency is desired by most consumers. This is achieved by including ingredients such as cereal flakes, nuts and seeds, which provide a crunchy sensation. In addition, the combination of ingredients also influences the flavor of cereal bars, which can range from sweet to slightly salty, depending on consumer preferences. Finally, physical properties, such as ease of handling and resistance to breakage, are essential to ensure product quality and the consumption experience (Moreira-Araújo et al., 2021).

7

Conjoint analysis

The models developed through the Conjoint Analysis test (21 models) were evaluated by all consumers using a 9-point hedonic scale. The study was conducted between August 2022 and February 2023, and both analyses were performed using ANOVA (comparing each of the models) and a preference map that represents the distribution of preferences and their potential relationship with the ideal taste of each consumer group.

In general, the consumption of amaranth bars is low in Brazil (75% of respondents do not consume them), while in Mexico, 75% consume a bar every week or every 15 days. The formulation of an ideal amaranth bar for the Mexican population is relatively simple: a rectangular, yellow bar with honey and nuts, while for Brazil, the ingredients are more varied, consisting of a rectangular bar, also yellow, containing nuts, oats, honey, cocoa, chocolate and raisins (as shown in Table 3). These low rates of amaranth consumption in Brazil are mainly due to the population's lack of knowledge about this species and the country's traditional eating habits, which are based on cereals such as wheat, rice and corn (Ferreira, 2019).

According to Borges et al. (2010), the low consumption of pseudocereals in Brazil can be attributed to the lack of knowledge about these foods and the preference for cereals that are more common in Brazilian culture. Research conducted by Profeto et al. (2019), who applied a questionnaire to 474 participants, revealed that a significant portion of the interviewees had already consumed quinoa and/or amaranth. Of the participants, 312 (65.8%) consumed these foods, of which 65.2% consumed quinoa, while 20.5% consumed amaranth. These results suggest that, although consumption is still relatively low compared to traditional cereals, a considerable portion of the population has already had experience with quinoa and amaranth.

Regarding the evaluation of the conceptual flavor of the models, the amaranth bar for the Brazilian population presented a low score (6.6). However, when performing the conceptual evaluation, three conceptual models with a higher level of flavor were identified: "Yellow Rectangular with Chocolate", "Organic" and "Yellow Rectangular with Honey" (as shown in Table 4). In the case of Mexico, the conceptual product was perceived with a high level of acceptance (7.4) and three models were also evaluated with a good level of flavor (above 7). In both countries, the rectangular amaranth bars with chocolate and honey were perceived as appreciated products, confirming the options selected during the selection stage of the ideal attributes for an amaranth bar.

Table 4. Average degree of liking by country, Brazil and Mexico of amaranth bar

Brazil	Mean	Mexico	mean
Ret Am Chocolate	7,3a	Ret Am Honehy	7,5a
Organic	7,0ab	Conceptual (ideal)	7,4ab
Ret Am Honey	6,9b	Ret Am Chocolate	7,2abc
Conceitual (ideal)	6,7bc	Cir Am Dried fruits	7,1bcd
Ret Am Passas	6,5cd	Cir Am Cocoa	6,8cde
Cir Am Dried fruits	6,4cd	Cir Am Peanuts	6,8de
Ret Am Sesame	6,4cd	Organic	6,6ef
Cir Am Oat	6,4cd	Ret Am Sesame	6,6efg
Cir Am Cocoa	6,3cd	Cir Am Honey	6,3fgh
Cir Am Peanut	6,1de	Cir Am Chia	6,3ghi
Ret Am Agave	5,8ef	Ret Am Agave	6,0hi

Cir Am Chia	5,7f	Ret Am Raisins	5,9i
Ret Ve Cacau	5,1g	Cir Ve Honey	5,3j
Cir Ve Chocolate	5,1g	Ret Ve Dried fruits	5,3j
Ret Ve Peanut	5,1gh	Ret Ve Cocoa	5,2jk
Ret Ve Dried fruits	5,1gh	Ret Ve Peanut	5,1jkl
Cir Ve Honey	4,9ghi	Cir Ve Chocolate	5,1jkl
Ret Ve Oat	4,9ghi	Ret Ve Chia	5,0jkl
Cir Ve Sesame	4,7hij	Ret Ve Oat	4,9kl
Cir Ve Raisins	4,7ij	Cir Ve Agave	4,8kl
Ret Ve Chia	4,6ij	Cir Ve Sesame	4,8l
Cir Ve Agave	4,5j	Cir Ve Raisins	4,4m

Legenda: Ret = Rectangular, Am = Yellow, Cir = circular, Ve = Green.

* médias seguidas de letras distintas diferem significativamente com LDS ($p < 0,05$)

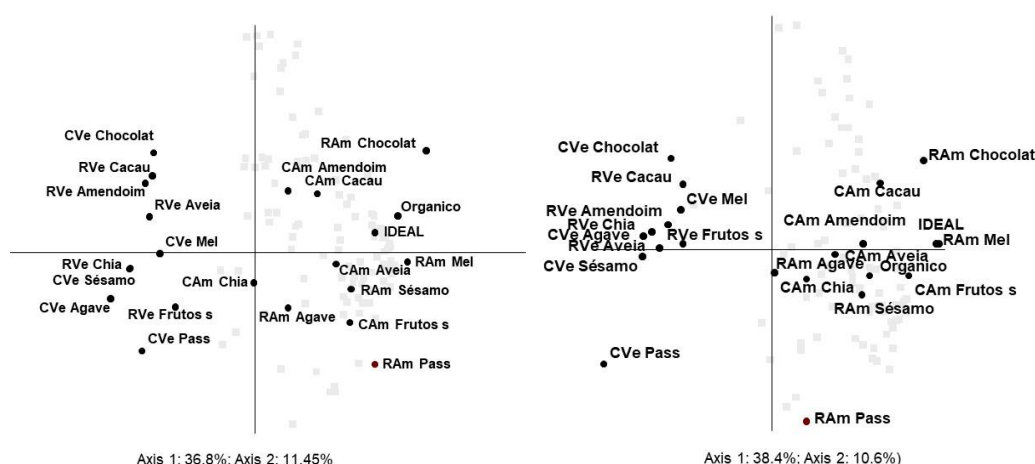


Figura 2a. Mapa de preferência dos protótipos e ideal de barra de amaranto para população Brasileira. Figura 2b. Mapa de preferência dos protótipos e ideal de barra de amaranto para população Mexicana.

After applying a preference map with the models, it was possible to observe that the favorable trend falls on the rectangular models of amaranth bars, with yellow coloring, especially those with the chocolate or honey variant. It is important to highlight that, in the case of Brazil, the organic option is better received than in Mexico. The maps provide an explanation of the percentage of variability in the first two axes, being 48.2% for Brazil and 49% for Mexico, which, being exploratory, offers a good description of the perception of the

products (Figure 2). In general terms, the rectangular and yellow models are better accepted than the circular ones. The acceptance of the organic model by the Brazilian consumer stands out, who perhaps has a greater awareness of organic products compared to the Mexican consumer. It is suggested that this observation be validated through a specific study in a particular population or segment.

CONCLUSIONS

Rapid methods, such as the CATA approach, in conjunction with traditional methodologies, such as acceptance assessment, and the conjoint analysis test, are useful in the initial development of product prototypes. In this research, it is possible to identify a product that is attractive to both populations, Brazil and Mexico. In the case of Mexico, the results indicated a rectangular, yellow product, with honey or chocolate, which was well accepted (with a score above 7). While for Brazil, a rectangular, yellow product, with chocolate or organic, was well perceived (with an acceptance score of 7). From a prototype that conceptually reflects what the consumer expects from an amaranth bar, it is possible to develop a physical prototype and, later, start industrial production and carry out evaluations with consumers, physical-chemical analyses and shelf-life tests.

10

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