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Spotting the sensory preferences of artichokes to improve the consumption of this functional food

Abstract

Given the greater varietal supply of the globe artichoke and evaluating its use for human consumption, it is important to carry out market positioning work, including the recognition of the newly available cultivars. Sensory analysis comes up as an important instrument to assess the potential of insertion of artichoke into the market. Within this perspective, the aim of the present study was to determine the sensorial quality characteristics of three globe artichoke cultivars produced in the Rosario´s Horticultural Belt and associated with the preference of local consumers. For the sensory evaluation, the method called CATA (Check All That Apply) was used. The results of the CATA test were analyzed using multivariate statistics, applying the Correspondence Analysis. The most distinguishing elements between artichokes were the color and aroma. When associating these results with which was the artichoke that consumers liked the most, it was observed that the Romanesco obtained the best rating. Consumers preferred sweet and tender artichokes. This information will guide the production strategies to offer cultivars that meet these characteristics.

Keywords: CATA, *Cynara cardunculus,* fruits, vegetables, *scolymus* L

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Introduction

The cultivation of the globe artichoke (*Cynara cardunculus* var. *scolymus* L.) in Argentina began at the start of 1900s with the arrival of Italian and Spanish immigrants. They introduced the first cultivars and adapted their agricultural practices to the conditions of the local climate and soil. Currently, Argentina is the fourth largest producer of globe artichokes in the world, after Italy, Egypt and Spain.[1]

The Horticultural Belt of Rosario (33° LS, 60° 59W, Argentina) has a long tradition in the production of cultivars destined for fresh consumption. The edible portion of the plant consists of the flower buds before the flowers come into bloom. The budding artichoke flower-head is a cluster of many budding small flowers (an inflorescence) together with many bracts, on an edible basis.[2] Artichokes also have nonfoods as their leaves that are a source of antioxidant compounds, such as luteolin and dicaffeoylquinic acids (cynarin),[3] and the roots contain inulin, an oligosaccharide known to have a positive effect on human intestinal flora, and thus a positive impact on health.[4,5] It is not only a source of pharmaceutically useful compounds, but also potentially good energy crop.[2,6]

At present, different technologies have been used for the production of the globe artichoke, such as the use of seed reproductive materials and drip irrigation, which facilitates their production, expanding the varietal spectrum and prolonging the supply period in the market. The producers have incorporated cultivars with different characteristics in terms of shape, color, texture and taste.[2] However, such differences are not clearly identified by consumers, who are often unaware of the species in question and its mode of consumption.

The quality in fruits and vegetables, can have different meanings according to the different parties involved in the distribution chain. Mainly, it can be divided into product-oriented quality and consumer-oriented quality. When referring to quality from the point of view of the consumer its measurement becomes less tangible and quantifiable. In this case, sensorial analysis becomes a very useful tool, since it allows the identification of important value attributes for consumers, which would otherwise be very difficult to measure.[7]

Given the greater varietal supply of the globe artichoke and evaluating its use for human consumption, it is important to carry out market positioning work, including the recognition of the newly available cultivars. The innovative sensorial Check all that apply (CATA) technique have sprung up in search of a direct link with consumers. The CATA methodology consists in statements used by consumers to mark out as many options as are needed to express their opinion about the product under analysis. Such methodology is descriptive, not lengthy, flexible and can be apply on the consumers without the need for trained appraisers.[8]

Techniques involving consumers are apply in knowing the relationship among several factors and help interpret the perception of food by the human being linked to the pleasure experienced in its consumption.[9] Sensory analysis comes up as an important instrument to assess the potential of insertion of new product into the market.[8]

Within this perspective, the aim of the present study was to determine which sensory characteristics are preferred by consumers for the globe artichokes. This will allow to propose strategies for their production and commercialization and increase the consumption of this functional food.

Materials and methods

The work was carried out with globe artichoke heads harvested during September and October of 2017 in the area of Rosario (33° LS, 60° 59W, Argentina). Three cultivars were used (Figure 1): the hybrids Opal (1.a) and Madrigal (1.b), both from the Nunhems Company, and the Romanesco, also known as French variety (1.c), produced using asexual reproduction, being the most traditional farming material in the area.

For the sensory evaluation, the method called CATA (Check All That Apply) was used, which consists of the participants selecting the terms that they consider appropriate for the description of each product from a set of terms provided (Valentin et al., 2012). For the selection of these terms previous sessions were conducted with trained assessors. To determine the shape of the head, the classification shown in Figure 2 was used.[11]

In order to make the descriptors of the heads more accessible to consumers who participated in the test, terms that were more familiar to them were used; the circular and long elliptical forms were jointed under the term "compact", oval and triangular as "ovoid" and the long transverse elliptical form was identified as "flat" (Figure 2).

The color of the bracts was established by differentiating between green (Figure 3a) and violet (Figure 3b) and the percentage of parts that are edible was evaluated according to Figure 3c. The presence of "hairs or thorns", presented by the very developed flowers and that appear when the heads are overripe, was identified as shown in Figure 3d.[11]

As a result of this preliminary work, the trained assessors selected 21 terms with which the score sheet was drawn (Figure 4). Terms were randomly presented in order to avoid any mistake related to the order.[12] Consumers also had to indicate their preference in a hedonic verbal scale of 9 points.[13]

Fifty people participated in the test,[14] aged between 20 and 60 years old. They were the students and teachers of culinary schools of Rosario, such as the "Asociación de Empresarios Hoteleros Gastronómicos de Rosario" (AEHGAR), "Instituto Superior" (ISHYR), "Instituto de María de los Ángeles Soso" (MAS) and students of "Licenciatura en Nutrición de la Universidad del Centro Educativo Latinoamericano" (UCEL). Participants were selected considering their knowledge of food, their taste and preference for ingredients, their ability to observe and their vocabulary to describe food.

The heads of the three cultivars were presented raw, in order to evaluate their appearance, and cooked to the point of tenderness, to complete the evaluation of the sensorial characteristics.

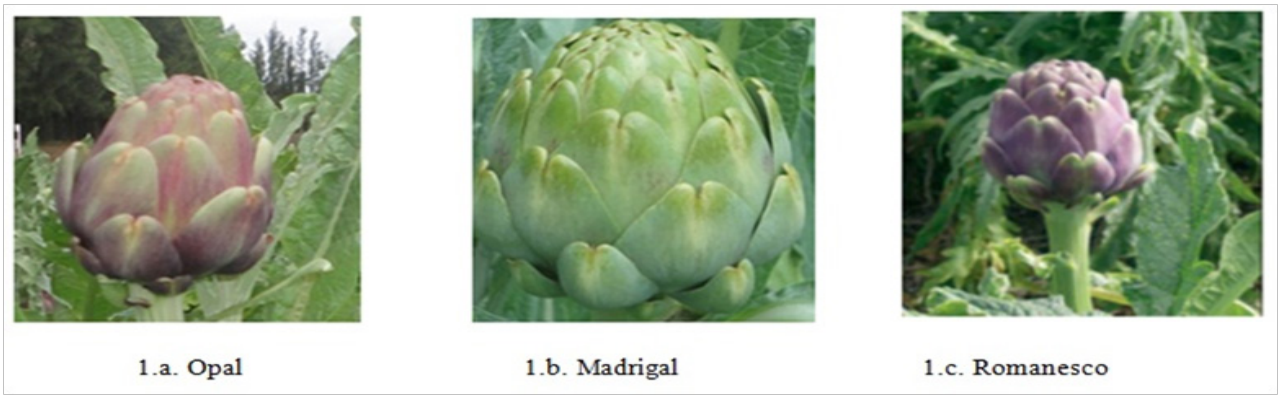

Figure 1 Cultivars used for consumer test.

Figure 2 Different forms of globe artichoke head.

The results of the CATA test were analyzed using multivariate statistics, applying the Correspondence Analysis (CA) methodology by R-project v.3.3.3.[15] CA is a multidimensional scaling multivariate technique that uses non-metric data in the crossed design to create percentage maps including all variable categories.[16]

Results and discussion

Table 1 shows the number of times that consumers marked each statement. It was observed that the descriptors inedible bracts, tomato flavor and aroma were practically not marked by the participants, so they were excluded from the statistical analysis so as not to generate distortions.

The most marked terms were "Ovoid", "Green or Purple bracts", "Bitter taste", "Herbaceous aroma", "Tender texture" and "Presence of hair or spikes". In order to better appreciate the relationship between the CATA terms and the hedonic points, a Correspondence Analysis (CA) was conducted (Figure 5).

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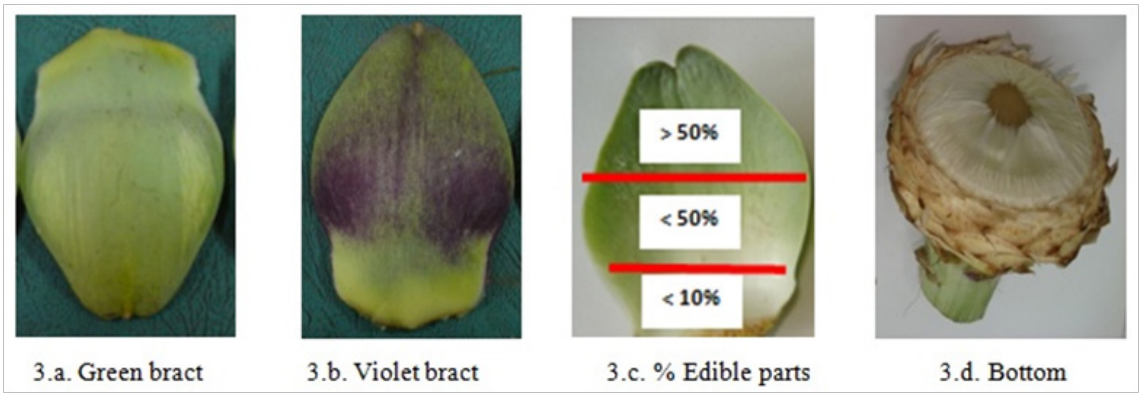

Figure 3 Parameters established for the evaluation of samples.

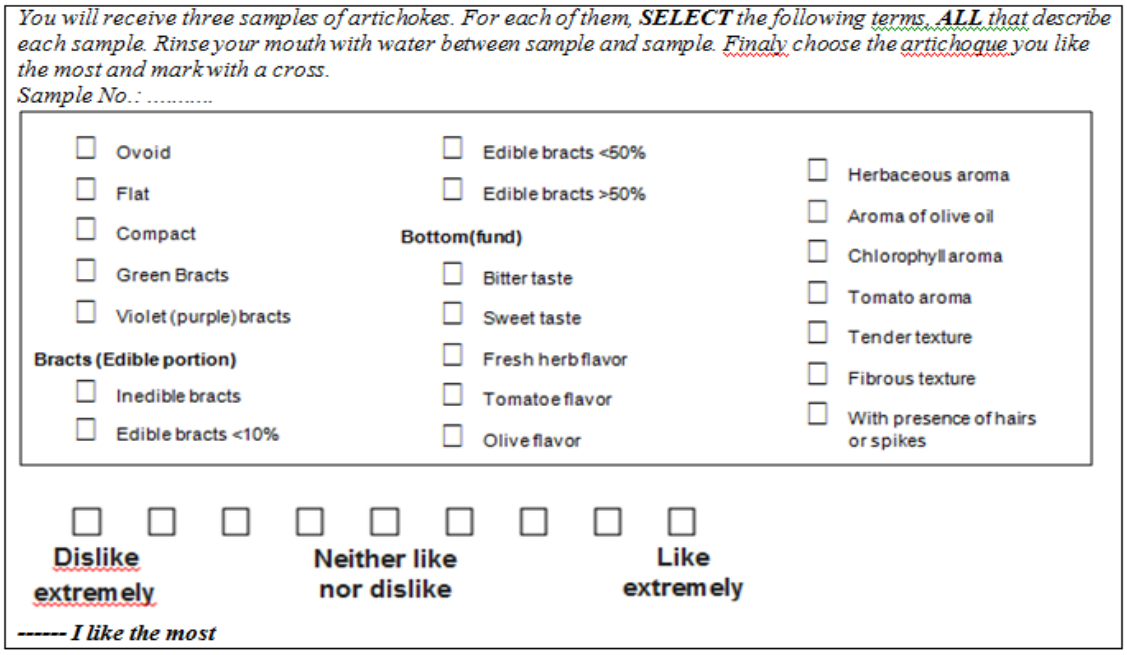

Figure 4 Example of CATA score sheet.

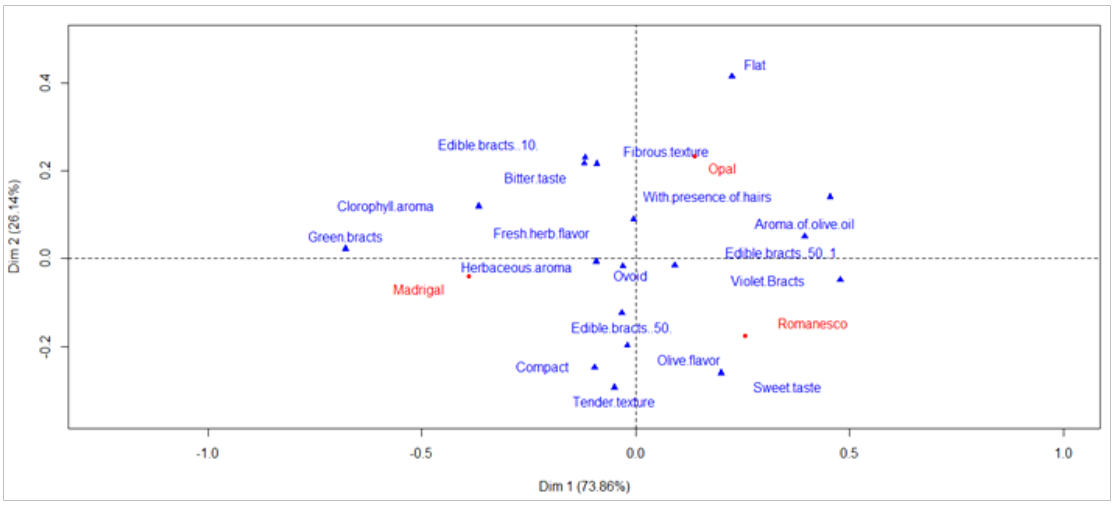

Figure 5 Factorial Map obtained by Correspondence Analysis on the evaluations carried out on Romanesco, Madrigal and Opal.

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Table 1 Frequencies of markings for each term of the CATA questionnaire

	Ovoid	Flat	Compact	Green Bracts	Violet bracts	Inedible bracts	Edible bracts <10%	Edible bracts <50%	Edible bracts >50%	Bitter	Sweet	Fresh herb flavor	Tomato Flavor	Olive flavor	Herbaceous aroma	Aroma of olive oil	Chlorophyll aroma	Tomato aroma	Tender texture	Fibrous Texture	Presence of hair or spikes
Romanesco	35	4	25	9	47	0	9	25	14	21	15	14	1	9	28	9	3	0	36	14	34
Madrigal	42	3	25	47	11	0	15	24	11	32	8	15	0	8	29	3	8	0	32	23	9
Opal	33	8	12	16	34	2	16	17	12	35	7	16	1	5	25	8	5	1	15	24	35

The first dimension (Dim 1) explains 73.86% of the differences found between the globe artichokes. The most distinguishing elements are the color, "green" for Madrigal and "violet" for Romanesco and Opal, and the "Clorophyl aroma" or the "Aroma of olive oil", respectively. The "presence of hairs" is a descriptor close to the Romanesco and Opal artichokes, indicating that the Madrigal artichoke does not have this characteristic.

In the second dimension (Dim 2), 26.14% of variations are explained. The descriptors of form "flat" and "compact", of taste "bitter" and "sweet" and of texture "fibrous" and "tender" were the terms that differentiated the samples. Romanesco and Madrigal were described as sweeter, tender and compact, unlike the Opal hybrid was described as bitter and fibrous.

Figure 6 shows the preference of consumer for these artichokes. When associating these results with which was the alcaucil that he liked the most, it was observed that the Romanesco obtained the best rating. It was preferred by 48.6%, while Madrigal and Opal obtained 27.0% and 24.3% of preferences, respectively.

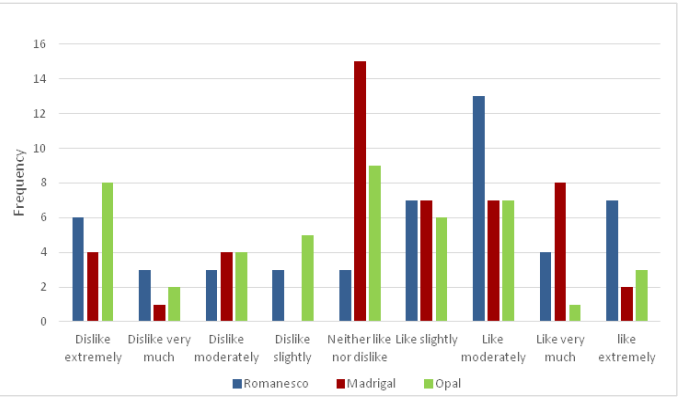

Figure 6 Frequencies of preference of the consumers for the different cultivars Romanesco, Madrigal y Opal.

CA on the preference of consumers for these artichoques showed that Madrigal was closed to the neutral phrase "Neither like or dislike", but the phrases related to disgust were around Opal. Instead, Romanesco was nearby to the "Like extremely" and "Like moderately" phrases, but also "Dislike very much" was near too (Figure 7).

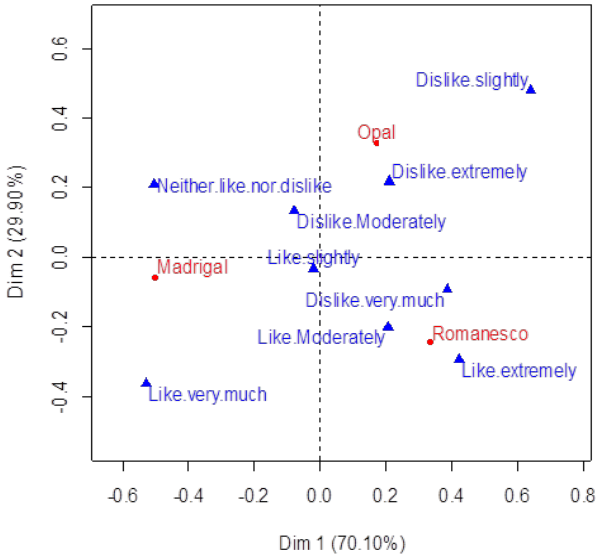

Figure 7 Correspondence Analysis on the preference of the consumers for the different cultivars Romanesco, Madrigal y Opal.

In short, the Romanesco had consumers who appreciate it but it also had detractors; Madrigal was more homogenous, and Opal had the more negative comments. Participants preferred tender and sweet artichokes, characteristics offered by the Romanesco.

Segovia et al.[17] reported that consumers from Texas (USA) preferred fresh, large and green artichokes compared to small and violet canned cultivars; since the taste, the freshness and the aspects related to the nutrition are the three main factors that influence in the decisions of purchase of the artichoke consumers. The different preferences for color and size of the heads is associated with each country, as is usual for all foods whose consumption is related to culture.

While in Spain green and small heads are preferred (Blanca de Tudela), in Italy they opt for the violet and median variety (Romanesco). In Bretagne (France), they prefer green and large heads (Camus de Bretagne) and in Provence (France), violet and medium heads (Violeta de Provenza).[18] Aubert et al.[19] agreed that the color of

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the head is the variable that has the most influence on the habits of consumption of each zone.

Conclusion

The CATA technique made it possible to obtain information about the sensorial characteristics of the three globe artichoke cultivars that were evaluated, differentiating them and associating them with the preference of consumers. It proved to be an important tool for researching consumer market.

Consumers prefered sweet and tender artichokes. This information will guide the production strategies to offer cultivars that meet these characteristics.

It is necessary to continue this line of work, to deepen the knowledge of the different cultivars in relation to consumers and the use of artichokes.

Acknowledgments

None.

Conflicts of interest

The author declares that there is no conflicts of interest.

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