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Flash Profile for rapid descriptive analysis in sensory characterization of passion fruit juice

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ABSTRACT. The Flash Profile is a descriptive analysis method derived from Free-Choice Profile, in which each taster chooses and uses his/her own words to evaluate the product while comparing several attributes. Four passion fruit juices were analyzed, two juices were produced with concentrated juice, one with pulp and one with reconstituted juice; all juices had different levels of sugar, some had gum and dyes. This study aimed to evaluate the physicochemical properties (color, titratable acidity and solid content) as well as sensory analysis like Flash profile and affective test. In physicochemical characterization and in Flash Profile, the juice A (pulp) had higher solid content and consistence, the juice B (concentrated juice) was the least acidic and presented the lowest value of soluble solids and presented strong aroma and flavor of passion-fruit, the juice C (reconstituted juice) was pale yellow and showed artificial flavor and the juice D (concentrated juice) was the most acidic, consistent with the natural flavor. In the acceptance test, all the juices scored 5-6, indicating that panelists tasters neither liked nor disliked. Flash Profile proved to be an easy and rapid technique showing a good correlation between panelists and the attributes and confirmed the results of physicochemical characterization.

Keywords: free-choice profile, generalized procrustes analysis.

Emprego do Perfil Flash uma alternativa para análise descritiva rápida na caracterização sensorial de sucos de maracujá

RESUMO. O Perfil Flash é um método descritivo, derivado do Perfil Livre, em que cada provador escolhe e usa suas próprias palavras para avaliar o produto quanto à comparação de diversos atributos. Quatro amostras de sucos de maracujá foram analisadas, dois sucos foram produzidos com suco concentrado, um com polpa e outro com suco reconstituído, todos possuíam diferentes quantidades de açúcares, alguns tinham espessantes e corantes. Este estudo teve o objetivo de avaliar as características físico-químicas (cor, acidez titulável e conteúdo de sólidos) assim como análises sensoriais como o Perfil Flash e teste afetivo. Na caracterização físico-química e no Perfil Flash, o suco A (polpa) teve maior conteúdo de sólidos solúveis e consistência, o suco B (suco concentrado) foi o menos ácido e apresentou baixos valores de conteúdo de sólidos solúveis e forte aroma e sabor de maracujá, o suco C (suco reconstituído) apresentou cor amarela fraca e sabor artificial e o suco D (suco concentrado) foi o mais ácido, consistente e com sabor natural. No teste de aceitação, todos os sucos obtiveram notas entre 5 e 6 pontos, demonstrando que os provadores nem gostaram ou desgostaram. O Perfil Flash provou ser uma técnica fácil e rápida com boa correlação entre os provadores e os atributos e foi concordante com os resultados físico-químico.

Palavras-chave: perfil livre, análise de procruste generalizada.

Introduction

The Free-Choice Profile is an alternative method to enable panelists to be free to express themselves in descriptive terms, reducing the analysis time once it does not require previous training. Among conventional descriptive tests, the Free-Choice Profile is closer to consumers based on the principle that people perceive the same sensory properties even when expressing themselves differently. The results are analyzed through Generalized Procrustes Analysis (GPA), whose principle is to make the configurations for each taster closer to a consensus by transforming the results in order to prevent variations in the scale used or descriptors (MEILGAARD et al., 1999; OLIVEIRA; BENASSI, 2003; STONE; SIDEL, 1998; RICHTER et al., 2010).

The procedures are described as the use of a session to individually develop the descriptors and another session in which the tasters are informed about all descriptors proposed by other members in the panel,

which would enable them to change their individual list before the analysis. In this way, all the members in the panel had to finish the first session in order to proceed with the analysis (final ordination session). Considering that the Free-Choice Profile concept is about tasters using the descriptors they wish, with no training or discussion with the panel, the procedure proposed for Flash Profile could be individualized and synthetized in only one session to allow larger panels with an approach concerning studies on consumers (DEHLHOLM et al., 2012; LASSOUED, et al., 2008; SANTOS et al., 2013; TERHAAG; BENASSI, 2010).

Sensory analysis also uses the affective tests (also known as hedonic or consumer test) to evaluate individual responses regarding preference and/or acceptance of a given product or concerning its particular properties by using habitual or potential consumers. The acceptance test is highly relevant since it reflects the level at which consumers like or dislike a given product by using the structured 9-point hedonic scale easily understood by tasters (STONE; SIDEL 1998).

This study applied the flash profile to passion fruit juices. Brazil stands out as the largest producer of passion fruit. The yellow passion fruit is one of the most popular and well known tropical fruit, has an exotic ester aroma with a sharp sulfury note. Furthermore, it has a very complex volatile composition, and the juice has pronounced aroma and flavor. Flavor and aroma are the result of numerous compounds, which have quite variable concentrations and contribute differently to the overall aroma and flavor at very different levels, depending not only on the chemical nature, but also on their concentrations (DELLA MODESTA et al.; 2005; FERRARI et al., 2004; SANDI et al., 2003; VIANNA-SILVA et al., 2008).

Studies of sensory and physicochemical characteristics in food have been conducted to guide sensory analysis. Furthermore, such evaluation allows a better understanding on the factors that change sensory profiles of foods, contributing to optimize production processes. In this context, this study aimed to characterize commercial passion fruit juices regarding their physicochemical attributes and apply sensory analysis, through Flash Profile and Affective Tests.

Material and methods

The experiments were conducted in the laboratories of Food Engineering Department, State University of Maringá (UEM), Maringá, Paraná State.

Material

Four commercial juices purchased in supermarkets in Maringá were used; they present differences in composition and sensory acceptance. Table 1 presents the composition of the samples, corresponding to the brands found in the market and more consumed in the region. In general, there are six brands, four were selected, which contained different ingredients and similar price.

Table 1. List of ingredients of commercial passion fruit juices.

Sample	List of Ingredients
A	Water, sugar, passion fruit pulp, acidulant: citric acid, flavoring: aroma identical to natural, antioxidant ascorbic acid and natural beta carotene dye.
B	Water, passion fruit concentrate, sugar, stabilizer carboxymethylcellulose, natural passion fruit flavor and ascorbic acid (vitamin C). Without preservatives.
C	Water, reconstituted passion fruit juice, sugar, natural flavor, citric acid and xanthan gum thickener.
D	Water, sugar, passion fruit juice concentrate, vitamin C, acidulant citric, stabilizer, sodium carboxymethylcellulose and guar gum, antioxidant, ascorbic acid, natural dye: beta carotene

Methods

Physicochemical characterization

pH was measured with a digital potentiometer and the titratable acidity was determined according to the AOAC (1995) methodology. For acidity analysis, the solutions were titrated with 0.1N NaOH to pH 8.4 and the result was expressed in g $100g^{-1}$ of the product. The content of Total Soluble Solids was determined through digital refractometer (refractometer ABEE, Biobrix), expressed in ºBrix (AOAC 1995). For color instrumental analysis, we used a CR-10 colorimeter (Hunter Lab), Cielab color system, which directly provided the parameters L* (luminosity), a* (red-green component) and b* (yellow-blue component). The results were evaluated by Analysis of Variance (ANOVA) and Tukey's test at 5% significance level (STATISTICA, 2004).

Sensory Analysis

The volunteers signed an Informed Consent, approved by the Research Ethics Committee of State University of Maringa (Protocol 0122.0.093.0.0010). The sensory tests were carried out in the Sensory Analysis Laboratory, Food Engineering Department, State University of Maringá (UEM) in 2012, whose facilities include individual cabins, lighting and room temperature control. For evaluation, 30 mL of each sample at 4°C were served in disposable plastic cups codified with three-digit random numbers. Tasters were required to rinse their mouths with water at room temperature before and between samples. In the Flash Profile, all samples were presented in each session, while in the affective test, the samples were presented monadically.

Flash Profile Protocol.

Eighteen non-trained panelists were selected for the Flash Profile: 12 women and 6 men, 77% aged 18 to 25 years old and 23% aged 25 to 35 years old. Two panelists have provided different evaluation from the others and thus were excluded from the group. Before the test, there was a brief explanation on the Flash Profile method to each taster with a description of the fundamental steps. A protocol to be used for attribute survey during the analyses was also presented, with instructions on the evaluation on attributes of appearance (observing color and aspect), aroma (smelling the sample twice), flavor (tasting the drink), texture (moving the drink in the cup and evaluating the sensation felt in the mouth) and also any sensation in the oral cavity after swallowing (residual). To ordinate the attributes, the beverages were simultaneously presented, the tasters were asked to write down similarities and differences.

After the ordination of attributes through an individual interview with each participant, we created a sample evaluation form and a list of attribute definition to each taster. After, samples were presented again and the tasters were oriented on how to ordinate the samples according to an ascending intensity order for each attribute previously defined by using the form presented in Figure 1. Tasters were instructed to possibly change their forms during the ordination procedure by excluding or including attributes or even changing definitions in the glossary. In general, the total time of the session varied from 40 to 60 minutes for each taster.

The results were analyzed through Generalized Procrustes Analysis using the software Senstools 2.3.28 (OP and P PRODUCT RESEARCH, 1998). Data were inserted in a matrix (one for each taster) of four rows (samples) and the number of columns varied according to the attributes ordered.

Name:_____Date ___/___/___

Please, taste the samples and sort them in ascending order for each attribute

Attributes	Attribute Description	Ascending order			

Figure 1. Form for evaluation by the descriptive Flash Profile technique.

Affective Test

Sample acceptance was evaluated by 50 consumers. The test was carried out in a session where each taster sequentially received a cup of each three-digit randomly codified sample. In order to evaluate the sample acceptance, the tasters used a 9-point hedonic scale (9= like extremely; 5= neither like nor dislike; 1= dislike extremely) (STONE; SIDEL 1998). The form used is illustrated in Figure 2. The results were analyzed by Analysis of Variance (ANOVA) Tukey's test at 5% significance level (STATISTICA, 2004).

Acceptance Test

Name: Date:

Evaluate the sample of passion fruit juice, using the scale below to describe how you like or dislike the product

Sample code: _____

1 - Dislike extremely
2 - Dislike very much
3 - Dislike moderately
4 - Dislike slightly
5 - Neither like nor dislike
6- Like slightly
7- Like moderately
8 - Like very much
9 – Like extremely

Comments:_____

Figure 2. Acceptance test form.

Results and discussion

Physicochemical characterization of juices

The results of the physicochemical analysis of the commercial passion fruit juices are presented in Table 2.

Although all juices were yellow, the color evaluation was performed to identify differences in intensity. All samples presented negative values for a*, but lower than 2, revealing that the red color is not present in the product, while the green color hardly appears. The values for b* were positive and higher than 7.36, indicating the yellow color in the product. The juice D presented the highest values for L*, and b* and the lowest for a* and the strongest yellow color; the juice C presented the weakest yellow color, and A and B presented intermediate values ($p \leq 0.05$). The juice D was the most acidic, presenting low pH and high acidity, while the juice B was the least acidic ($p \leq 0.05$). Regarding the content of solids, juices A, C and D presented the highest numbers, being similar to each other, while the juice B presented the lowest value ($p \leq 0.05$).

Flash profile analysis

The tasters used several terms to characterize the appearance, flavor, aroma and texture of the juices. The number of attributes varied from 5 to 9. The behavior of the panel was analyzed through the first three dimensions responsible for 90.11% explanation presented in Table 3.

Figure 3 illustrates the dispersion of scores of panelists, indicating a slightly different behavior among the members. The individual configuration of samples for each panelist presented in Figure 4 was similar and presented low residual variance, varying from 1.37 (taster 1) and 0.26 (taster 18). Such results indicate a consensus.

In general, for Free-Choice Profile panelists, we can observe a greater residual variance than for descriptive methods for training steps. The greatest consensus observed in Flash Profile is probably due to the easy ordination procedure (KOBAYASHI; BENASSI, 2012; TERHAAG; BENASSI 2010). Such behavior had already been described by Richter et al. (2010), who compared the efficiency of Free-Choice Profile and QDA panels (using interval scales) through Descriptive Analysis by Ordination. Most of the terms used by tasters were similar and are listed in Table 4. The most used ones were: yellow color, brightness, consistence (appearance), presence of lumps, passion-fruit aroma, sweet aroma, passion-fruit flavor, sweet flavor, viscosity. The least used terms were residual flavor and artificial flavor.

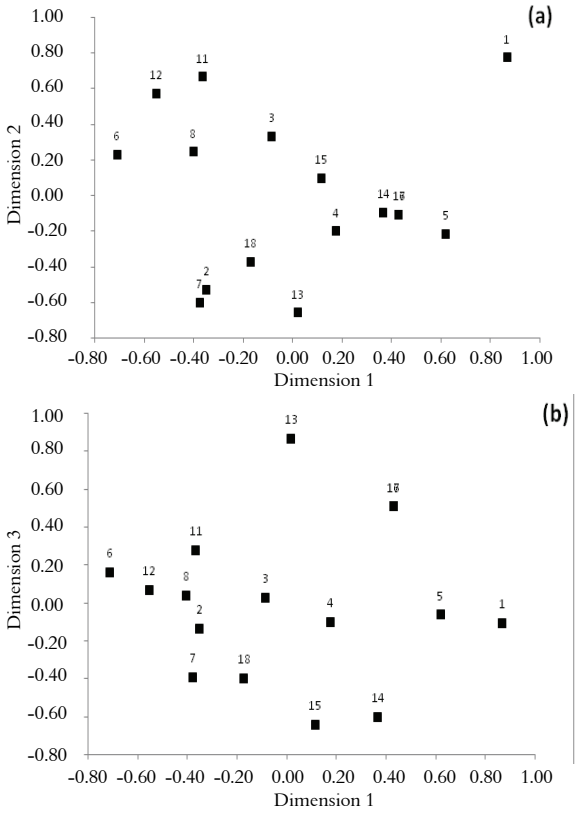

Figure 3. Overall configuration of taster in the dimensions D1 and D2 (a) and D1 e D3 (b) (tasters 1 to 18). Note: The analysis was performed without the tasters 9 and 10.

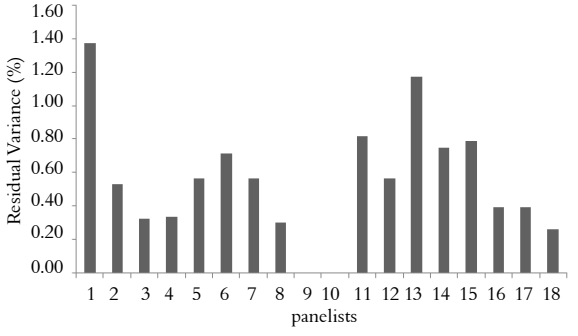

Figure 4. Distribution of the residual variance of the tasters in three-dimensional solution (Panelists 1 to 18). Note: The analysis was performed without the tasters 9 and 10.

As a criterion to select the most relevant terms to describe the sample, we decided to use attributes common to several panelists and with module correlation, for each panelist, higher than or equal to 0.70.

Table 2. Physicochemical characterization of passion fruit juices.

Sample	L*	a *	b*	pH	Acidity	Solid content
A	40.65 ± 0.12^{c}	-0.84 ± 0.02^{a}	7.61 ± 0.05^{c}	3.27 ± 0.02^{c}	5.13 ± 0.02^{b}	13.10 ± 0.04^{a}
B	41.30 ± 0.06^{b}	-1.43 ± 0.02^{c}	8.08 ± 0.06^{b}	3.78 ± 0.01^{a}	4.57 ± 0.02^{c}	12.13 ± 0.09^{b}
C	40.32 ± 0.07^{d}	-0.90 ± 0.03^{b}	7.36 ± 0.00^{c}	3.38 ± 0.01^{b}	5.15 ± 0.02^{b}	12.98 ± 0.08^{a}
D	43.17 ± 0.11^{a}	-1.63 ± 0.02^{d}	8.36± 0.09^{a}	3.15± 0.01^{d}	5.33 ± 0.02^{a}	12.83 ± 0.03^{a}

*Results correspond to the average of triplicates ±standard deviation. **Different letters in the same column indicate significant differences at 5% level of significance between samples.

Table 3. Explanation (%) of three-dimensional solution.

Dimension	Consensus	Residue	Total
D1	40.75	4.13	44.88
D2	28.53	3.00	31.52
D3	20.83	2.76	23.60
Total	90.11	9.89	100.00

Table 4. Attributes better correlated with the three dimensions (D1, D2, D3) for each panelists Flash Profile.

P*	Dimension 1	Dimension 2	Dimension 3
1	Yellow color (0.70); brightness (0.84); passion fruit aroma (0.80); sweet aroma (-0.80); passion fruit flavor (0.80); sweet flavor (-0.80); viscosity (0.80)	Presence of lumps (0.99)	
2	Yellow color (0.98); brightness (-0.98); artificial aroma of passion fruit (-0.89)	Passion fruit flavor (-0.99)	Consistency (appearance) (0.84); sweet aroma (-0.91); flavor of powdered drink (0.91); viscosity (0.91).
3	Yellow color (0.80); viscosity (appearance) (-0.71); passion fruit flavor (0.89); sweetness (0.81)	Brightness (-0.88); sweet aroma (-0.81); viscosity (0.88)	Passion fruit aroma (-0.87)
4	Yellow color (0.98); consistency (appearance) (0.80); viscosity (-0.80)	Passion fruit aroma (0.88), sweet aroma (0.99)	Brightness (0.91); passion fruit flavor (-0.87); sweetness (-0.91)
5	Yellow color (egg yolk) (0.70); passion fruit aroma (-0.98), passion fruit flavor (-0.98); sweetness (0.98)	Viscosity (-0.88)	Residual flavor (0.94)
6	presence of lumps (0.89); viscosity (appearance) (0.89); sweet aroma (0.89); sweetness (0.89)	Passion fruit aroma (0.99); passion fruit flavor (0.99); viscosity (-0.71)	Yellow color (-0.84)
7	Consistency (0.98); sweet flavor (0.89)	Viscosity (0.81)	Yellow color (fruit) (-0.84); passion fruit aroma (-0.94); passion fruit flavor (0.84)
8	Yellow color (0.98); passion fruit flavor (-0.89), sweetness (-0.89)	Passion fruit aroma (-0.99); sweet aroma (-0.99)	Brightness (0.87)
11	Passion fruit flavor (-0.89); viscosity (0.71)	Yellow color (0.99); brightness (-0.99); sweetness (0.99)	Passion fruit aroma (-0.94)
12	Yellow color (0.89); passion fruit aroma (-0.71), passion fruit flavor (-0.98); viscosity (-0.71)	Presence of lumps (0.99); sweetness (-0.99)	Brightness (-0.84)
13		Yellow color (-0.71); brightness (0.81); consistency (-0.71); passion fruit aroma (-0.81); sweet aroma (-0.81); viscosity (-0.71)	Passion fruit flavor (-0.84), sweetness (-0.84)
14	Yellow color (gold) (0.80); brightness (-0.80); consistency (appearance) (0.98); viscosity (0.98)	Passion fruit aroma (-0.88)	Sweet aroma (0.87), passion fruit flavor (0.87); sweetness (-0.87)
15	Yellow color (egg yolk) (0.98); brightness (-0.98); consistency (appearance) (0.98); passion fruit aroma (-0.89); passion fruit flavor (-0.89); sweetness (0.98); residual flavor (0.71); viscosity (0.98)		Presence of lumps (0.94)
16	Yellow color (snacks) (0.98); brightness (0.80); passion fruit flavor (0.98)	Presence of lumps (0.88); passion fruit aroma (-0.71); sweet aroma (0.81); sweetness (0.99); viscosity (-0.71)	Consistency (appearance) (-0.91)
17	Yellow color (egg yolk) (0.98); consistency (appearance) (0.80); sweetness (0.98)	Presence of lumps (0.88); sweet aroma (-0.71); passion fruit flavor (0.81); residual flavor (0.99); viscosity (-0,71)	Passion fruit aroma (-0.91)
18	Yellow color (0.98); brightness (-0.80); viscosity (0.89)	Passion fruit aroma (-0.81)	Passion fruit flavor (-0.84); sweetness (-0.87)

*Panelists were indicated by numbers 1 to 18. **The analysis was performed without panelists 9 and 10.

After using such criteria, the attributes regarded as more relevant when describing the beverages were the yellow color (positive correlation with D1), brightness (negative correlation with D1), consistence (appearance) (positive correlation with D1), passion-fruit aroma (negative correlation with D2), sweet aroma (positive correlation with D2), passion-fruit flavor (negative correlation with D1), sweet flavor (positive correlation with D1), and for in-mouth viscosity, there was no consensus despite of the significant correlation, for instance, it presented positive and negative correlations in dimensions 1 and 2. According to Terhaag and Benassi (2010), such behavior may be attributed to the little difference between samples and/or possibly there was greater difficulty in describing and applying such attributes.

The sensorial profile of sample A presented strong sweet aroma, sweet flavor and consistence

(Figure 5; Table 4) in contrast to the sample B, which presented strong yellow color, brightness, passion-fruit aroma and flavor (Figure 5; Table 4). Sample C presented strong yellow color, brightness, passion-fruit aroma, sweet aroma and passion-fruit flavor (Figure 5; Table 4) and the sample D exhibited strong yellow color, sweet aroma and flavor (Figure 5; Table 4). The sample A was probably the most consistent, since it was produced with passion-fruit pulp, while the other juices were produced with concentrated or reconstituted juice. Samples A and D were sweeter as the amount of sugar was the second most added ingredient. Finally, the sample B presented strong passion-fruit aroma and flavor once the concentrated juice was one of its main elements. Although the juice C had presented the thickener xanthan gum, the tasters did not identify such samples as the most consistent one. Samples A and D contained beta-carotene dye color, however the strongest yellow color was perceived in samples C and D. The sensory description obtained confirmed the results of physical and chemical characterization presented in the previous item.

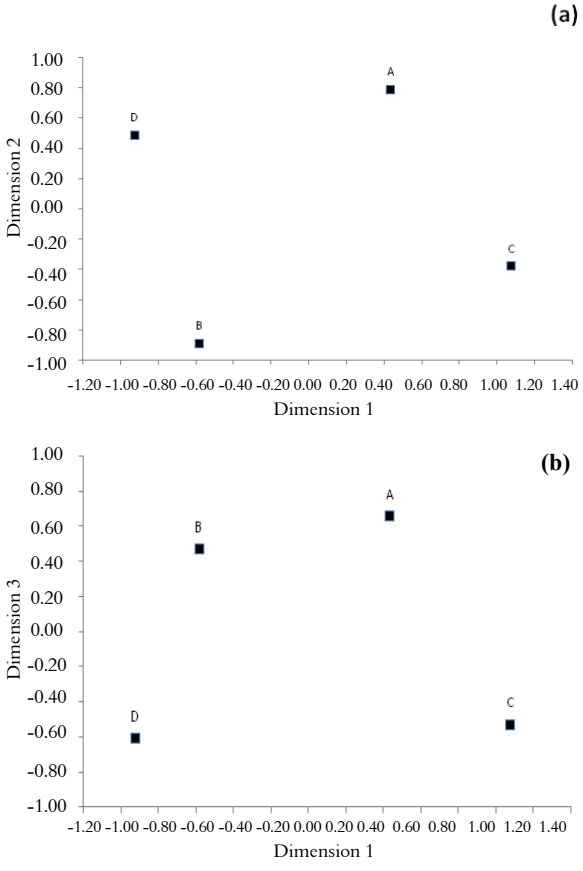

Figure 5. Consensus configuration of passion fruit juices (A, B, C and D) along the dimensions (a) D1 and D2, (b) D1 and D3.

Tasters 9 and 10 did not present consensus with the remaining tasters (Figure 6), and showed different results causing a slight distortion in the results. In this way, we decided to remove their results and perform the evaluation again, thus observing an increase in the explained variance.

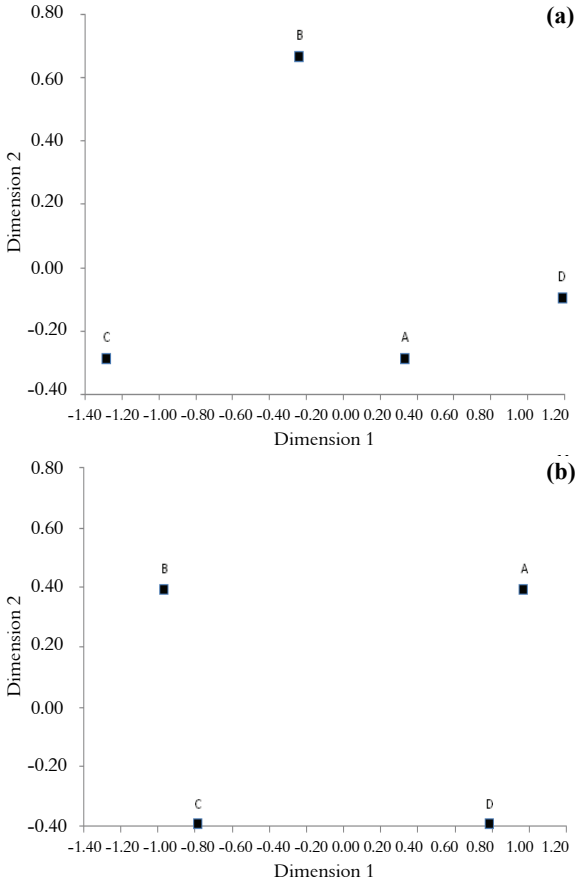

Figure 6. Configuration of samples for tasters 9 and 10.

Figure 7 presents the variance attributed to each sample considering the three-dimensional solution pointing the percentage associated to the consensus (at the bottom of the histogram) and the residual variance (at the top). It is relevant to highlight the low residual variance for all samples, demonstrating an agreement concerning the characterization by the members of the panel.

The sample C obtained the highest value for consensus variance (about 25%), which is related to the fact that it had extreme intensity for several attributes when ordered (Figures 5 and 7). In contrast, the sample A obtained 9% of consensus variance (Figure 7), in general, the values for consensus were close, not allowing a distinction whether there had been lower agreement among tasters or the beverages had presented intermediate attributes.

Figure 7. Variance distribution (%) of the consensus and residue in the three dimensional solution.

The descriptive analysis by the Flash Profile method presented consensual results among the panelists and in accordance to the ingredients and to the results of the physicochemical analysis, demonstrating the efficiency and good capacity in discriminating and describing the products analyzed.

Among the advantages, it is relevant to highlight that the description was obtained in only one session with untrained panelists, in which each one had less than 60 minutes to complete the test. Besides gaining time for panelists, we highlight the sample saving, about 100 mL of each juice for each taster. Taking into account the independence of analyses, the number of tasters may be increased, once there is an interest in providing the description with a focus on consumers (TERHAAG; BENASSI 2010).

Terhaag and Benassi (2010) observed that once the ordination procedure is easier to be performed when compared to the use of interval scales, the achievement of a consensus is also easier, although it is also limited, since the amount of samples to be evaluated is simultaneously restricted by the possibility of sensory fatigue. Another difficulty in applying the method is the necessity to apply the Generalized Procrustes Analysis, a less usual statistical technique, concerning data analysis.

Acceptance

The acceptance presented in Table 5 scored 5 – 6, indicating that tasters neither liked nor disliked. The samples B and D were the best accepted, probably because they were produced with concentrated juice, were less acidic and less sweet, resembling a natural juice. The sample C received the worst accepted, probably due to their pale yellow color, strong aroma and artificial flavor.

Table 5. – Results of the acceptability of passion fruit juices.

Samples	Acceptability	% Approval (scores 6 - 9)	% Indifference (score 5)	% Rejection (scores 1 - 4)
A	5.18 ± 0.022^{c}	46	10	44
B	6.24 ± 0.021^{a}	70	8	22
C	4.98 ± 0.020^{d}	44	10	46
D	5.78 ± 0.022^{b}	66	4	30

*Mean values followed by different lowercase letters in the same column are significantly different at $p \leq 0.05$. Hedonic Value = dislike extremely, 5 = neither like nor dislike, 9 = extremely like.

Conclusion

The Flash Profile method applied in only one session aiming to characterize passion-fruit juices proved to be efficient in rapidly describing a set of samples with untrained panelists. In the physicochemical characterization, the juice D presented the highest values for L*, and b* and the lowest for a* and had the strongest yellow color; the juice C presented the weakest yellow color. The juice D was the most acidic and the sample B was the least acidic one and presented the lowest value of solid content. In the Flash Profile, the sample A was probably the most consistent, since it was produced with passion-fruit pulp, while the other juices were produced with concentrated or reconstituted juice. The samples A and D were sweeter because the amount of sugar was the second most added ingredient. Finally, the sample B exhibited strong passion-fruit aroma and flavor, as the concentrated juice was one of its main elements. Although the juice C had presented the thickener xanthan gum, the tasters did not identify such samples as the most consistent. The juices B and D were the most accepted juices.

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