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Abstract

The aim of this work was to determine the sensory profile and stability of a new ready-to-drink passion fruit juice beverage sweetened with different sweetener systems: sucrose, aspartame, sucralose and an aspartame/acesulfame-K blend (4:1), during six months of storage. Samples of each beverage were stored at room temperature and under refrigeration, and were evaluated at 0, 60, 120 and 180 days of storage. Descriptive sensory profiles and the stability of the beverages were determined using a trained panel (n=8). The sweetener type played a very important role in the perception of color, sweet taste, sweet aftertaste and sour aftertaste. The beverages sweetened with sucrose and sucralose were the most stable with respect to those characteristics. In the beverages containing aspartame, on the other hand, the intensities of those descriptors were only preserved if stored under refrigeration. Storing the beverages under refrigeration was crucial to preserve the fresh fruit aroma and flavor characteristics in all the beverages, independently of the sweetener type, during at least 120 days of storage, period after which those characteristics started to decrease at the same time as the canned fruit aroma and flavor, overripe fruit aroma and fishy aroma and flavor increased. The results indicated that, based on the sensory profile, the best option of sweetener to be used in the ready-to-drink natural passion fruit juice

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beverage studied was the sucrose for the standard version and the sucralose for the light version.

Keywords: passion fruit, sweetener, sensory profile, stability, descriptive analysis, principal component analysis.

1. Introduction

The ready-to-drink fruit based beverages segment is growing all over the world due to consumer preference for healthier beverages. Global consumption of fruit beverages increased 30% from 2003 to 2009 (Neves, Milan, Trombin, & Pereira, 2011). Consumers want to enjoy beverages that not only quench thirst but also offer innovation, health, convenience and some nutritional value (Adbdullah & Cheng, 2001).

Among the tropical fruit juices consumed on both internal and external markets, passion fruit juice stands out due to its exotic and intense flavor, strong aroma, high acidity and pulp yield (Fernandes et al., 2011; Souza, Cardoso, Folegatti, & Matsuura, 2002). This beverage is very appreciated by Brazilian consumers, who are responsible for 90% of the total passion fruit juice consumed in the world (Vera, Dornier, Ruales, Vaillant, & Reynes, 2003; Sandi, Chaves, Souza, & Silva, & Parreiras, 2003). Passion fruit juice is also exported - mostly frozen and concentrated (50°Brix), to Holland, followed by the USA and Germany (Fracaro, 2004).

An increasing trend for the consumption of healthier and lower-calorie beverages is being observed all over the world. Simultaneous lifestyle changes have occurred in the last few decades creating an imbalance in energy intake and energy expenditure that has led to overweight and obesity. There is evidence that total daily calories available per capita increased 28% since 1970, and that total energy intake among men and women has also

increased dramatically since that time (Storey, 2010). In fact, in the US, slightly more than 85% of the population is reported to gain weight because of an average calorie excess of less than 25 calories a day. Yet 25 extra calories per day can gradually become a big problem over the long run (Wansink, 2007). Beverage manufacturers have responded with fewer calories per ounce and healthier credentials, which has resulted in a shift to lower-calorie, smaller-portion, and natural ingredients-based beverages. For instance, research by the Hartman Group shows that diabetes and overweight are the top two health conditions that food is used to prevent (Sloan, 2012).

Sweetness plays a major role in the sensory acceptance of many foods, especially beverages. Different sweetener types may provide similar sweetness but simultaneously impart different "flavor" characteristics to the beverage system in which they are used (Baldwin & Korschgen, 1979; Redlinger & Setser, 1987; Nahon, Roozen, & De Graaf, 1996). Relative sweetness is also influenced by temperature and acidity (Giese, 1992). Furthermore, the sweetness intensity of many high intense sweeteners may change during storage. Thus when food products and beverages are sweetened with high intense sweeteners, it is important to determine that the products have adequate shelf lives and that there is no effective loss of sweetness under the conditions of use or storage (Quinlan & Jenner, 1990). Moreover, maintaining the product with an acceptable flavor is crucial; at the same time consumers seek convenience, they don't want to give up the original flavor characteristics of a fresh product. Accordingly, the objective of this study was to determine the sensory profile and stability of a new ready-to-drink passion fruit juice beverage sweetened with different sweetener systems: sucrose, aspartame, sucralose and an aspartame/acesulfame-K blend (4:1), during six months of storage.

2. Material and Methods

2.1 Samples

The samples consisted of four ready-to-drink, Tetra-Pak® packaged passion fruit juice beverages, of which the ingredients included: passion fruit pulp (De Marchi Indústria e Comércio de Frutas Ltda®), propylene glycol alginate (ISP do Brasil®), natural passion fruit aroma (Givaudan®), water and sweetener. The standard beverage was sweetened with 10% sucrose (União®), and the light beverages with 10% sucrose equi-sweet concentrations of aspartame, sucralose and an aspartame/acesulfame-K blend (4:1): 0.043%, 0.016% and 0.026%, respectively (De Marchi, Mc Daniel, Bolini, 2009).

The sucrose, aspartame, sucralose and aspartame/acesulfame-K blend - sweetened beverages were stored at room temperature (20-25°C) and under refrigeration (2-5°C) during 6 months. Samples of each beverage, stored under both temperature conditions, were evaluated at each of the following shelf-life periods: 0, 60, 120 and 180 days. In order to avoid retraining the panelists at every period of evaluation, the samples were frozen and evaluated at the end of the study. Thus for each period of shelf-life (0, 60, 120 and 180 days), 250mL samples of each beverage, stored under both temperature conditions, were bottled into 375mL glass bottles, filled in with N_2, covered with plastic screw caps and frozen. Frozen samples were kept at -23°C until used. At the end of the shelf-life period, all the samples were thawed and submitted to Descriptive Analysis.

2.2 Descriptive analysis

The sensory profile of the four different-sweetened passion fruit juice beverages and the changes occurring in the beverages during 6 months of storage were monitored by a trained descriptive panel.

Eight panelists, from a group of 16 professional panelists from the Department of Food Science and Technology of Oregon State University (with a minimum of 250 hours of sensory work on a wide variety of foods using the Generic Descriptive Analysis), were selected according to their perception of sweetness and passion fruit flavor. Ranking tests with samples of passion fruit juice beverage containing five different concentrations of sucrose and passion fruit pulp were performed in triplicate, and the panelists who consistently differentiated the samples and replicated their results were selected to evaluate the beverages studied.

The panelists were trained in 12 sessions over a period of 4 weeks. In the initial training sessions, the panelists evaluated the samples and generated their own descriptive terms for appearance, aroma, flavor, texture and aftertaste. In subsequent sessions, reference materials were provided to help standardize the panelists in the use of each descriptive term. Further training sessions and group discussions under the panel leader's guidance resulted in the final ballot, which was comprised of the following descriptive terms: color intensity, amount of particles, overall aroma intensity, overall fresh fruit aroma, passion fruit aroma, pineapple aroma, orange aroma, peach aroma, overall canned fruit aroma, overripe fruit aroma, fir-pine tree aroma, grassy aroma, fishy aroma, overall flavor intensity, sweet taste, sour taste, overall fresh fruit flavor, passion fruit flavor, pineapple flavor, orange flavor, peach flavor, overall canned fruit flavor, fishy flavor,

wateriness, astringency, sour aftertaste, sweet aftertaste, and artificial sweetness aftertaste. A written, consensus definition of each descriptive term was developed and reviewed by each panelist before each testing session (Table 1). The discussion and evaluation of a wide array of passion fruit beverages was also conducted during training to enable panelists to consistently differentiate and replicate the samples. The intensity of each descriptor was rated on a 16-point structured scale (0=none, 3=slight, 7=moderate, 11=large, 15=extreme). Intensity standards were provided as scale reference points to reduce the variability among panelists. The standards were anchored at point 3 (40 ml of safflower oil, Saffola Quality Foods Inc.), 7 (30 ml of orange drink, Hi-C, Coca Cola Foods), 11 (30 ml of grape juice, Welch's) and 13 (cinnamon bubble gum, Plen T-Pak Big Red). The panelists were also presented with reference solutions of basic tastes. An analysis of the data collected from training sessions confirmed that the panel results were consistent and that the terms were not redundant.

For the sensory evaluation, samples of each beverage were served at 5°C in tulip shaped wine glasses coded with random 3-digit numbers and capped with plastic lids. Sample evaluation was carried out in individual booths under white lighting.

<Table 1□

2.3 Experimental design

A randomized complete block design with full factorial treatment structure (4 types of sugar x 2 temperature conditions x 4 times of shelf-life study) was used to evaluate the appearance, aroma, flavor, texture and aftertaste of the 32 samples, which were evaluated in 8 distinct evaluation sessions. This procedure was repeated three times (three repetitions over the treatments), amounting to a total of 96 samples per panelist.

2.4 Data analysis

Principal components analyses (PCA), applied with the factor analysis were conducted using the SPSS statistical package (SPSS Statistics 15.0) and STATISTICA (Statsoft, Inc. Tulsa, Okla., USA). To facilitate interpretation of the results, the factors were orthogonally rotated, following the Varimax with Kaiser Normalization method. The attributes selected were those that had loadings with an absolute value greater than or equal to 0.6.

Analysis of variance (ANOVA) was performed on each attribute using a randomized complete block design for full factorial experiment, with panelists as a block and factors being the types of sugar, temperature conditions and storage time ($p \leq 0.05$). In order to evaluate differences in sensory characteristics of samples, paired comparisons of the means were carried out both to compare the sweetener systems and the storage conditions using the Tukey HSD test ($p \leq 0.05$).

3. Results and Discussion

3.1 Principal Component Analysis (PCA)

To visualize, in the space, the differences and the similarities among the samples and the correlations among the descriptors, PCA was applied to the means attribute ratings to simplify interpretation of data from 26 attributes measured on eight products in each storage time. Loadings with an absolute value greater than or equal to 0.60 were considered as representing a strong influence.

At 0 day of storage, two rotated principal components (PC) accounted for 43.72% of the total variance (Figure 1).

The descriptors that showed higher positive correlation with PC1 were passion fruit flavor, passion fruit aroma, overall fresh fruit flavor, overall fresh fruit aroma, pineapple flavor, pineapple aroma, peach flavor, peach aroma, overall aroma intensity, and sweet taste. PC2 was highly positively correlated with orange aroma and orange flavor, and highly negatively correlated with sour taste, sour aftertaste, and wateriness (Figure 1). As shown in Figure 1, the four different-sweetened beverages were very similar to each other and were associated with "fresh fruit" notes and sweet taste. It is important to note that, at this time point, the beverages SR, AR, LR and MR were identical to the beverages SRe, ARe, LRe, and MRe.

<Figure 1□

At 60 days of storage, two rotated principal components (PC) accounted for 45.08% of the total variance (Figure 2).

PC1 was highly positively correlated with pineapple aroma, passion fruit flavor, pineapple flavor, overall fresh fruit flavor, peach aroma, passion fruit aroma, peach flavor, overall fresh fruit aroma, and orange aroma. PC2 was highly positively correlated with overall canned fruit flavor, overall canned fruit aroma, fishy aroma, and fishy flavor, and highly negatively correlated with color intensity (Figure 2). At this time point the temperature of storage started to play a major role on sample differentiation. Overall, meanwhile the beverages stored under refrigeration (SRe, ARe, LRe, and MRe) were more strongly associated with "fresh fruit" notes, "canned fruit" and "fishy" notes started to be perceived in the beverages stored at room temperature, and these changes were especially noticed on the beverages sweetened with sucralose (LR) and aspartame (AR).

<Figure 2□

At 120 days of storage, two principal components (PC) accounted for 41.40% of the total variance (Figure 3).

PC1 was highly positively correlated with peach flavor, pineapple aroma, pineapple flavor, peach aroma, orange aroma, orange flavor, passion fruit flavor, and overall fresh fruit flavor. PC2 was highly positively correlated with sour aftertaste, passion fruit aroma, overall fresh fruit aroma, passion fruit flavor, astringency, and sour taste, and highly negatively correlated with overripe fruit aroma, overall canned fruit flavor, fishy flavor, and overall canned fruit aroma (Figure 3). At this time point, differentiation among samples by temperature of storage became even more evident. Overall, the four different-sweetened beverages stored under refrigeration (SRe, ARe, LRe, and MRe) were more strongly associated with "fresh fruit" notes as compared to the same beverages stored at room temperature (SR, AR, LR, and MR). These changes were especially perceived for the beverages sweetened with sucrose and aspartame/acesulfame-K. Differences on the intensity of "canned fruit" and "fishy" characteristics depending on the temperature of storage were also more evident on the last two types of beverage.

<Figure 3□

At 180 days of storage, two principal components (PC) accounted for 50.60% of the total variance (Figure 4).

PC1 was highly positively correlated with pineapple aroma, peach aroma, pineapple flavor, peach flavor, passion fruit aroma, passion fruit flavor, overall fresh fruit aroma, and overall fresh fruit flavor. PC2 was highly positively correlated with fishy flavor, fishy

aroma, overall canned fruit flavor, overall canned fruit aroma, overall aroma intensity, and overripe fruit aroma, and highly negatively correlated with color intensity, and orange flavor (Figure 4). Again, the four different-sweetened beverages stored under refrigeration (SRe, ARe, LRe, and MRe) were more strongly associated with "fresh fruit" notes as compared to those stored at room temperature (SR, AR, LR, and MR). Some differentiation in function of type of sweetener also became evident at this time point. The sucrose and the sucralose-sweetened beverages stored under refrigeration (SRe and LRe) were distinctively higher in "fresh fruit" notes than the beverages containing aspartame (ARe and MRe). Moreover, the beverages sweetened with aspartame and aspartame/acesulfame-K blend that were stored at room temperature (AR and MR) were associated with the highest intensity of "fishy" notes, while the standard beverage stored under refrigeration (SRe) presented the lowest intensity of "fishy" and the highest intensity of orange aroma, orange flavor, and color.

<Figure 4□

3.2 Analysis of variance

The results of the analysis of variance are presented in Tables 2-5 and Figures 5a-c.

<Table 2□

<Table 3□

<Table 4□

<Table 5□

For most descriptors, significant effects ($p \leq 0.05$) for type of sweetener, temperature of storage, and time of storage were obtained. Also, significant interaction effects ($p \leq 0.05$) such as time of storage x temperature of storage, time of storage x sweetener type, temperature of storage x sweetener type, and sweetener type x temperature of storage x time of storage, were obtained for some attributes.

The most important differences across the beverages (sweetener type) during storage time were observed for color intensity, sweet taste, sweet aftertaste, amount of particles, artificial sweetness aftertaste (Tables 2-5, Figure 5a), sour taste, and sour aftertaste (Tables 2-5).

For both temperatures of storage, the perceptions of color intensity were significantly higher ($p \leq 0.05$) for the beverages sweetened with sucrose (S) and sucralose (L) than for those sweetened with aspartame (A) and the aspartame/acesulfame-K blend (M) during the whole storage period (Tables 2-5; Figure 5a). At 60, 120 and 180 days of storage, this descriptor was also influenced by the temperature conditions. At 60 days of storage the aspartame-sweetened beverage (A) kept under refrigeration showed significantly higher scores than the same beverage stored at room temperature ($p \leq 0.05$). At 120 and 180 days all the beverages kept under refrigeration showed significantly higher scores than those kept at room temperature ($p \leq 0.05$).

Concerning the sweet taste and the sweet aftertaste, when stored at room temperature, a gradual decrease on the intensity of these descriptors during storage time was observed for the beverages containing aspartame (A and M). These beverages were perceived significantly less sweet ($p \leq 0.05$) from the first 60 days of storage. On the contrary, the beverages sweetened with sucrose (S) and sucralose (L) maintained its

sweetness intensity over time independently of the temperature of storage (Tables 2-5, Figure 5a).

Further differences across the beverages (sweetener type) were observed for amount of particles and artificial sweetness aftertaste (Tables 2-5, Figure 5a).

As can be seen in Tables 2-5 and Figure 5a, during the entire period of storage, at both temperature conditions, the amount of particles for the light beverages (A, L, M) was significantly superior to that for the standard beverage (S) ($p \leq 0.05$). Moreover, for the light beverages stored under refrigeration, this descriptor did not change over time ($p \leq 0.05$) while for the light beverages stored at room temperature it started to decrease after 120 days of storage.

With respect to the artificial sweetness aftertaste, when the beverages were stored at room temperature, this descriptor was perceived significantly higher, during the entire period of storage, for the sucralose-sweetened beverage (L) ($p \leq 0.05$), and for both the sucralose-sweetened beverage and the aspartame-sweetened beverage (L and A) when stored under refrigeration ($p > 0.05$) (Tables 2-5; Figure 5a).

Finally, the sour taste and the sour aftertaste (Tables 2-5) were perceived to be slightly higher for the beverages sweetened with aspartame (A) and the aspartame/acesulfame-K blend (M) than for the standard beverage (S) when stored at room temperature for 120 and 180 days.

Concerning the differences across the temperatures of storage as a function of time, fresh fruit, canned fruit, overripe, and fishy aroma and flavor descriptors played a major role in differentiating the samples (Tables 2-5, Figures 5b-c). The only descriptors that did

not show significant differences ($p>0.5$) for temperature of storage were overall flavor, wateriness, and artificial sweetness. Despite that, it is worth noting that such attributes showed significant differences among the sweetener type ($p\leq0.5$).

For all beverages stored at room temperature, the perceived intensities of overall fresh fruit aroma, passion fruit aroma, overall fresh fruit flavor and passion fruit flavor gradually decreased during the period of storage while the beverages stored under refrigeration maintained the levels of these characteristics up to 120 days of storage (Tables 2-5; Figure 5b). At 180 days of storage, only the light beverages – especially those containing aspartame (A and M) – showed a slight decrease on the intensity of those descriptors.

Pineapple aroma, orange aroma, peach aroma, pineapple flavor, orange flavor and peach flavor were perceived at low levels in all beverages. However, these descriptors were also influenced by temperature of storage, being perceived slightly higher for the beverages stored under refrigeration (Tables 2-5).

Also, for all beverages stored at room temperature, the perceived intensities of overall canned fruit aroma, overripe fruit aroma, fishy aroma, overall canned fruit flavor and fishy flavor gradually increased during the period of storage (Tables 2-5; Figure 5c) while the beverages stored under refrigeration maintained the levels of these characteristics up to 120 days of storage. At 180 days of storage, only the light beverages stored under refrigeration – especially the aspartame/acesulfame-K blend (M) beverage - showed a slight increase on the intensity of those descriptors.

The ANOVA analysis showed, in general, that the storage temperature played a major role on most of the descriptors' changes over time, the refrigerated temperature being

much more suitable for preserving the original sensory properties of the beverages, especially after 120 days of storage, when the most expressive changes were observed.

<Figure 5a□

<Figure 5b□

<Figure 5c□

3.3 General discussion

Sweetener type played a very important role in the perception of color, sweetness, and sourness. The beverages sweetened with sucrose and sucralose were the most stable with respect to those characteristics, independently of storage temperature. In the beverages sweetened with aspartame and aspartame/acesulfame-K blend, on the other hand, the intensities of those descriptors were only preserved if stored under refrigeration. These results were in line with those of Quinlan and Jenner (1990), who studied the stability of sucralose in carbonated beverages and instant black coffee during 12 months, using HPLC and sensory analysis. They observed no significant changes in the sucralose level in any of the products investigated, that is, no loss of sweetness nor any interaction with other sample ingredients during storage, even when subjected to elevated temperatures.

Storing the beverages under refrigeration was crucial in order to preserve the fresh fruit aroma and flavor characteristics, as well as the color intensity characteristics, in all the beverages, independently of sweetener type, during a minimum period of 120 days. Only after 120 days of storage did these "positive" characteristics start to decrease. Storing the beverages at room temperature, on the contrary, not only favored the loss of these characteristics, but also contributed to the appearance and/or increase in the intensity of

"negative" characteristics, such as canned fruit aroma and flavor, overripe fruit aroma, and fishy aroma and flavor. It is worth noting that these changes in the beverages stored at room temperature were constant, from the first 60 days of storage. These results were in line with those of Talcott, Percival, Pittet-Moore and Celoria (2003), Sandi et al. (2003), and Kishore, Pathak, Shukla and Bharali (2011). Talcott et al. (2003) studied the stability of a pasteurized yellow passion fruit juice fortified with sucrose and ascorbic acid during 28 days at 37ºC. They observed that pasteurization (85ºC for 30 min) resulted in minor changes to physicochemical attributes, but appreciable changes occurred during storage such as juice browning and development of sulfur, pungent aromas that resulted in discontinuation of the storage study after 28 days. Sandi et al. (2003) studied the sensory quality of a passion fruit juice submitted to three equivalent time-temperature binomials (85°C/27s, 80°C/41s, 75°C/60s) and stored for 120 days at 25°C and 5°C. They found that, even though the passion fruit juice presented good microbiological quality and could be stored at room temperature, storing the juice under refrigeration contributed significantly ($p \leq 0.05$) to the preservation of its sensory quality. Kishore et al. (2011) assessed the physico-chemical and sensory quality of juice from purple passion fruit under different storage temperature and time. They found that fruits stored at 25±1°C developed off-flavour in juice after 5 days, while storage at 8±1°C produced no off-flavor even up to 21 days.

There is evidence for the flavor degradation in fruit juices (Dinsmore & Nagy, 1974; Marcy & Roussef, 1984) and the development of brown pigments (Dinsmore & Nagy, 1972; Kaanane, Kane, & Labuza, 1988) to be correlated with an increase in the hydroxymethylfurfural (HMF) concentration. According to Nagy & Randall (1973), several

compounds are formed during the ascorbic acid degradation, when HMF is produced. Fang, Chen and Chiou (1986), studying a pasteurized yellow passion fruit juice stored at room temperature during four months observed a slight increase in the HMF content, which was followed by loss in sensory quality. Freitas, Garruti, Souza Neto, Facundo and Correia (2011) also found a slight increase in the HMF content in commercial glass-bottled passion fruit juice samples stored at room temperature during 120 days of storage, but with no significant sensory changes.

Sweetness and sourness were also perceived differently depending on the temperature of storage, but only in the beverages sweetened with aspartame and the aspartame/acesulfame-K blend. These beverages were perceived as less sweet and more sour when stored at room temperature than when stored under refrigeration. These findings were consistent with those obtained by Baron and Hanger (1998), who verified that increasing acid levels increased sourness and slightly decreased sweetness in a raspberry flavored beverage sweetened with an aspartame/acesulfame-K blend.

The flavor enhancer effect of aspartame in certain fruit flavored non-carbonated beverages demonstrated by Baldwin & Korschgen (1979) was not evident in the passion fruit based beverages evaluated in this study.

The only disadvantage of the beverage sweetened with sucralose was the higher amount of particles perceived in this beverage relative to the others, especially when stored under refrigeration, as well as the artificial sweetness aftertaste, also perceived higher in this beverage as compared to the others. Apart from this, the beverage sweetened with sucralose was much more stable and similar to the beverage sweetened with sucrose during

storage, than those containing aspartame, and this stability was effectively improved by the use of refrigerated storage.

4. Conclusions

The results obtained in this study make two important contributions to juice beverage developers and researchers alike. Firstly, they demonstrate that the use of aspartame should be avoided when formulating a natural passion fruit juice beverage to be stored at room temperature, even for periods inferior to 60 days, as losses to its sweetness potency occur. The use of this sweetener would be appropriate only if the beverage were formulated to be stored under refrigeration. Sucralose, on the other hand, can be efficiently used in this type of beverage, as its sweetness potency does not change during the storage time, neither at room nor refrigerated temperatures**.** Secondly, and conversely, despite the high stability of the sucralose sweetness potency and consequent advantage of not requiring refrigeration, the results revealed that the use of a refrigerated temperature is crucial to preserve the "positive" fresh fruit aroma and flavor characteristics of the beverage for a minimum period of 120 days. The sensory profile and stability results, therefore, indicated that the best option of sweetener to be used in the ready-to-drink natural passion fruit juice beverage studied was sucrose for the standard version and sucralose for the light version. Despite that, further tests with consumers are strongly encouraged in order to determine the acceptance for each beverage and to assess the attributes that drive consumer preference.

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Table 1. Attribute definitions and reference standards used by the descriptive sensory panel during the evaluation of the passion fruit juice beverage appearance, aroma, flavor, texture and aftertaste.

Descriptor	Definition and reference preparation
Appearance	
Color intensity	The intensity of yellow from light to dark.
Amount of particles	The total amount of visible yellow particles.
Aroma	
Overall aroma intensity	The overall impact (intensity) of all aromas as perceived by the nose.
Overall fresh fruit	The overall impact (intensity) of fresh fruit aromas.
Passion fruit	An aroma note associated with 30mL passion fruit pulp (De Marchi Indústria e Comércio de Frutas Ltda).
Pineapple	An aroma note associated with 30g of 2cm pieces of fresh pineapple.
Orange	An aroma note associated with 30g of 2cm pieces of fresh orange.
Peach	An aroma note associated with 30g of 2cm pieces of fresh peach.
Overall canned fruit	An aroma note associated with a mixture of 6g canned apricot nectar (Kerns), 6g canned peach (Del Monte), 6g canned pineapple (Dole), 6g canned mandarin orange (Del Monte), and 6g canned pear (Kroger).
Overripe fruit	An aroma note associated with overripe fruits.
Fir-pine tree	An aroma note associated with 10g fresh fir-pine needles.
Grassy	Green, slightly sweet aromatic associated with 10g fresh cut grass.
Fishy	Aromatic associated with 30mL Norwegian cod liver oil (Natural Choices).
Flavor	
Overall flavor intensity	The overall flavor impact (intensity) as perceived in the mouth, which includes all the aromatic, taste and feeling factors contributing to the product flavor.
Sweet	Taste on the tongue stimulated by sugars and high potency sweeteners.
Sour	Taste on the tongue stimulated by acids.
Overall fresh fruit	The overall intensity of fresh fruit flavor.
Passion fruit	Flavor associated with 30mL passion fruit pulp (De Marchi Indústria e Comércio de Frutas Ltda).
Pineapple	Flavor associated with 30g of 2cm pieces of fresh pineapple.
Orange	Flavor associated with 30g of 2cm pieces of fresh orange.
Peach	Flavor associated with 30g of 2cm pieces of fresh peach.
Overall canned fruit	Flavor associated with a mixture of 6g canned apricot nectar (Kerns), 6g canned peach (Del Monte), 6g canned pineapple (Dole), 6g canned mandarin orange (Del Monte), and 6g canned pear (Kroger).
Fishy	Flavor associated with fish.
Texture	
Wateriness	Watery mouthfeel.
Astringency	The shrinking or puckering of the tongue surface caused by substances such as tannin or alum.
Aftertaste	
Sour	Aftertaste on the tongue stimulated by 0.1% citric acid in water.
Sweet	Aftertaste on the tongue stimulated by 5% sucrose in water.
Artificial sweetness	Artificial aftertaste on the tongue stimulated by solutions containing 0.02% aspartame, 0.006% sucralose, and 0.02% aspartame/acesulfame-K (4:1) in water.

Table 2. Descriptive attribute averages (n=8) for the passion fruit juice beverages sweetened with sucrose (S), aspartame (A), sucralose (L) and the aspartame/acesulfame-K blend (M) stored at room temperature (Room) and under refrigeration (Refr), at 0 day of storage.

Descriptors	**Sucrose (S)**		**Aspartame (A)**		**Sucralose (L)**		**Aspartame/A-K (M)**	
	Room	**Refr**	**Room**	**Refr**	**Room**	**Refr**	**Room**	**Refr**
Appearance								
Color intensity	8.13^{Aab}	7.88^{Aa}	7.33^{Ab}	6.67^{Ab}	8.83^{Aa}	8.50^{Aa}	7.08^{Ab}	7.75^{Aa}
Amount of particles	5.08^{Ab}	3.75^{Bc}	9.21^{Aa}	8.67^{Ab}	10.63^{Aa}	10.38^{Aa}	9.67^{Aa}	10.42^{Aa}
Aroma								
Overall aroma intensity	8.50^{Aa}	8.29^{Aa}	8.46^{Aa}	8.46^{Aa}	8.33^{Aa}	8.46^{Aa}	8.75^{Aa}	8.75^{Aa}
Overall fresh fruit	6.79^{Aa}	6.33^{Aa}	5.75^{Ab}	6.04^{Aa}	6.58^{Aab}	6.88^{Aa}	6.71^{Aab}	5.88^{Aa}
Passion fruit	6.42^{Aa}	5.88^{Aa}	5.29^{Ab}	5.54^{Aa}	6.21^{Aab}	6.29^{Aa}	6.04^{Aab}	5.58^{Aa}
Pineapple	2.75^{Aa}	2.00^{Aa}	2.13^{Aa}	2.21^{Aa}	2.21^{Aa}	2.63^{Aa}	2.00^{Aa}	1.92^{Aa}
Orange	1.83^{Aa}	1.58^{Aa}	1.50^{Aa}	1.58^{Aa}	1.83^{Aa}	1.96^{Aa}	1.50^{Aa}	1.67^{Aa}
Peach	2.00^{Aa}	1.33^{Ba}	1.50^{Aa}	1.79^{Aa}	1.96^{Aa}	1.75^{Aa}	1.88^{Aa}	1.92^{Aa}
Overall canned fruit	2.21^{Aa}	2.75^{Aa}	2.79^{Aa}	1.96^{Bab}	2.17^{Aa}	1.54^{Ab}	1.96^{Aa}	2.25^{Aab}
Overripe fruit	0.21^{Aa}	0.58^{Aa}	0.75^{Aa}	0.67^{Aa}	0.71^{Aa}	0.21^{Aa}	0.42^{Aa}	0.71^{Aa}
Fir-pine tree	1.04^{Aab}	0.75^{Aa}	0.79^{Ab}	1.17^{Aa}	1.33^{Aab}	1.08^{Aa}	1.46^{Aa}	1.25^{Aa}
Grassy	0.83^{Aa}	0.63^{Aa}	0.67^{Aa}	0.92^{Aa}	0.75^{Aa}	0.75^{Aa}	0.88^{Aa}	0.75^{Aa}
Fishy	1.38^{Aa}	0.75^{Aa}	0.63^{Aa}	0.29^{Aab}	0.25^{Aa}	0.21^{Ab}	0.29^{Aa}	0.42^{Aab}
Flavor								
Overall flavor intensity	9.58^{Aa}	9.17^{Aa}	9.13^{Aa}	9.21^{Aa}	9.08^{Aa}	9.38^{Aa}	9.13^{Aa}	9.17^{Aa}
Sweet	6.71^{Aa}	6.75^{Aa}	6.08^{Aa}	6.17^{Aab}	6.29^{Aa}	6.04^{Aab}	6.13^{Aa}	5.83^{Ab}
Sour	4.00^{Ab}	4.04^{Aa}	4.17^{Aab}	4.50^{Aa}	4.83^{Aa}	4.29^{Ba}	4.75^{Aa}	4.92^{Aa}
Overall fresh fruit	7.29^{Aa}	6.96^{Aa}	6.29^{Ab}	6.17^{Aa}	6.50^{Aab}	6.92^{Aa}	6.75^{Aab}	6.29^{Aa}
Passion fruit	6.67^{Aa}	6.21^{Aa}	5.79^{Ab}	5.75^{Aa}	6.13^{Aab}	6.38^{Aa}	6.13^{Aab}	5.83^{Aa}
Pineapple	2.79^{Aa}	2.75^{Aa}	2.29^{Aa}	2.25^{Aa}	2.17^{Aa}	2.79^{Aa}	2.58^{Aa}	2.13^{Aa}
Orange	2.00^{Aa}	1.83^{Aa}	1.88^{Aa}	1.71^{Aa}	1.79^{Ba}	2.38^{Aa}	2.13^{Aa}	1.96^{Aa}
Peach	1.83^{Aa}	1.88^{Aa}	1.75^{Aa}	1.67^{Aa}	1.54^{Ba}	2.13^{Aa}	1.63^{Aa}	1.54^{Aa}
Overall canned fruit	1.83^{Ba}	2.63^{Aa}	2.04^{Aa}	2.04^{Aab}	1.75^{Aa}	1.50^{Ab}	2.00^{Aa}	1.96^{Aab}
Fishy	0.08^{Aa}	0.33^{Aa}	0.38^{Aa}	0.25^{Aa}	0.29^{Aa}	0.08^{Aa}	0.04^{Aa}	0.13^{Aa}
Texture								
Wateriness	7.13^{Ab}	7.54^{Ab}	8.33^{Aa}	8.46^{Aa}	8.50^{Aa}	8.25^{Aab}	8.21^{Aa}	8.71^{Aa}
Astringency	3.42^{Aa}	3.75^{Aa}	3.96^{Aa}	3.75^{Aa}	4.00^{Aa}	3.71Aa	4.10^{Aa}	3.88^{Aa}
Aftertaste								
Sour	3.00^{Aa}	3.13^{Aa}	3.54^{Aa}	3.38^{Aa}	3.71^{Aa}	3.46^{Aa}	3.75^{Aa}	3.88^{Aa}
Sweet	4.21^{Aa}	4.33^{Aa}	4.04^{Aa}	4.21^{Aa}	4.13^{Aa}	4.46^{Aa}	3.96^{Aa}	4.04^{Aa}
Artificial sweetness	1.17^{Ac}	0.75^{Ab}	3.00^{Aab}	2.88^{Aa}	3.88^{Aa}	3.33^{Aa}	2.38^{Abc}	2.46^{Aa}

$^{A, B, C}$ For each beverage, averages in a row followed by different capital letters represent significant differences ($p \leq 0.05$).

$^{a, b, c}$ For each temperature of storage, averages in a row followed by different tinny letters represent significant differences ($p \leq 0.05$).

Table 3. Descriptive attribute averages (n=8) for the passion fruit juice beverages sweetened with sucrose (S), aspartame (A), sucralose (L) and the aspartame/acesulfame-K blend (M) stored at room temperature (Room) and under refrigeration (Refr), at 60 days of storage.

Descriptors	**Sucrose (S)**		**Aspartame (A)**		**Sucralose (L)**		**Aspartame/A-K (M)**	
	Room	**Refr**	**Room**	**Refr**	**Room**	**Refr**	**Room**	**Refr**
Appearance								
Color intensity	8.25^{Aa}	7.91^{Aa}	5.54^{Bc}	6.38^{Ab}	7.75^{Aab}	8.04^{Aa}	6.88^{Ab}	6.38^{Ab}
Amount of particles	5.25^{Ab}	4.42^{Ac}	8.96^{Aa}	9.21^{Ab}	9.71^{Ba}	10.63^{Aa}	8.92^{Aa}	9.29^{Ab}
Aroma								
Overall aroma intensity	8.08^{Ab}	8.33^{Aa}	9.00^{Aa}	8.33^{Ba}	9.17^{Aa}	8.42^{Ba}	8.92^{Aa}	8.08^{Ba}
Overall fresh fruit	5.50^{Aab}	6.46^{Aa}	4.79^{Bb}	6.33^{Aa}	4.96^{Bab}	7.13^{Aa}	6.25^{Aa}	6.17^{Aa}
Passion fruit	5.13^{Aa}	6.08^{Aa}	4.71^{Ba}	5.79^{Aa}	4.79^{Ba}	6.67^{Aa}	5.79^{Aa}	5.96^{Aa}
Pineapple	1.63^{Aa}	2.29^{Aa}	1.58^{Aa}	1.79^{Aa}	1.46^{Ba}	2.67^{Aa}	2.04^{Aa}	1.79^{Aa}
Orange	1.25^{Aa}	1.67^{Aa}	1.21^{Aa}	1.75^{Aa}	1.00^{Ba}	2.04^{Aa}	1.71^{Aa}	1.29^{Aa}
Peach	1.38^{Aa}	1.96^{Aab}	1.04^{Ba}	1.79^{Aab}	1.33^{Ba}	2.21^{Aa}	1.67^{Aa}	1.29^{Ab}
Overall canned fruit	2.83^{Ab}	2.46^{Aa}	4.29^{Aa}	2.08^{Bab}	3.79^{Aab}	1.42^{Bb}	2.79^{Ab}	2.21^{Aab}
Overripe fruit	1.08^{Aa}	0.33^{Ba}	1.71^{Aa}	0.46^{Ba}	2.00^{Aa}	0.29^{Ba}	1.04^{Aa}	0.50^{Aa}
Fir-pine tree	0.83^{Aa}	1.00^{Aab}	0.75^{Aa}	0.92^{Ab}	0.86^{Ba}	1.46^{Aa}	0.86^{Aa}	0.83^{Ab}
Grassy	0.75^{Aa}	0.92^{Aa}	0.63^{Aa}	0.83^{Aa}	0.96^{Aa}	0.79^{Aa}	0.63^{Aa}	0.75^{Aa}
Fishy	0.75^{Aa}	0.42^{Aab}	1.54^{Aa}	0.67^{Bab}	1.71^{Aa}	0.08^{Bb}	1.13^{Aa}	0.71^{Aa}
Flavor								
Overall flavor intensity	9.29^{Aa}	9.29^{Aa}	8.67^{Aa}	9.00^{Aa}	9.29^{Aa}	9.37^{Aa}	8.92^{Aa}	8.71^{Aa}
Sweet	6.75^{Aa}	6.50^{Aa}	5.00^{Bb}	5.88^{Aab}	6.00^{Aa}	6.58^{Aa}	5.00^{Ab}	5.58^{Ab}
Sour	3.75^{Ab}	3.83^{Ab}	4.79^{Aa}	4.17^{Bab}	4.92^{Aa}	4.25^{Bab}	4.79^{Aa}	4.71^{Aa}
Overall fresh fruit	6.13^{Ba}	6.92^{Aa}	4.75^{Bb}	6.17^{Aa}	4.75^{Bb}	6.88^{Aa}	5.58^{Aab}	6.04^{Aa}
Passion fruit	5.63^{Ba}	6.46^{Aa}	4.50^{Ba}	5.71^{Aa}	4.58^{Ba}	6.50^{Aa}	5.17^{Aa}	5.71^{Aa}
Pineapple	3.00^{Aa}	2.75^{Aab}	1.38^{Bb}	2.13^{Aab}	1.71^{Bb}	2.83^{Aa}	1.96^{Ab}	1.92^{Ab}
Orange	2.21^{Aa}	2.00^{Aa}	1.25^{Ab}	1.67^{Aa}	1.00^{Bb}	2.00^{Aa}	1.46^{Ab}	1.33^{Aa}
Peach	1.75^{Aa}	1.75^{Aab}	0.92^{Aa}	1.42^{Ab}	1.21^{Ba}	2.29^{Aa}	1.46^{Aa}	1.54^{Aab}
Overall canned fruit	3.08^{Aa}	1.67^{Bab}	3.67^{Aa}	2.21^{Ba}	3.75^{Aa}	1.29^{Bb}	2.79^{Aa}	2.17^{Aa}
Fishy	0.54^{Ab}	0.13^{Bb}	1.46^{Aab}	0.67^{Ba}	1.75^{Aa}	0.00^{Bb}	1.13^{Aab}	0.17^{Bb}
Texture								
Wateriness	7.21^{Ac}	7.46^{Ab}	8.79^{Aa}	8.46^{Aa}	7.83^{Abc}	8.33^{Aa}	8.46^{Aab}	9.04^{Aa}
Astringency	3.17^{Ab}	3.50^{Ab}	3.96^{Aa}	3.83^{Aab}	3.96^{Aa}	3.92^{Aab}	4.25^{Aa}	4.46^{Aa}
Aftertaste								
Sour	3.46^{Ab}	2.83^{Ab}	4.08^{Aab}	3.21^{Bb}	3.96^{Aab}	3.71^{Aab}	4.54^{Aa}	4.25^{Aa}
Sweet	4.38^{Aa}	4.08^{Aab}	3.00^{Bb}	4.21^{Aa}	4.21^{Aa}	4.58^{Aa}	3.38^{Ab}	3.42^{Ab}
Artificial sweetness	0.83^{Ac}	0.79^{Ab}	2.67^{Ab}	3.13^{Aa}	4.21^{Aa}	3.29^{Ba}	1.88^{Abc}	1.63^{Ab}

$^{A, B, C}$ For each beverage, averages in a row followed by different capital letters represent significant differences ($p \leq 0.05$).

$^{a, b, c}$ For each temperature of storage, averages in a row followed by different tinny letters represent significant differences ($p \leq 0.05$).

Table 4. Descriptive attribute averages (n=8) for the passion fruit juice beverages sweetened with sucrose (S), aspartame (A), sucralose (L) and the aspartame/acesulfame-K blend (M) stored at room temperature (Room) and under refrigeration (Refr), at 120 days of storage.

Descriptors	Sucrose (S)		Aspartame (A)		Sucralose (L)		Aspartame/A-K (M)	
	Room	Refr	Room	Refr	Room	Refr	Room	Refr
Appearance								
Color intensity	7.08^{Ba}	8.42^{Aa}	5.13^{Bb}	5.88^{Ab}	6.46^{Ba}	8.17^{Aa}	5.04^{Bb}	6.63^{Ab}
Amount of particles	5.45^{Ab}	5.96^{Ab}	8.21^{Aa}	8.96^{Aa}	7.96^{Ba}	10.29^{Aa}	8.08^{Aa}	9.13^{Aa}
Aroma								
Overall aroma intensity	9.21^{Aab}	8.71^{Aa}	8.67^{Ab}	8.67^{Aa}	8.88^{Aab}	8.54^{Aa}	9.63^{Aa}	8.75^{Ba}
Overall fresh fruit	3.71^{Bb}	6.38^{Aa}	4.75^{Bab}	6.46^{Aa}	4.88^{Ba}	6.42^{Aa}	4.13^{Bab}	6.46^{Aa}
Passion fruit	3.58^{Bb}	5.88^{Aa}	4.46^{Bab}	5.96^{Aa}	4.75^{Ba}	5.79^{Aa}	3.88^{Bab}	6.04^{Aa}
Pineapple	0.96^{Ba}	1.79^{Aa}	1.46^{Ba}	2.25^{Aa}	1.42^{Aa}	2.04^{Aa}	0.83^{Ba}	2.46^{Aa}
Orange	0.67^{Ba}	1.46^{Aa}	1.67^{Aa}	1.33^{Aa}	1.13^{Aa}	1.50^{Aa}	0.75^{Ba}	1.87^{Aa}
Peach	0.67^{Ba}	1.54^{Aa}	1.25^{Aa}	1.46^{Aa}	1.08^{Ba}	1.75^{Aa}	0.88^{Ba}	1.67^{Aa}
Overall canned fruit	4.46^{Aa}	2.75^{Ba}	3.58^{Aa}	2.50^{Ba}	3.71^{Aa}	2.21^{Ba}	4.21^{Aa}	2.08^{Ba}
Overripe fruit	2.17^{Aab}	0.42^{Ba}	1.46^{Ab}	0.58^{Ba}	1.58^{Ab}	0.63^{Ba}	2.83^{Aa}	0.38^{Ba}
Fir-pine tree	0.58^{Ba}	1.17^{Aa}	0.83^{Aa}	1.00^{Aa}	0.67^{Ba}	1.25^{Aa}	0.67^{Ba}	1.17^{Aa}
Grassy	0.86^{Aa}	0.92^{Aa}	0.83^{Aa}	0.92^{Aa}	1.04^{Aa}	1.08^{Aa}	1.29^{Aa}	0.88^{Aa}
Fishy	2.50^{Aa}	0.96^{Ba}	1.50^{Aa}	0.79^{Aa}	1.67^{Aa}	0.42^{Ba}	2.58^{Aa}	0.54^{Ba}
Flavor								
Overall flavor intensity	9.58^{Aa}	9.33^{Aa}	8.50^{Ab}	9.00^{Aa}	9.13^{Aab}	9.13^{Aa}	8.92^{Aab}	9.00^{Aa}
Sweet	6.21^{Aa}	6.67^{Aa}	4.54^{Bb}	6.25^{Aab}	6.00^{Aa}	6.58^{Aa}	4.58^{Bb}	5.67^{Ab}
Sour	4.04^{Ab}	4.13^{Aa}	5.13^{Aa}	4.04^{Ba}	4.46^{Aab}	4.42^{Aa}	5.17^{Aa}	4.25^{Ba}
Overall fresh fruit	3.75^{Bb}	6.29^{Aa}	4.54^{Bab}	6.25^{Aa}	5.13^{Ba}	6.29^{Aa}	3.58^{Bb}	6.38^{Aa}
Passion fruit	3.67^{Bb}	5.92^{Aa}	4.17^{Bab}	5.88^{Aa}	4.79^{Ba}	5.88^{Aa}	3.29^{Bb}	6.00^{Aa}
Pineapple	1.58^{Bab}	2.54^{Aa}	1.63^{Aab}	2.21^{Aa}	2.21^{Aa}	2.17^{Aa}	1.08^{Bb}	2.17^{Aa}
Orange	0.96^{Bab}	1.96^{Aa}	1.25^{Aa}	1.25^{Aa}	1.46^{Aa}	1.75^{Aa}	0.54^{Bb}	1.75^{Aa}
Peach	0.75^{Bab}	1.79^{Aa}	1.13^{Aab}	1.42^{Aa}	1.42^{Aa}	1.63^{Aa}	0.50^{Bb}	1.33^{Aa}
Overall canned fruit	4.54^{Aa}	2.38^{Ba}	3.83^{Aab}	2.04^{Ba}	3.17^{Ab}	1.92^{Ba}	4.58^{Aa}	1.71^{Ba}
Fishy	2.89^{Aa}	0.58^{Ba}	1.50^{Ab}	0.46^{Ba}	1.25^{Ab}	0.46^{Aa}	3.08^{Aa}	0.42^{Ba}
Texture								
Wateriness	7.38^{Ab}	7.21^{Ab}	9.00^{Aa}	8.58^{Aa}	8.04^{Bb}	8.63^{Aa}	9.00^{Aa}	8.50^{Aa}
Astringency	3.88^{Aa}	3.79^{Aa}	4.08^{Aa}	3.92^{Aa}	3.92^{Aa}	3.83^{Aa}	4.04^{Aa}	4.21^{Aa}
Aftertaste								
Sour	3.33^{Ab}	3.29^{Aa}	4.50^{Aa}	3.63^{Ba}	3.21^{Ab}	3.29^{Aa}	4.38^{Aa}	3.13^{Ba}
Sweet	4.13^{Aa}	4.25^{Aa}	3.04^{Ab}	3.50^{Ab}	4.04^{Aa}	4.29^{Aa}	2.54^{Bb}	3.71^{Aab}
Artificial sweetness	1.54^{Ab}	1.13^{Ab}	2.21^{Ab}	2.96^{Aa}	3.83^{Aa}	2.96^{Ba}	2.13^{Ab}	1.54^{Ab}

$^{A, B, C}$ For each beverage, averages in a row followed by different capital letters represent significant differences ($p \leq 0.05$).

$^{a, b, c}$ For each temperature of storage, averages in a row followed by different tinny letters represent significant differences ($p \leq 0.05$).

Table 5. Descriptive attribute averages (n=8) for the passion fruit juice beverages sweetened with sucrose (S), aspartame (A), sucralose (L) and the aspartame/acesulfame-K blend (M) stored at room temperature (Room) and under refrigeration (Refr), at 180 days of storage.

Descriptors	**Sucrose (S)**		**Aspartame (A)**		**Sucralose (L)**		**Aspartame/A-K (M)**	
	Room	**Refr**	**Room**	**Refr**	**Room**	**Refr**	**Room**	**Refr**
Appearance								
Color intensity	5.92^{Ba}	8.50^{Aa}	4.21^{Bb}	6.13^{Ac}	5.58^{Ba}	7.25^{Ab}	4.46^{Bb}	6.42^{Ac}
Amount of particles	5.54^{Ab}	6.13^{Ab}	8.29^{Aa}	8.96^{Aa}	8.42^{Ba}	10.29^{Aa}	8.08^{Ba}	9.21^{Aa}
Aroma								
Overall aroma intensity	9.29^{Aa}	8.63^{Bb}	9.54^{Aa}	8.96^{Ab}	8.92^{Aa}	9.29^{Aab}	9.50^{Aa}	9.75^{Aa}
Overall fresh fruit	4.04^{Ba}	6.25^{Aa}	3.29^{Ba}	5.58^{Aab}	3.58^{Ba}	5.88^{Aab}	3.83^{Ba}	4.79^{Ab}
Passion fruit	4.08^{Ba}	6.08^{Aa}	3.17^{Ba}	5.13^{Aab}	3.46^{Ba}	5.67^{Aa}	3.83^{Aa}	4.50^{Ab}
Pineapple	1.21^{Ba}	2.50^{Aa}	1.00^{Ba}	2.00^{Aa}	0.79^{Ba}	2.08^{Aa}	0.96^{Ba}	1.54^{Aa}
Orange	0.75^{Bab}	2.00^{Aa}	0.92^{Aa}	1.33^{Aab}	0.38^{Bb}	1.50^{Aab}	0.58^{Aab}	0.92^{Ab}
Peach	0.92^{Ba}	2.00^{Aa}	0.63^{Aa}	1.25^{Aab}	0.50^{Ba}	1.50^{Aab}	0.50^{Aa}	0.92^{Ab}
Overall canned fruit	4.67^{Aa}	2.50^{Bb}	4.54^{Aa}	3.29^{Bab}	4.67^{Aa}	3.08^{Bab}	5.00^{Aa}	3.79^{Ba}
Overripe fruit	2.17^{Aa}	0.29^{Bb}	2.50^{Aa}	0.92^{Bab}	2.13^{Aa}	1.17^{Bab}	2.38^{Aa}	1.75^{Aa}
Fir-pine tree	0.83^{Ba}	1.29^{Aa}	0.50^{Ba}	1.00^{Aa}	0.58^{Aa}	0.83^{Aa}	0.42^{Ba}	0.92^{Aa}
Grassy	1.04^{Aa}	0.83^{Aa}	0.79^{Aa}	0.58^{Aa}	0.88^{Aa}	0.58^{Aa}	0.67^{Aa}	0.96^{Aa}
Fishy	2.46^{Aa}	0.75^{Bb}	3.04^{Aa}	1.58^{Bab}	2.71^{Aa}	1.63^{Bab}	3.38^{Aa}	2.33^{Ba}
Flavor								
Overall flavor intensity	9.63^{Aa}	9.58^{Aab}	8.42^{Ab}	9.00^{Ab}	9.42^{Aa}	9.83^{Aa}	9.04^{Aab}	9.25^{Aab}
Sweet	6.21^{Aa}	6.75^{Aa}	3.46^{Bb}	6.13^{Aa}	6.21^{Aa}	6.42^{Aa}	3.96^{Bb}	5.96^{Aa}
Sour	4.04^{Ac}	3.83^{Aa}	5.04^{Aab}	4.25^{Ba}	4.21^{Abc}	4.17^{Aa}	5.54^{Aa}	4.33^{Ba}
Overall fresh fruit	3.79^{Ba}	6.75^{Aa}	3.21^{Ba}	5.58^{Abc}	3.88^{Ba}	6.04^{Aab}	3.21^{Ba}	4.79^{Ac}
Passion fruit	3.63^{Ba}	6.29^{Aa}	3.00^{Ba}	5.38^{Aa}	3.67^{Ba}	5.67^{Aa}	3.04^{Ba}	4.33^{Ab}
Pineapple	1.71^{Ba}	3.29^{Aa}	1.13^{Bab}	2.42^{Aab}	1.46^{Bab}	2.58^{Aab}	0.83^{Bb}	1.71^{Ab}
Orange	1.21^{Bab}	2.63^{Aa}	0.58^{Bc}	1.67^{Ab}	1.33^{Ba}	1.75^{Ab}	0.63^{Bbc}	1.25^{Ab}
Peach	0.75^{Bab}	2.13^{Aa}	0.46^{Bab}	1.46^{Aab}	1.04^{Ba}	1.88^{Aa}	0.25^{Bb}	0.79^{Ab}
Overall canned fruit	4.92^{Aa}	2.46^{Bb}	4.21^{Aa}	2.83^{Bab}	4.25^{Aa}	2.75^{Bab}	4.75^{Aa}	3.67^{Ba}
Fishy	2.79^{Aa}	0.38^{Bb}	3.17^{Aa}	1.13^{Bab}	2.83^{Aa}	1.33^{Ba}	3.63^{Aa}	2.00^{Ba}
Texture								
Wateriness	7.54^{Aa}	7.33^{Aa}	8.17^{Aa}	7.75^{Aa}	8.17^{Aa}	7.46^{Aa}	8.25^{Aa}	7.79^{Aa}
Astringency	3.54^{Aa}	3.71^{Aa}	4.00^{Aa}	3.79^{Aa}	3.96^{Aa}	3.96^{Aa}	4.33^{Aa}	3.83^{Aa}
Aftertaste								
Sour	3.04^{Ac}	3.29^{Aa}	4.46^{Aab}	3.54^{Ba}	3.67^{Abc}	3.88^{Aa}	4.67^{Aa}	3.79^{Ba}
Sweet	4.04^{Aa}	4.42^{Aa}	2.04^{Bb}	3.96^{Aab}	4.33^{Aa}	4.25^{Aab}	1.88^{Bb}	3.63^{Ab}
Artificial sweetness	0.83^{Ac}	1.25^{Ac}	2.00^{Bb}	2.75^{Aab}	3.25^{Aa}	3.75^{Aa}	1.17^{Abc}	1.83^{Abc}

$^{A, B, C}$ For each beverage, averages in a row followed by different capital letters represent significant differences ($p \leq 0.05$).

$^{a, b, c}$ For each temperature of storage, averages in a row followed by different tinny letters represent significant differences ($p \leq 0.05$).

Figure Captions:

Figure 1. Principal component plot of passion fruit juice beverages separated according to their sensory descriptors on the PC1 and PC2 axes at 0 day of storage.

Figure 2. Principal component plot of passion fruit juice beverages separated according to their sensory descriptors on the PC1 and PC2 axes at 60 days of storage.

Figure 3. Principal component plot of passion fruit juice beverages separated according to their sensory descriptors on the PC1 and PC2 axes at 120 days of storage.

Figure 4. Principal component plot of passion fruit juice beverages separated according to their sensory descriptors on the PC1 and PC2 axes at 180 days of storage.

Figure 5a. Means with error plot of the scores attributed to color intensity, sweet taste, sweet aftertaste, amount of particles, and artificial sweetness aftertaste of the passion fruit juice beverages sweetened with sucrose (S), aspartame (A), sucralose (L) and the aspartame/acesulfame-K blend (M) stored at room temperature and under refrigeration at 0, 60, 120 and 180 days of storage.

Figure 5b. Means with error plot of the scores attributed to the overall fresh fruit aroma, passion fruit aroma, overall fresh fruit flavor, and passion fruit flavor of the passion fruit juice beverages sweetened with sucrose (S), aspartame (A), sucralose (L) and the aspartame/acesulfame-K blend (M) stored at room temperature and under refrigeration at 0, 60, 120 and 180 days of storage.

Figure 5c. Means with error plot of the scores attributed to the overall canned fruit aroma, overripe fruit aroma, overall canned fruit flavor, fishy aroma, and fishy flavor of the

passion fruit juice beverages sweetened with sucrose (S), aspartame (A), sucralose (L) and the aspartame/acesulfame-K blend (M) stored at room temperature and under refrigeration at 0, 60, 120 and 180 days of storage.

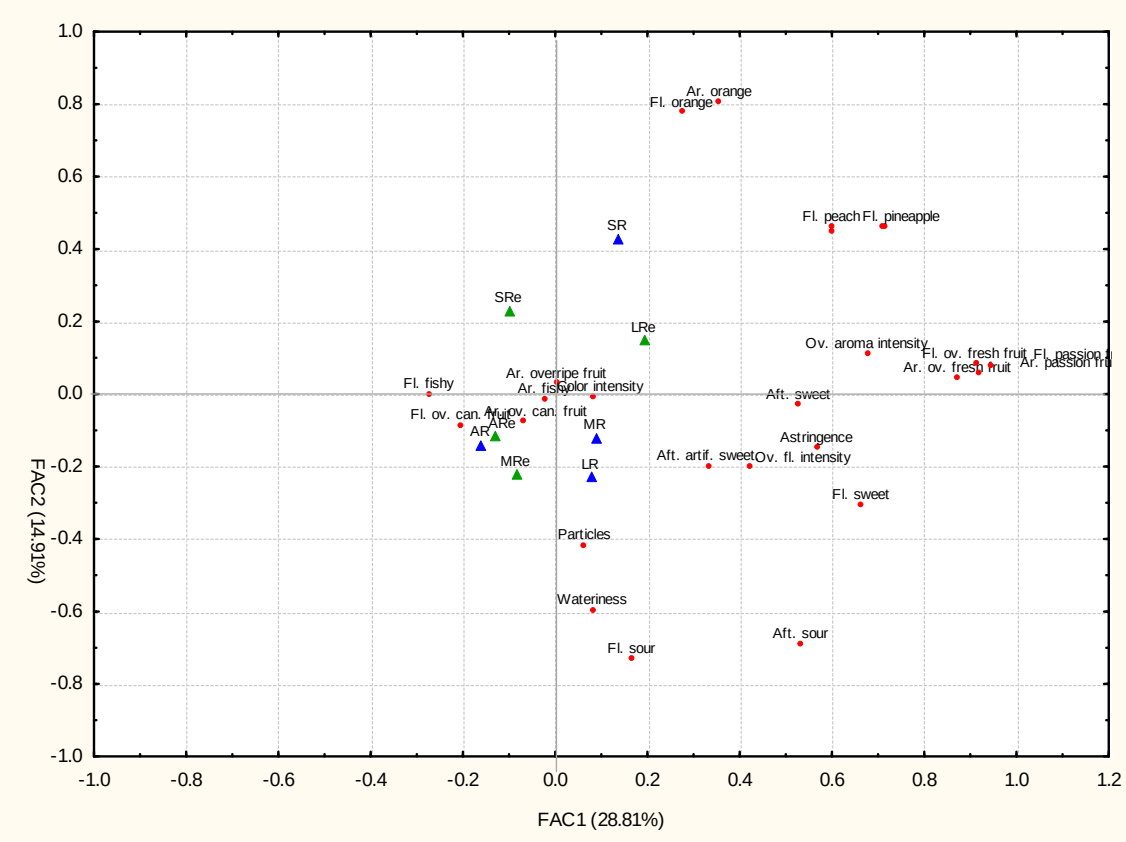

Ar. orange
Fl. orange
Fl. peach
Fl. pineapple
SR
SRe
LRe
Ov. aroma intensity
Fl. ov. fresh fruit
Ar. ov. fresh fruit
Ar. passion fru
Fl. fishy
Ar. overripe fruit
Ar. fishy
Color intensity
Aft. sweet
Fl. ov. can. fruit
Ar. ov. can. fruit
ARe
AR
MR
Astringence
Aft. artif. sweet
Ov. fl. intensity
MRe
LR
Fl. sweet
Particles
Wateriness
Aft. sour
Fl. sour
FAC2 (14.91%)
FAC1 (28.81%)
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
-1.0
-0.8
-0.6
-0.4
-0.2
0.0
0.2
0.4
0.6
0.8
1.0
1.2

Figure 1

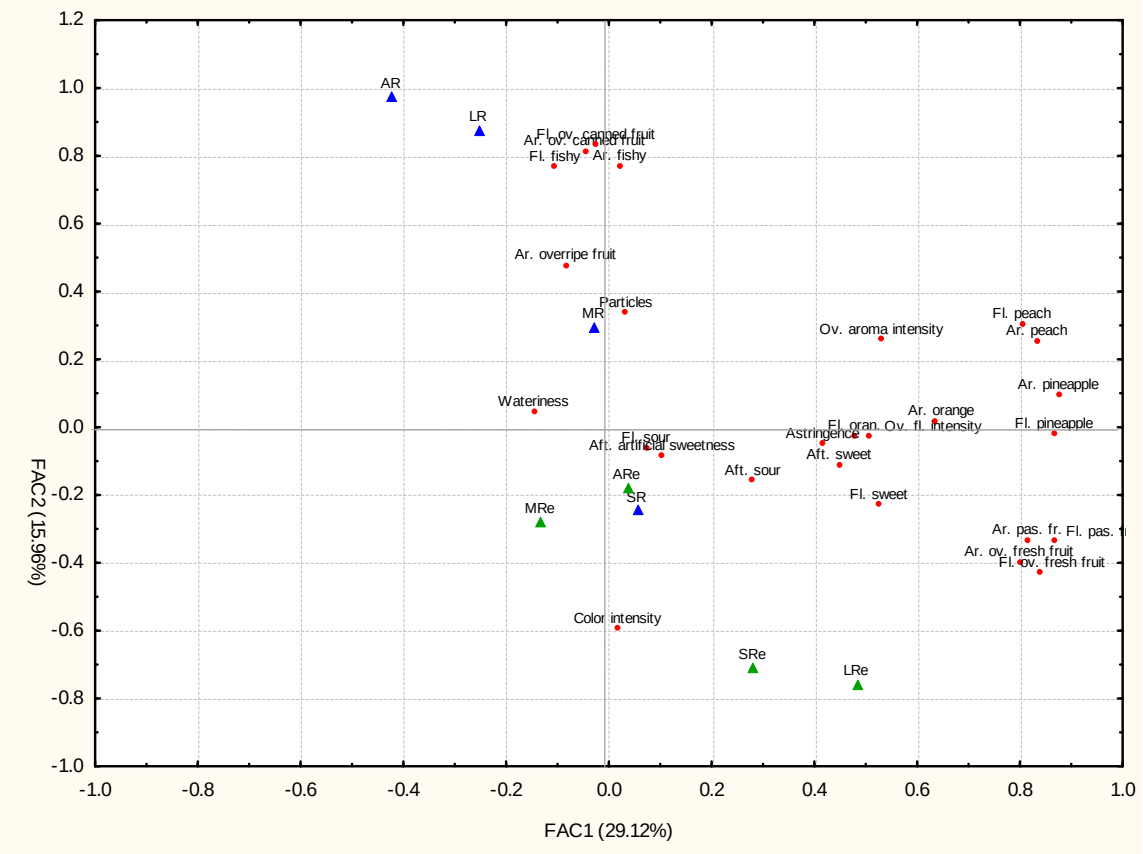

AR
LR
Fl. ov. canned fruit
Ar. ov. canned fruit
Fl. fishy
Ar. fishy
Ar. overripe fruit
Particles
MR
Ov. aroma intensity
Fl. peach
Ar. peach
Ar. pineapple
Wateriness
Ar. orange
Astringency
Fl. gran. Ov. fl. intensity
Fl. pineapple
Fl. sour
Aft. artificial sweetness
Aft. sweet
Aft. sour
ARe
SR
Fl. sweet
MRe
Ar. pas. fr.
Fl. pas.
Ar. ov. fresh fruit
Fl. ov. fresh fruit
Color intensity
SRe
LRe
FAC2 (15.96%)
FAC1 (29.12%)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
-1.0
-0.8
-0.6
-0.4
-0.2
0.0
0.2
0.4
0.6
0.8
1.0

Figure 2

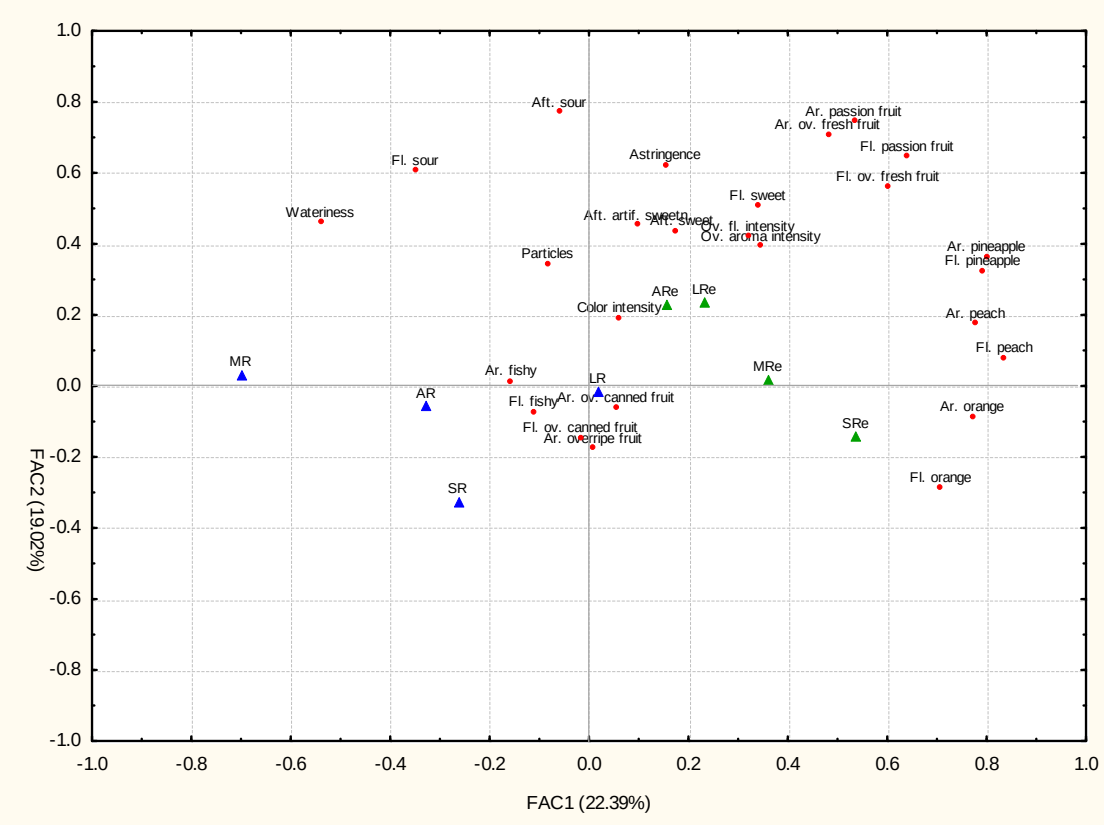

1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
-1.0
-0.8
-0.6
-0.4
-0.2
0.0
0.2
0.4
0.6
0.8
1.0
FAC2 (19.02%)
FAC1 (22.39%)
Aft. sour
Ar. passion fruit
Ar. ov. fresh fruit
Fl. passion fruit
Fl. sour
Astringence
Fl. ov. fresh fruit
Fl. sweet
Wateriness
Aft. artif. sweetn
Aft. sweet
Ov. fl. intensity
Ov. aroma intensity
Ar. pineapple
Particles
Fl. pineapple
ARe
LRe
Color intensity
Ar. peach
Fl. peach
MR
Ar. fishy
MRe
LR
AR
Fl. fishy
Ar. ov. canned fruit
Ar. orange
Fl. ov. canned fruit
SRe
Ar. overripe fruit
Fl. orange
SR

Figure 3

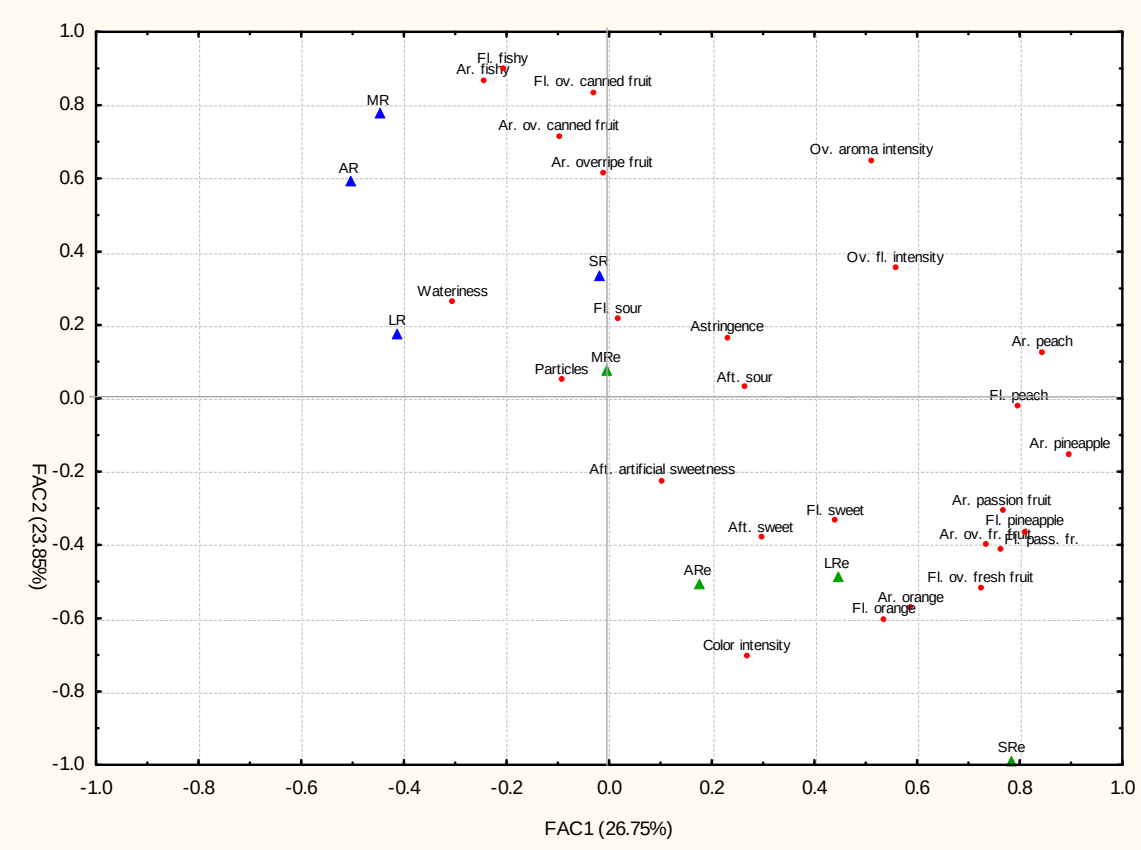
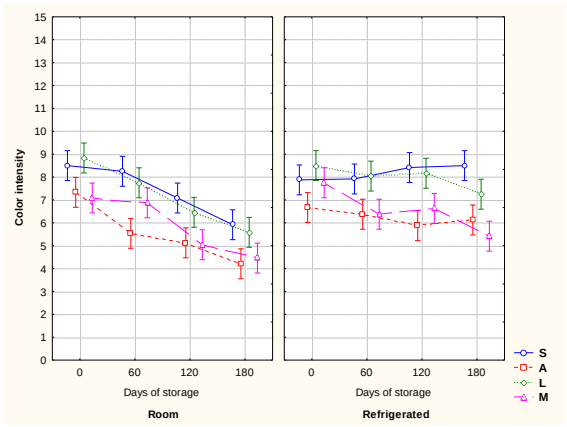
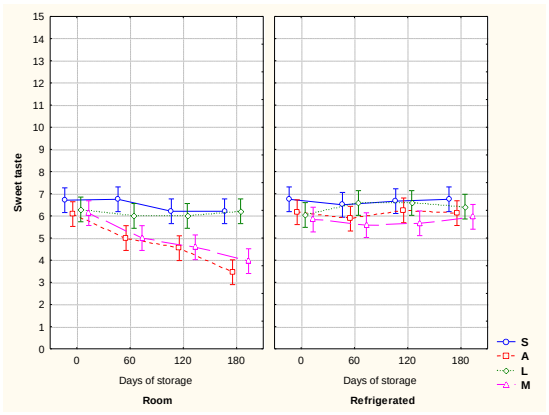

Fl. fishy
Ar. fishy
Fl. ov. canned fruit
MR
Ar. ov. canned fruit
Ov. aroma intensity
AR
Ar. overripe fruit
SR
Ov. fl. intensity
Wateriness
Fl. sour
LR
Astringence
Ar. peach
MRe
Particles
Aft. sour
Fl. peach
Ar. pineapple
Aft. artificial sweetness
Ar. passion fruit
Fl. sweet
Fl. pineapple
Aft. sweet
Ar. ov. fr. fruit
Fl. pass. fr.
LRe
ARe
Fl. ov. fresh fruit
Ar. orange
Fl. orange
Color intensity
SRe
FAC2 (23.85%)
FAC1 (26.75%)
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
-1.0
-0.8
-0.6
-0.4
-0.2
0.0
0.2
0.4
0.6
0.8
1.0

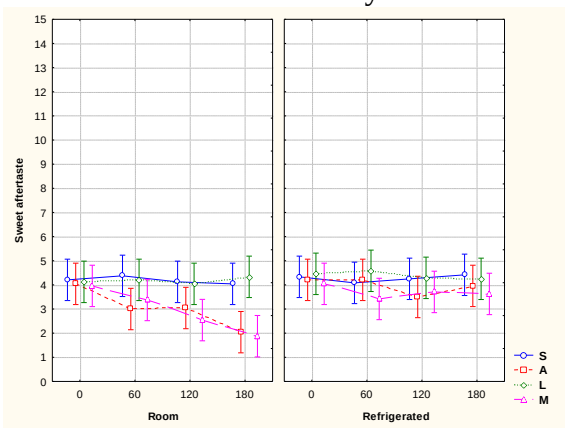
Figure 4



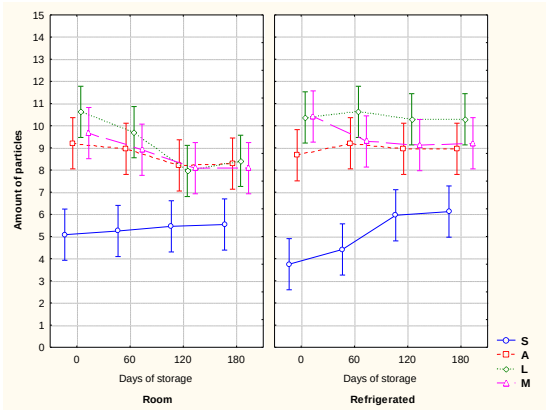
Color intensity



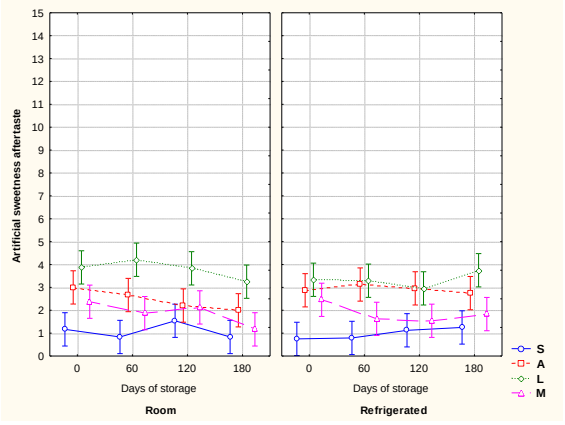
Sweet taste



Sweet aftertaste

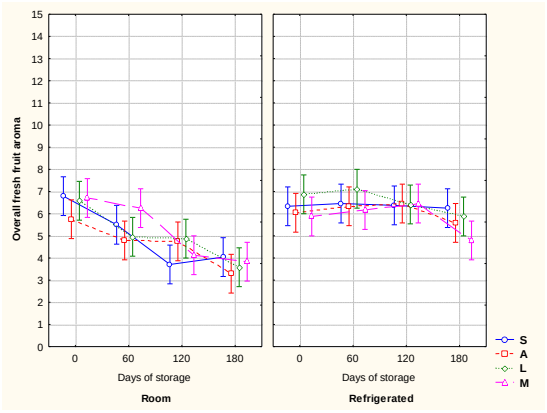


Amount of particles

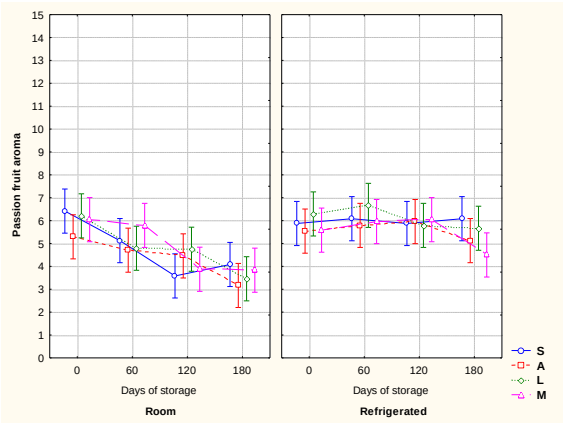


Artificial sweetness aftertaste

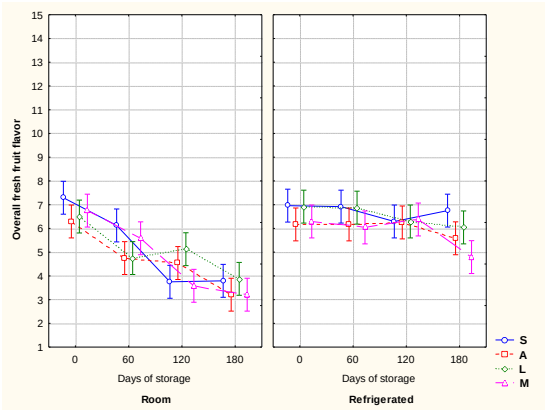
Figure 5a



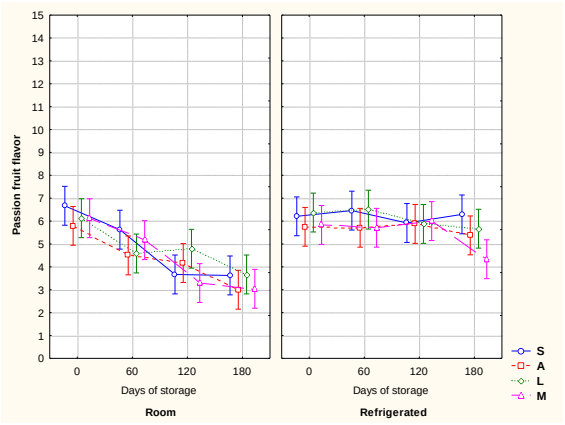
Overall fresh fruit aroma



Passion fruit aroma

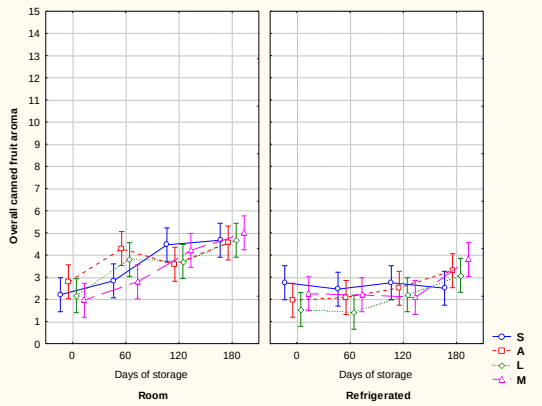


Overall fresh fruit flavor

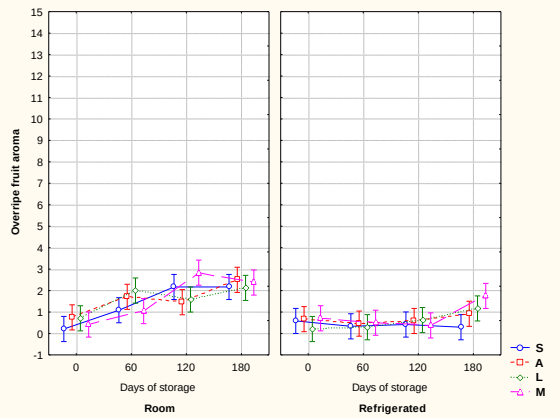


Passion fruit flavor

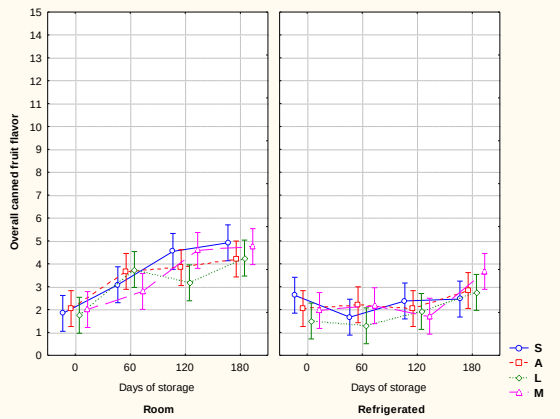
Figure 5b



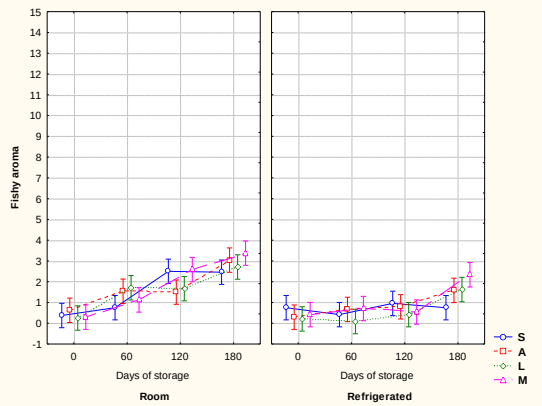
Overall canned fruit aroma



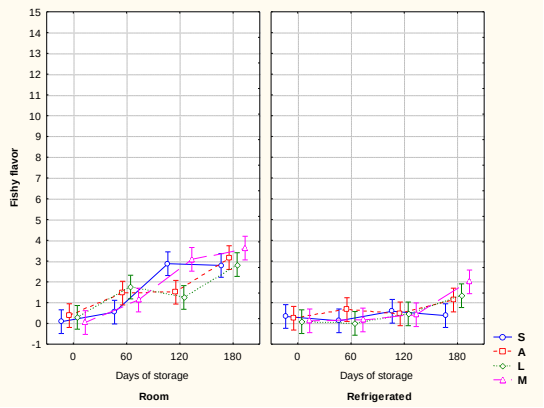
Overripe fruit aroma



Overall canned fruit flavor



Fishy aroma



Fishy flavor

Figure 5c