

Date: October 15, 2013

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Subject: Gorko 2 Report

BACKGROUND

Consumers desire naturally sweetened mid- and low-calorie beverages that taste great. TCCC is partnering with Pure Circle to expand sensory knowledge around CC-00276 and CC-00293, which represent different purity grades (95% & 80% respectively) of a new natural steviol glycoside (SG) sweetener for use in mid- to low-calorie beverages.

The current study (Gorko 2), builds on previous work (Gorko 1). Using Descriptive Analysis (DA), Gorko 1 examined CC-00276, sucrose, RebaudiosideA (RebA) + sucrose, aspartame (APM), APM + acesulfame potassium (ACK) in sparkling and still solutions of three matrices (phosphoric acid (PA), citric acid (CA), and water). Gorko 1 demonstrated that CC-00276 was similar in sensory profile to previously tested SGs exhibiting delayed appearance time, prolonged linger and bitter taste in comparison to the other sweeteners examined; however, these attributes were of lower intensity in matrices sweetened with CC-00276 than with other SGs. In addition, licorice flavor, a negative attribute associated previously reported with RebA and other SGs, was not detected in CC-00276-sweetened samples.

The goal of Gorko 2 was to further investigate the sensory characteristics of CC-00276 and CC-00293. Additionally, Gorko 2 included the evaluation of a number of sweetener blends, both caloric and non-caloric, to provide insight into the utility of blending sweeteners to mitigate what are perceived as negative attributes in CC-00276, CC-00293, and RebA. Gorko 2 comprised two modules; in Module 2 DA was used to create sensory profiles of CC-00276, CC-00293, RebA, sucrose, and APM at 8% sucrose equivalence (SE). Module 1 provided information on the same sweeteners, with the exception of RebA, at 10% SE, and their blends, including RebA and erythritol (ERY), at a target of 10% SE.

OBJECTIVES

Business: To grow the still and sparkling beverage categories by providing zero-, mid-, and low-calorie naturally sweetened beverage options.

Project: To provide sensorial characterization of sweeteners and their blends toward optimization of zero-, low-, and mid-calorie blends.



Study: Module 2:

- 1) To create full sensory profiles, including the temporal attribute of appearance time, of each of CC-00276, CC-00293, RebA, sucrose, and APM at 8% SE.

Module 1:

- 1) To create full sensory profiles (including appearance time) of each CC-00276, CC-00293, sucrose, and APM at 10% SE individually.
- 2) To create full sensory profiles (including appearance time) of CC-00276, CC-00293 blended with RebA or ERY, and each of CC-00276, CC-00293, and RebA blended with sucrose.

EXECUTIVE SUMMARY

Gorko 2 explored the sensory characteristics of CC-00276 and CC-00293, which represent different purity grades (95% & 80% respectively) of a new natural SG sweetener. Additionally, Gorko 2 included the evaluation of a number of caloric and non-caloric sweetener blends to provide insight into the ability of a blend to mitigate the negative attributes associated with low calorie sweeteners. Gorko 2 comprised two modules; Module 2 and Module 1. In Module 2 DA was used to provide sensory profiles of CC-00276, CC-00293, RebA, sucrose, and APM at 8% SE. Module 1 examined the same sweeteners as Module 2, with the exception of RebA, at 10% SE. Module 1 also examined blends of: CC-00276, CC-00293, and RebA with sucrose; CC-00276, and CC-00293 with RebA; and CC-00276, CC-00293 with 1% and 2% ERY. The target sweetness of the blends was 10% SE. All sweeteners and blends in Module 1 and 2 were examined in still and sparkling phosphoric acid, citric acid, and water.

CC-00276 and CC-00293 exhibited similar sensory profiles across blends and matrices. Overall, the profiles of CC-00276 and CC-00293 indicate that their qualities fall between APM and RebA across matrices. Blends of CC-00276 and CC-00293 with either RebA or ERY reduce the negative sensory attributes typically associated with SGs in all matrices, suggesting that these zero-calorie blends should be further investigated. Licorice taste/aftertaste, sweetness linger, and bitter taste/aftertaste are all characteristic of RebA, and all were reduced in blends with either CC-00276 or CC-00293. Blends of either CC-00276 or CC-00293 with sucrose produce more favorable sensory profiles than blends of RebA with sucrose. Blends of sucrose with CC-00276 and sucrose with CC-00293 should be further examined for potential use as mid- to low-calorie sweetener blends.

SIGNIFICANT FINDINGS

Results from Module 2 are discussed first because they provide insight into the sensory characteristics of all the sweeteners examined individually.

Module 2

DA, including the temporal attribute appearance time, was performed on each of CC-00276, CC-00293, RebA, sucrose, and APM at 8% SE in sparkling and still PA, CA, and water. Sweeteners examined in Module 2 are presented in Table 1 with their variant identifier. Overall, sweeteners performed similarly across matrices with some minor differences. Summary findings are discussed below.

- Principle Components Analysis (PCA), used to visualize the data relationships, clearly demonstrates sweeteners are separated into groups with sucrose and RebA being on opposite extremes of Principle Component 1 (PC1). This indicates that sucrose is smoother, and imparts less bitterness and sweet linger than RebA. APM lays closest to sucrose, and CC-00293 and CC-00276 fall between APM and RebA. CC-00293 samples are to the left of CC-00276 suggesting CC-00293 imparts less bitterness and sweetness

linger and more smoothness than CC-00276. PC2 appears to differentiate samples along a sweet/sour dimension, which is likely matrix-driven as CA and PA samples tend toward the sour end of the axis and samples in water matrices toward the sweet end. Although APM significantly differs from sucrose in a number of attributes, of the sweeteners examined, APM's sensory profile is closest to that of sucrose, followed by CC-00276 and CC-00293. RebA was most different than sucrose and APM. While some differences between CC-00276 and CC-00293 were observed, the two were generally perceived as similar in intensity across attributes, and their profiles tended to fall between RebA and APM regardless of matrix type.

- Across all matrices, RebA had the longest time to maximum sweetness intensity (i.e., greatest appearance time) and sucrose the shortest. All sweeteners differed significantly in appearance time. Of the two, CC-00293 had a significantly shorter time to maximum than CC-00276.
- Bitter taste and aftertaste of each RebA, CC-00276, and CC-00293 trended together within matrices, with RebA imparting the most bitterness across matrices. CC-00276 and CC-00293 did not differ from each other in bitter taste or aftertaste intensity in any matrix. Bitter taste intensity of CC-00276 and CC-00293 was similar to that of APM in the majority of matrices; however, bitter aftertaste tended to be higher with CC-00276 and CC-00293 than with APM. Interestingly, bitter taste and aftertaste were perceived in all sparkling matrices with all sweeteners, including, at a low level, sucrose in water. Bitterness was not reported in still matrices sweetened with sucrose, suggesting that carbonation imparts bitterness.
- The perceived intensity of sweet taste did not differ significantly between sweeteners in sparkling PA, still CA, and still water. In the remaining matrices, significant differences were observed; however, CC-00276 and CC-00293 did not differ from each other.
- The sweetness linger of RebA, CC-00276, and CC-00293 differed significantly from APM and sucrose, with the highest level of sweetness linger in all matrices coming from RebA. Sweetness linger of CC-00276 and CC-00293 was similar in all matrices except still PA, where CC-00276 sweetness linger was closer to RebA than CC-00293.
- RebA imparted significantly higher licorice and licorice aftertaste across all matrices than any other sweetener. CC-00276 and CC-00293 did not differ from APM and sucrose in licorice taste and aftertaste in sparkling and still PA, and sparkling CA. Small, but significant differences were observed between sweeteners in still CA, and sparkling and still water with either CC-00276 or CC-00293 imparting more of one or both of these attributes than APM or sucrose.

Module 1

DA, including the temporal attribute appearance time, was conducted on each of CC-00276, CC-00293, sucrose, and APM at 10% SE in sparkling and still PA, CA, and water. Blends of CC-00276, CC-00293 with RebA, with ERY, and CC-00276, CC-00293, RebA with sucrose to a target sweetness of 10% SE were also evaluated. Sweeteners and blends examined in Module 1 are presented in Table 2 with their variant identifier. Though the perceived intensities of attributes between matrices tend to differ, overall the trends within a sweetener blend are maintained between matrices. Summary findings for blends are presented below.

- PCA conducted on individual sweeteners at 10% SE yielded a sensory map very similar to that discussed above for the individual sweeteners at 8%.
- Appearance time decreased linearly with increasing sucrose level in blends of sucrose with RebA, CC-00276, or CC-00293 across matrices. Appearance time was reduced in 5%/5% and 7.5%/2.5% blends of

RebA with either CC-00293 or CC-00276 compared to either sweetener alone or a blend of either CC-00276 or CC-00293 (at a level of 2.5%) with 7.5% RebA. CC-00276 and CC-00293 appearance time decreased linearly with increasing erythritol across all matrices. Of the zero-calorie blends, CC-00293/2% ERY yielded the fastest appearance time, followed by the above noted CC-0027/RebA and CC-00293/RebA blends, which were similar across matrices. CC-00276 blended with 2% ERY was similar to either CC-00276 or CC-00293 in combination with RebA.

- The attributes smoothness and smoothness aftertaste trended together. The smoothness and smoothness aftertaste of sucrose in combination with RebA, CC-00276, or CC-00293 decreased with decreasing sucrose level across matrices. Smoothness and smoothness aftertaste increased with decreasing RebA level in combination with CC-00276 and CC-00293. Blends with RebA and CC-00293 were slightly lower in smoothness than those with RebA and CC-00276 across matrices. ERY did not significantly change the smoothness or smoothness aftertaste of either CC-00276 or CC-00293 in any matrix.
- Bitter taste appears to increase linearly with increasing RebA levels in blends with sucrose across all matrices. The increase in bitterness with increasing CC-00276 and CC-00293 levels in blends with sucrose is somewhat curved, suggesting a slower rate of bitter taste increase with increasing levels of either CC-00276 or CC-00293 than observed for RebA in combination with sucrose. Bitter taste appears to plateau between blends of CC-00276 or CC-00293 with sucrose at 7.5% SE and CC-00293 or CC-00276 alone at 10% SE. Blends of CC-00276 and CC-00293 with RebA are similar to each other in bitter taste intensity; however, CC-00276/RebA blends impart lower bitter taste intensity overall than blends of CC-00293/RebA over all matrices. Bitter taste in blends of CC-00276 and CC-00293 with erythritol varied slightly between matrices and with carbonation. Similar trends were observed for bitter aftertaste.
- Sour taste intensity appears to have been dictated by matrix. Sparkling and still water had no perceivable sour taste; however, all other blends had some sourness, with CA having the highest sour taste scores regardless of sweetener. Sourness did vary slightly between blends, indicating that blend has an effect on sour taste, albeit a small effect. Overall, sour aftertaste was scored similarly to sour taste, although some variation was observed in blends with ERY.
- Sweet taste intensity was highest in water, followed by PA then CA. Across all matrices, carbonation appeared to increase sweet taste intensity slightly. Within each matrix, small, but significant differences in sweet taste intensity were observed between blends, indicating that exact iso-sweetness between sweeteners/blends was not achieved. In still PA, sweet taste intensity of CC-00293 7.5%/Sucrose 2.5% was significantly greater than sucrose alone; however, this result was not consistent across matrices.
- Sweetness linger appears to be dependent on matrix as overall matrices of CA followed by PA had the least sweetness linger, and water had the highest sweetness linger. Sweetness linger was highest for the highest level of RebA with sucrose across all matrices. A similar trend was observed for CC-00276 and CC-00293 in combination with sucrose. Though not statistically significant in all matrices, sweetness linger appears to be lower in 5%/5% and 7.5%/2.5% blends of CC-00276/RebA and CC-00293/RebA than in either CC-00276 or CC-00293 alone or in the blend with 7.5% RebA.
- Licorice taste was significantly increased with the addition of 7.5% RebA to sucrose in all matrices. Licorice taste did not differ significantly from sucrose in blends of sucrose with CC-00293 across all matrices. CC-00276 exhibited a similar trend; however, CC-00276 7.5%/sucrose 2.5% was significantly higher in licorice taste than sucrose alone in still CA and still water. A significant decrease in licorice taste was observed in blends of 5%/5% and 7.5%/2.5% CC-00276/RebA and CC-00293/ RebA compared to blends with high

levels of RebA or either CC-00276 or CC-00293 alone. 1% erythritol significantly reduces the licorice taste of both CC-00276 and CC-00293, with some residual licorice remaining in the water matrices. At the 2% erythritol level licorice taste is close to zero in all matrices. Licorice aftertaste was very similar to licorice taste across matrices.

RECOMMENDATIONS/NEXT STEPS

In order to further investigate the possible use of blends composed of either CC-00276 or CC-00293 with RebA in zero-calorie products, and the possible utility of using low levels of ERY to ameliorate the off-notes of SGs, a systematic study of blends should be undertaken. Additionally, validation of a sub-set of the sweeter blends examined here, including blends of RebA with CC-00293 and CC-00276, should be conducted in matrices that more closely resemble TCCC products (i.e., sparkling and still flavored beverage prototypes). This study provides insight into the use of the current lexicon to describe these sweeteners/blends in these matrices. These insights will be used to evaluate the current lexicon, aid in future lexicon development, and possibly create a more focused, abridged lexicon to be used across sweeteners.

PRODUCT DESCRIPTION

Tables 1 and 2 summarize the variants evaluated by DA in Module 2 and Module 1, respectively. In Module 2 RebA, CC-00276, CC-00293, APM and sucrose were evaluated in sparkling and still PA, CA, and water matrices at a level of 8% SE. In Module 1 CC-00276, CC-00293, APM, and sucrose were evaluated at a level of 10% SE. Additionally, blends of those sweeteners examined individually, plus RebA, were evaluated at a level of 10% SE.



Table 1. Variants for Descriptive Analysis Module 2

SWEETENER	SYSTEM					
	Phosphoric Acid		Citric Acid		Water	
	No Carbonation	With Carbonation	No Carbonation	With Carbonation	No Carbonation	With Carbonation
CC-00276	Variant II 1	Variant II 16	Variant II 6	Variant II 21	Variant II 11	Variant II 26
CC-00293	Variant II 2	Variant II 17	Variant II 7	Variant II 22	Variant II 12	Variant II 27
RebA	Variant II 3	Variant II 18	Variant II 8	Variant II 23	Variant II 13	Variant II 28
Sucrose	Variant II 4	Variant II 19	Variant II 9	Variant II 24	Variant II 14	Variant II 29
Aspartame	Variant II 5	Variant II 20	Variant II 10	Variant II 25	Variant II 15	Variant II 30

Table2. Variants for Descriptive Analysis Module 2

SWEETENER(S)	SYSTEM					
	Phosphoric Acid		Citric Acid		Water	
	No Carbonation	With Carbonation	No Carbonation	With Carbonation	No Carbonation	With Carbonation
CC-00293	Variant I 1	Variant I 61	Variant I 21	Variant I 81	Variant I 41	Variant I 101
CC-00293 + RebA (7.5% + 2.5%)	Variant I 2	Variant I 62	Variant I 22	Variant I 82	Variant I 42	Variant I 102
CC-00293 + RebA (5% + 5%)	Variant I 3	Variant I 63	Variant I 23	Variant I 83	Variant I 43	Variant I 103
CC-00293 + RebA (2.5% + 7.5%)	Variant I 4	Variant I 64	Variant I 24	Variant I 84	Variant I 44	Variant I 104
CC-00293 + Sucrose (2.5% + 7.5%)	Variant I 5	Variant I 65	Variant I 25	Variant I 85	Variant I 45	Variant I 105
CC-00293 + Sucrose (7.5% + 2.5%)	Variant I 6	Variant I 66	Variant I 26	Variant I 86	Variant I 46	Variant I 106
CC-00293 + 1% erythritol	Variant I 7	Variant I 67	Variant I 27	Variant I 87	Variant I 47	Variant I 107
CC-00293 + 2% erythritol	Variant I 8	Variant I 68	Variant I 28	Variant I 88	Variant I 48	Variant I 108
CC-00276	Variant I 9	Variant I 69	Variant I 29	Variant I 89	Variant I 49	Variant I 109
CC-00276 + RebA (7.5% + 2.5%)	Variant I 10	Variant I 70	Variant I 30	Variant I 90	Variant I 50	Variant I 110
CC-00276 + RebA (5% + 5%)	Variant I 11	Variant I 71	Variant I 31	Variant I 91	Variant I 51	Variant I 111
CC-00276 + RebA (2.5% + 7.5%)	Variant I 12	Variant I 72	Variant I 32	Variant I 92	Variant I 52	Variant I 112
CC-00276 + Sucrose (2.5% + 7.5%)	Variant I 13	Variant I 73	Variant I 33	Variant I 93	Variant I 53	Variant I 113
CC-00276 + Sucrose (7.5% + 2.5%)	Variant I 14	Variant I 74	Variant I 34	Variant I 94	Variant I 54	Variant I 114
CC-00276 + 1% erythritol	Variant I 15	Variant I 75	Variant I 35	Variant I 95	Variant I 55	Variant I 115
CC-00276 + 2% erythritol	Variant I 16	Variant I 76	Variant I 36	Variant I 96	Variant I 56	Variant I 116
RebA + Sucrose (2.5% + 7.5%)	Variant I 17	Variant I 77	Variant I 37	Variant I 97	Variant I 57	Variant I 117
RebA + sucrose (7.5% + 2.5%)	Variant I 18	Variant I 78	Variant I 38	Variant I 98	Variant I 58	Variant I 118
Sucrose	Variant I 19	Variant I 79	Variant I 39	Variant I 99	Variant I 59	Variant I 119
Aspartame	Variant I 20	Variant I 80	Variant I 40	Variant I 100	Variant I 60	Variant I 120

METHODOLOGY

Data Collection

Study Design

- Study conducted at SRL, Cork, Ireland, November-December, 2012



- Complete Block Design (CBD); all products randomized and balanced.
- Each product was evaluated three times by each panelist.
- Each panelist was served 50ml of chilled beverage (4 °C-4/°C).

Test Protocol

- The assessors were instructed to take a sip rate the appearance time and then ingest. Then they rated the mouth feel and taste/flavor of the samples and three minutes after ingestion they rated the sweetness linger and the aftertaste

Panel Calibration:

- The panel was calibrated at the beginning of each test session. In addition the panel also received anchor references representing early (sucrose), middle (stevioside) and late (thaumatin) appearance time every three test samples.

Palate Cleansing Procedure:

- At the beginning of the panel session, prior to sample evaluation all panelists rinsed their palate with warm water.
- Then rinsed again with cool water (9 °C +1 °C).
- Between samples evaluation a 10 minute rest period was allowed during which they rinsed their palate with several rinses at the following order: 5% sucrose solution, warm water, 0.75% NaCl solution, warm water. Then rinsed with still mineral grade water and wiped their lips with tissue in order to ensure to eliminate any potential carry over taste, flavor or mouth feeling factor.

Table 3. Descriptive Analysis Lexicon

INITIAL EVALUATION	
Attribute	Definition
Appearance Time	The time until you experience the maximum sweetness
MOUTHFEEL:	
Attribute	Definition
Smoothness	The velvety, silky sensation of the sample, ranging from harsh to smooth.
Carbonation	The amount of tingling, burning sensation in the mouth and throat.
TASTE/FLAVOUR:	
Attribute	Definition
Sweet Taste	The taste stimulated by sucrose other sugars and artificial sweeteners.
Bitter Taste	Taste stimulated by certain substances such as quinine, caffeine, sucrose octa-acetate.
Sour Taste	The sour taste associated with citric acid, phosphoric or malic acid.
Licorice Flavour	Fruity flavour associated with liquorice or anise.
AFTERTASTE:	
Attribute	Definition
Sweetness Linger	The intensity of the sweet taste, 3 minutes after ingestion.

Smoothness	The velvety, silky sensation of the sample, ranging from harsh to smooth, 3 minutes after ingestion.
Bitter Aftertaste	Aftertaste, 3 minutes after ingestion, stimulated by certain substances such as quinine, caffeine, sucrose octa-acetate.
Sour Aftertaste	The sour taste associated with citric acid, phosphoric or malic acid, 3 minutes after ingestion.
Licorice Aftertaste	Fruity aftertaste, 3 minutes after ingestion, associated with liquorice or anise.

Data Analyses

Two complementary analyses of the data were performed:

- Comparisons between each sample, analyzing differences by dividing the data by matrix and identifying homogeneous groups in each matrix with Tukey's Honestly Significant Difference (*HSD*) tests (more conservative);
- Global analysis of all data (across matrices), in two subsets:
 - All data obtained with a single sweetener only, pooling together the results of Module II with those of Module I containing only one sweetener, and performing a two-way ANOVA;
 - The various subgroups composed by every sweetener blend, with all data of Module I further subdivided into 4 subgroups: all mixes with CC-276, all mixes with CC-293, all mixes with sucrose, all mixes with Reb A.

RESULTS

Module 2 Results: Single Sweeteners at 8% SE

Sweeteners clearly separated into groups with sucrose and RebA being on opposite extremes of PC1, indicating that sucrose is smoother, and imparts less bitterness and sweet linger than RebA. APM lays closest to sucrose, and CC-00293 and CC-00276 fall between APM and RebA. CC-00293 samples are to the left of CC-00276 suggesting CC-00293 imparts less bitterness and sweetness linger and more smoothness than CC-00276. Across sweeteners, with the exception of sucrose, sparkling matrices appear less smooth with more bitterness and sweet linger than still matrices.

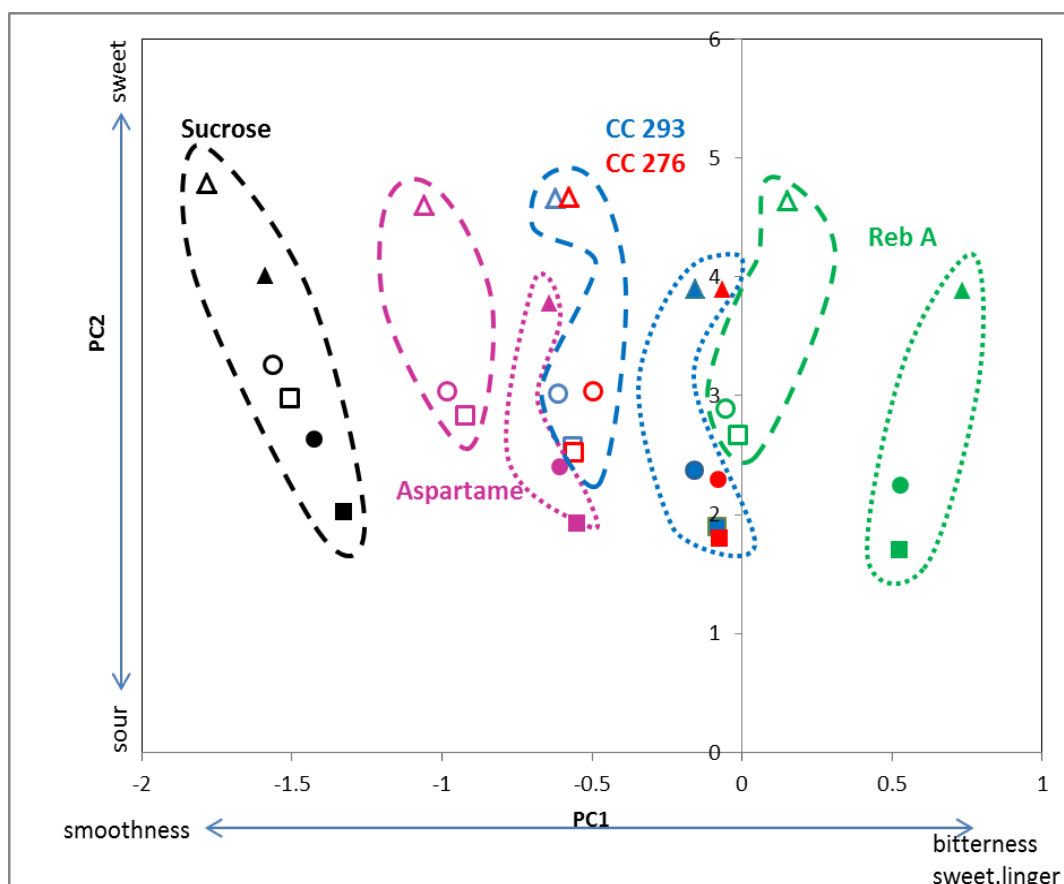


Figure 1. Mean scores of principal components 1 and 2 of the samples with single sweeteners in all matrices at 8% sucrose equivalence

Sweeteners are surrounded by dotted lines and shown in:
 black (sucrose), purple (aspartame), blue (CC-293), red (CC-276), and green (Reb A)
 open symbols: carbonated samples
 closed symbols: uncarbonated samples
 circles: phosphoric acid
 squares: citric acid
 triangles: water

The following tables and spider charts summarize the results of the DA of individual sweeteners at 8% SE.

Table 4: Descriptive Analysis of sparkling phosphoric acid

Notes: letters refer to homogeneous groups for comparisons of all sweeteners in this matrix for each attribute (to be read by row, and not by columnn); highest and lowest values for each attribute are highlighted.

Attributes	RebA		CC-00276		CC-00293		Aspartame		Sucrose	
Appearance Time	4.15	a	3.63	B	3.17	c	2.65	d	1.56	e
Carbonation	5.07	ab	5.19	A	5.13	ab	5.02	b	5.00	b
Smoothness	5.92	d	6.27	C	6.33	bc	6.53	b	7.11	a
Smoothness Aftertaste	5.98	d	6.20	Cd	6.27	bc	6.50	b	7.05	a
Bitter Taste	1.48	a	1.08	B	1.09	b	0.85	c	0.55	d
Bitter Aftertaste	1.18	a	0.89	B	0.89	b	0.55	c	0.49	c
Sour Taste	2.56	a	2.48	Ab	2.51	ab	2.50	ab	2.35	b
Sour Aftertaste	1.54	a	1.55	A	1.53	a	1.43	a	1.34	a
Sweet Taste	5.18	a	5.22	A	5.15	a	5.05	a	5.23	a
Sweetness Linger	2.68	a	2.54	Ab	2.36	b	2.04	c	1.32	d
Licorice	0.16	a	0.03	B	0.03	b	0.00	b	0.00	b
Licorice Aftertaste	0.19	a	0.04	B	0.04	b	0.00	b	0.00	b

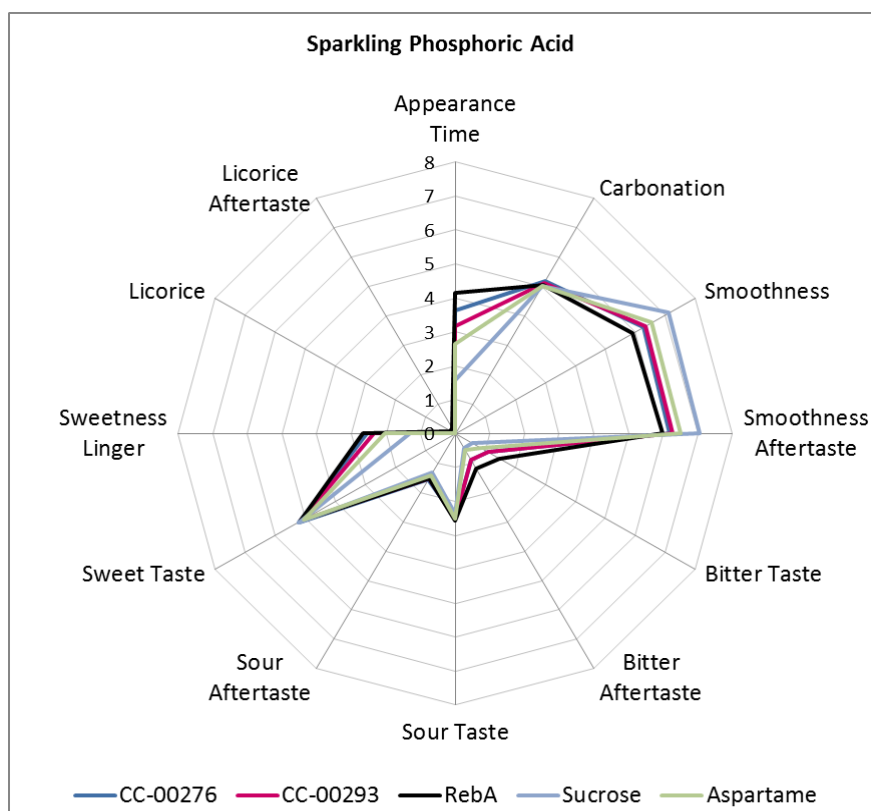


Figure 2. Spider chart summarizing Descriptive Analysis results of all attributes for all sweeteners in sparkling phosphoric acid

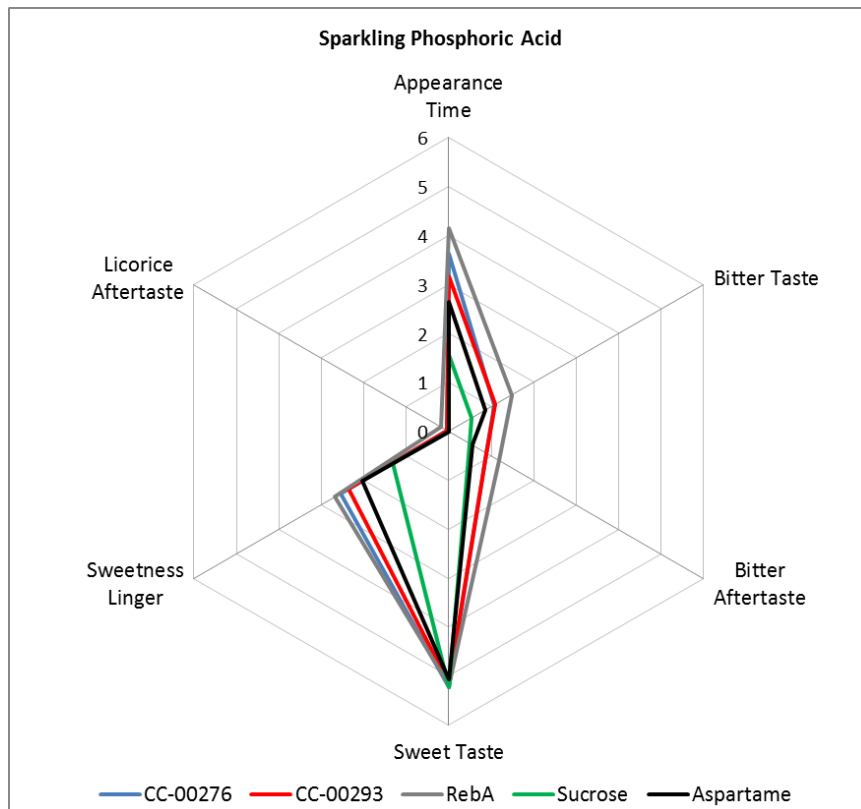


Figure 3. Spider chart summarizing Descriptive Analysis results of most salient attributes for all sweeteners in sparkling phosphoric acid

Table 5: Descriptive Analysis of still phosphoric acid.

Note: letters refer to homogeneous groups for comparisons of all sweeteners in this matrix for each attribute (to be read by row, and not by column); highest and lowest values for each attribute are highlighted.

Attributes	RebA		CC-00276		CC-00293		Aspartame		Sucrose	
Appearance Time	3.94	a	3.35	B	2.95	c	2.36	d	1.31	e
Carbonation	0.00	a	0.00	A	0.00	a	0.00	a	0.00	a
Smoothness	6.55	d	6.91	C	7.08	c	7.37	b	7.88	a
Smoothness Aftertaste	6.28	c	6.75	B	6.78	b	6.92	b	7.62	a
Bitter Taste	1.50	a	0.95	B	1.00	b	0.65	c	0.00	d
Bitter Aftertaste	1.22	a	0.70	B	0.83	bc	0.50	c	0.00	d
Sour Taste	2.48	a	2.41	A	2.38	ab	2.42	a	2.18	b
Sour Aftertaste	1.30	a	1.42	A	1.25	ab	1.08	bc	0.87	c
Sweet Taste	5.17	a	4.98	Ab	4.98	ab	4.89	b	4.82	b
Sweetness Linger	2.56	a	2.53	A	2.30	b	1.84	c	1.11	d
Licorice	0.36	a	0.13	B	0.09	b	0.00	b	0.00	b
Licorice Aftertaste	0.38	a	0.04	B	0.03	b	0.00	b	0.00	b

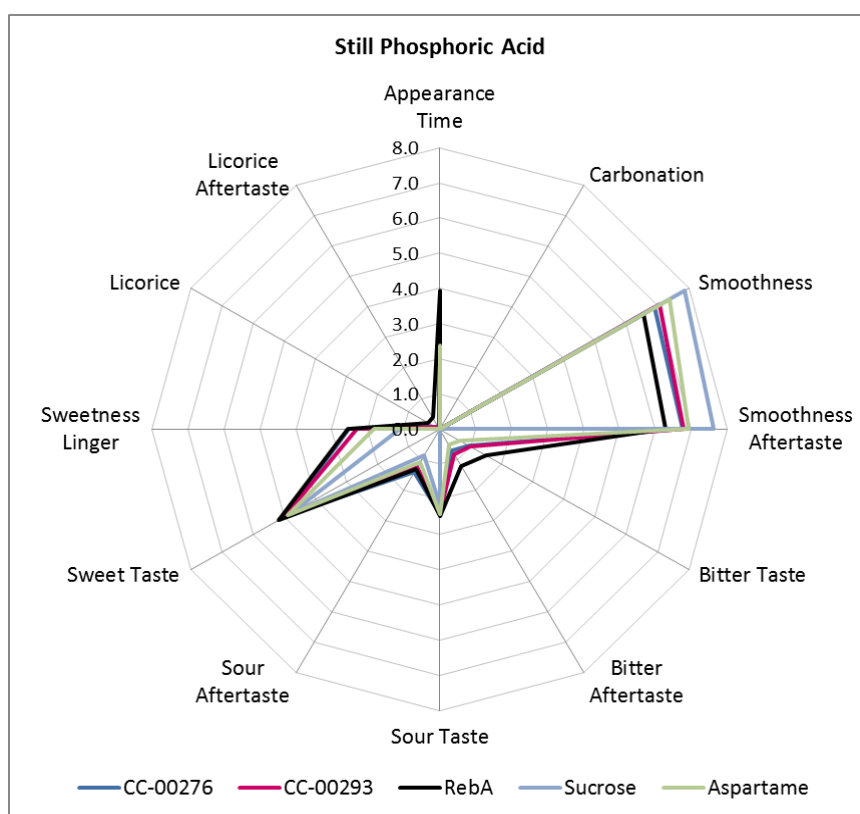


Figure 4. Spider chart summarizing Descriptive Analysis results of all attributes for all sweeteners in still phosphoric acid

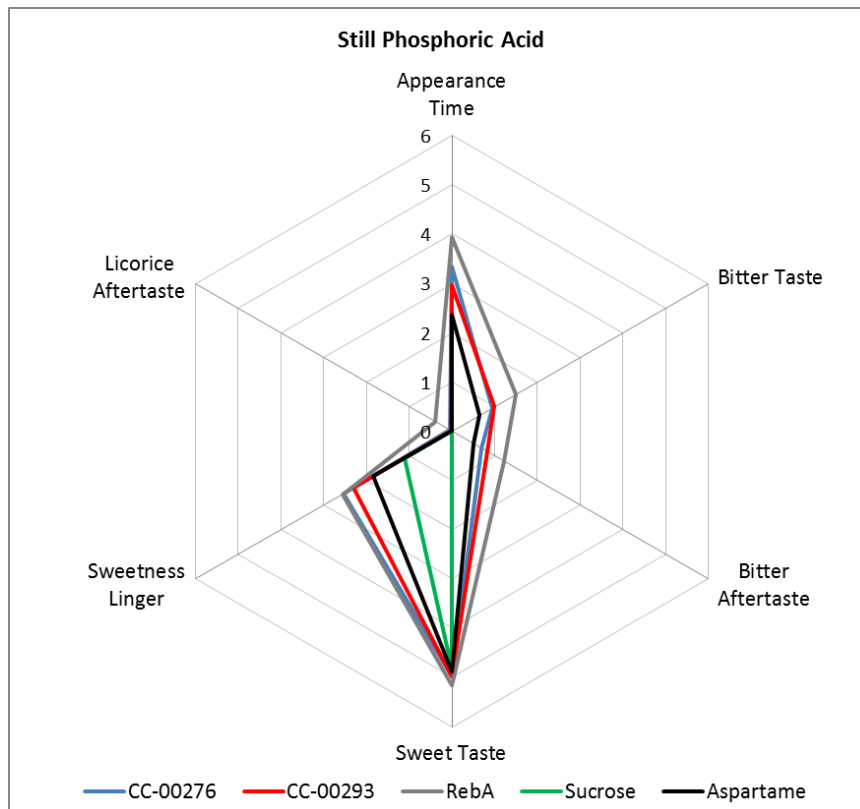


Figure 5. Spider chart summarizing Descriptive Analysis results of most salient attributes for all sweeteners in still phosphoric acid

Table 6: Descriptive Analysis of sparkling citric acid

Notes: letters refer to homogeneous groups for comparisons of all sweeteners in this matrix for each attribute (to be read by row, and not by column); highest and lowest values for each attribute are highlighted.

Attributes	RebA		CC-00276		CC-00293		Aspartame		Sucrose	
Appearance Time	4.24	a	3.74	b	3.45	c	2.78	d	1.75	e
Carbonation	5.08	a	5.11	a	5.12	a	5.14	a	5.12	a
Smoothness	5.77	d	6.14	c	6.05	c	6.41	b	6.73	a
Smoothness Aftertaste	5.93	d	6.25	c	6.22	bc	6.46	b	6.82	a
Bitter Taste	1.58	a	0.97	b	1.01	b	0.92	b	0.45	c
Bitter Aftertaste	1.05	a	0.71	b	0.81	b	0.80	b	0.45	c
Sour Taste	2.96	b	3.16	a	3.07	ab	2.75	c	2.72	c
Sour Aftertaste	1.56	a	1.66	a	1.60	a	1.45	ab	1.31	b
Sweet Taste	5.04	a	4.72	b	4.69	b	4.94	a	4.94	a
Sweetness Linger	2.59	a	2.36	b	2.36	b	1.75	c	1.31	d
Licorice	0.20	a	0.02	b	0.05	b	0.00	b	0.03	b
Licorice Aftertaste	0.28	a	0.04	b	0.02	b	0.00	b	0.04	b

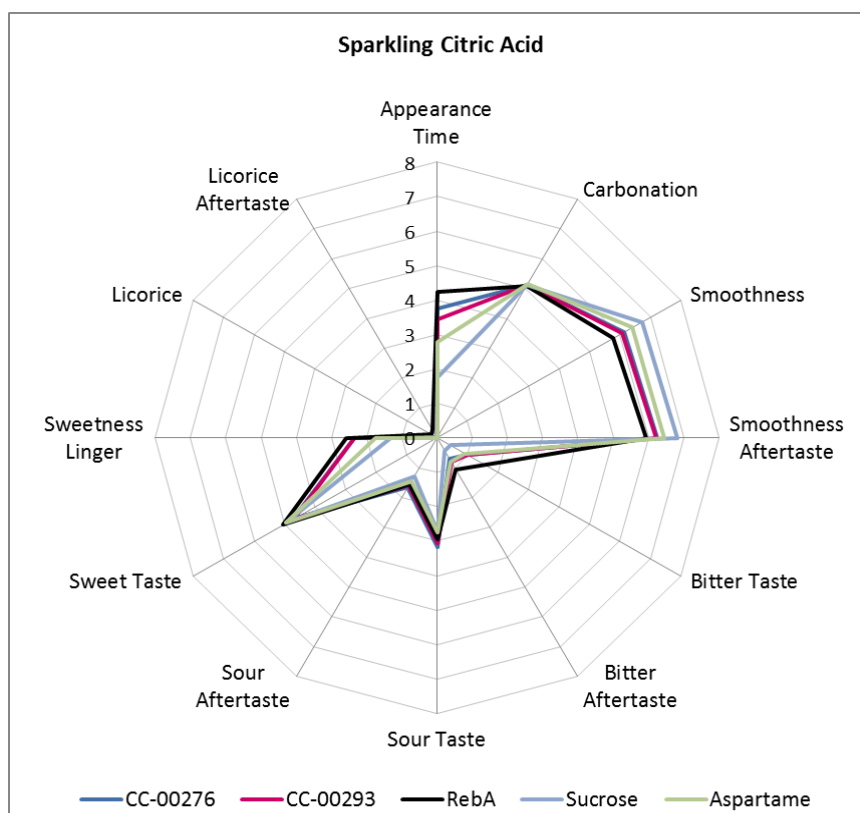


Figure 6. Spider chart summarizing Descriptive Analysis results of all attributes for all sweeteners in sparkling citric acid.

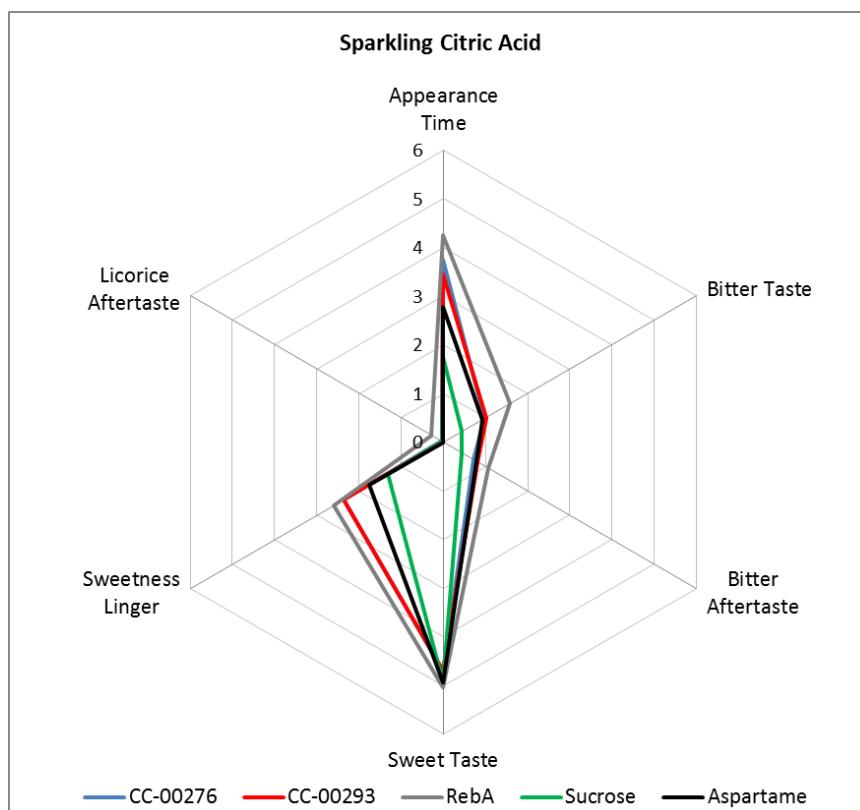


Figure 7. Spider chart summarizing Descriptive Analysis results of most salient attributes for all sweeteners in sparkling citric acid.

Table 7: Descriptive Analysis of still citric acid.

Notes: letters refer to homogeneous groups for comparisons of all sweeteners in this matrix for each attribute (to be read by row, and not by column); highest and lowest values for each attribute are highlighted.

Attributes	RebA		CC-00276		CC-00293		Aspartame		Sucrose	
Appearance Time	4.05	a	3.45	B	3.19	c	2.39	d	1.41	e
Carbonation	0.00	a	0.00	A	0.00	a	0.00	a	0.00	a
Smoothness	6.48	c	6.91	B	7.03	b	7.10	b	7.50	a
Smoothness Aftertaste	6.16	d	6.57	C	6.63	bc	6.84	b	7.18	a
Bitter Taste	1.53	a	0.87	B	0.93	b	0.78	b	0.00	c
Bitter Aftertaste	1.11	a	0.74	B	0.80	b	0.49	c	0.00	d
Sour Taste	2.89	a	2.76	Ab	2.80	ab	2.80	ab	2.66	b
Sour Aftertaste	1.61	a	1.58	Ab	1.54	ab	1.36	b	1.45	ab
Sweet Taste	4.55	a	4.40	a	4.53	a	4.44	a	4.51	a
Sweetness Linger	2.42	a	2.16	B	2.20	b	1.64	c	1.03	d
Licorice	0.35	a	0.15	B	0.15	b	0.00	b	0.00	b
Licorice Aftertaste	0.30	a	0.12	Bc	0.18	b	0.00	c	0.00	c

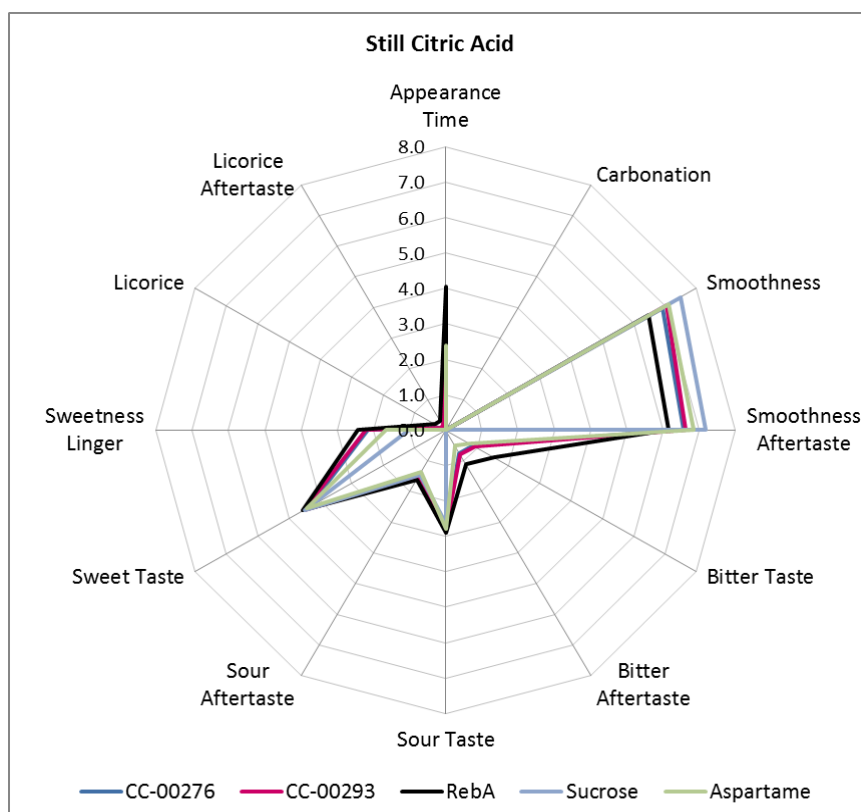


Figure 8. Spider chart summarizing Descriptive Analysis results of all attributes for all sweeteners in still citric acid.

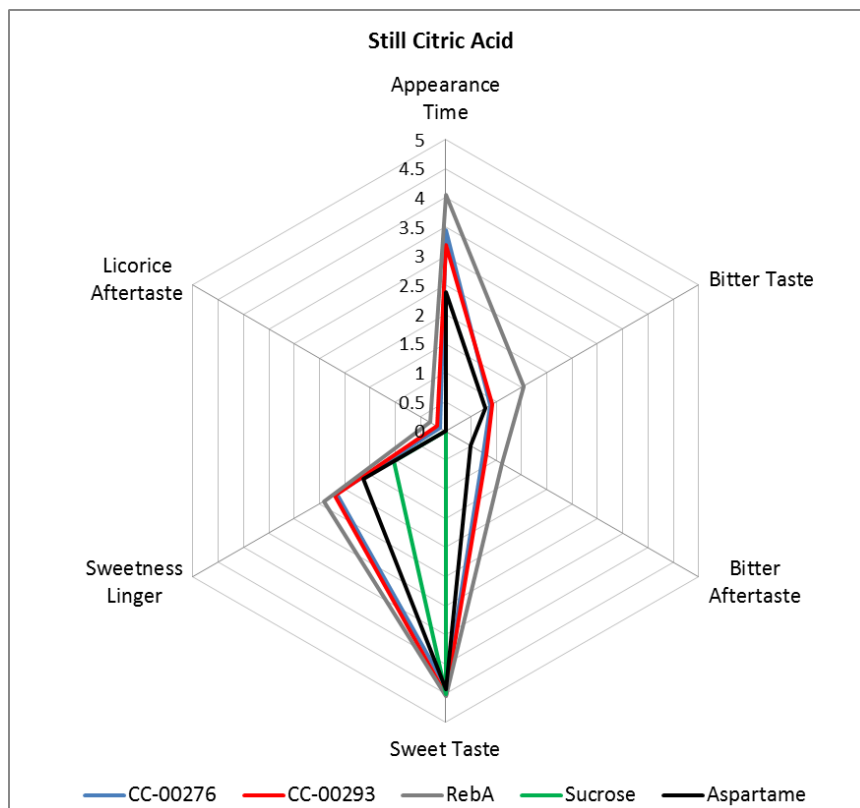


Figure 9. Spider chart summarizing Descriptive Analysis results of most salient attributes for all sweeteners in still citric acid.

Table 8: Descriptive Analysis of still citric acid

Notes: letters refer to homogeneous groups for comparisons of all sweeteners in this matrix for each attribute (to be read by row, and not by column); highest and lowest values for each attribute are highlighted.

Attributes	RebA		CC-00276		CC-00293		Aspartame		Sucrose	
Appearance Time	4.08	a	3.48	B	3.24	c	2.47	d	1.45	e
Carbonation	5.17	a	5.10	A	5.12	a	5.01	a	5.15	a
Smoothness	6.17	c	6.66	B	6.78	b	6.86	b	7.63	a
Smoothness Aftertaste	6.44	c	6.80	B	6.79	b	6.91	b	7.40	a
Bitter Taste	1.82	a	1.19	B	1.25	b	0.88	c	0.25	d
Bitter Aftertaste	1.33	a	0.85	B	0.80	b	0.56	c	0.24	d
Sour Taste	0.00	a	0.00	A	0.00	a	0.00	a	0.00	a
Sour Aftertaste	0.00	a	0.00	A	0.00	a	0.00	a	0.00	a
Sweet Taste	5.68	a	5.60	Ab	5.49	abc	5.33	c	5.40	bc
Sweetness Linger	2.84	a	2.42	B	2.44	b	2.13	c	1.65	d
Licorice	0.65	a	0.21	B	0.17	b	0.00	c	0.00	c
Licorice Aftertaste	0.72	a	0.25	B	0.21	b	0.00	c	0.00	c

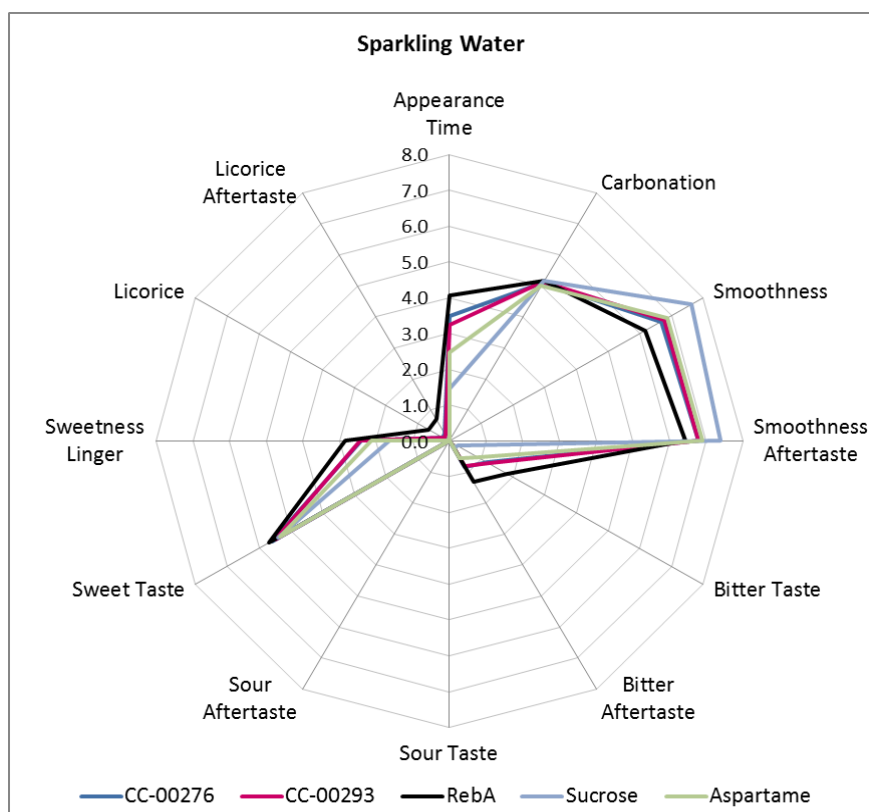


Figure 10. Spider chart summarizing Descriptive Analysis results of all attributes for all sweeteners in sparkling water.

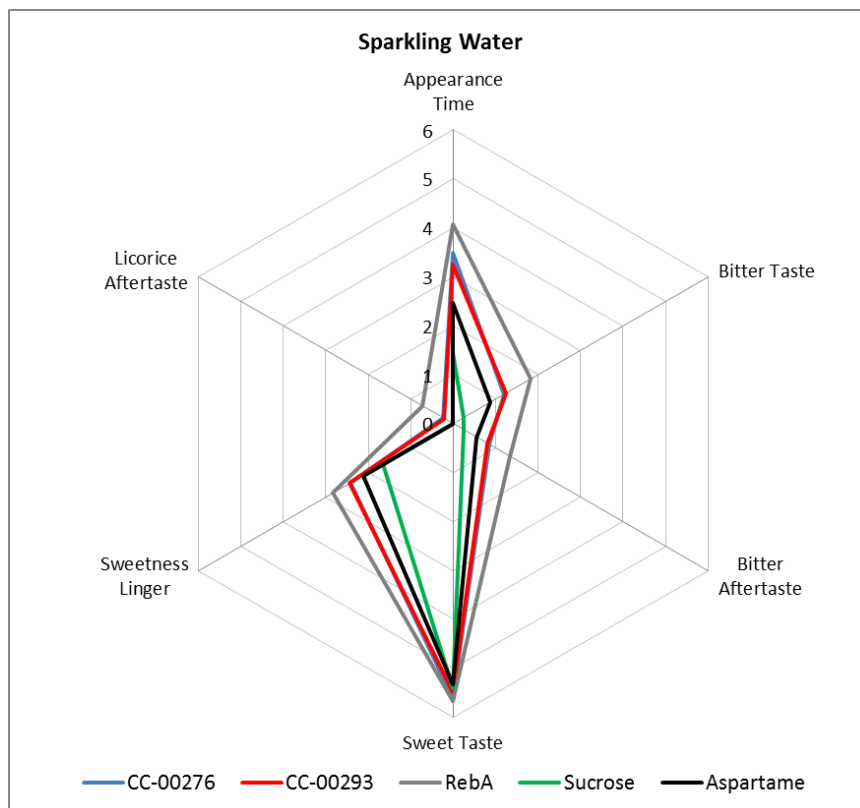


Figure 11. Spider chart summarizing Descriptive Analysis results of most salient attributes for all sweeteners in sparkling water.

Table 9: Descriptive Analysis of still water

Notes: letters refer to homogeneous groups for comparisons of all sweeteners in this matrix for each attribute (to be read by row, and not by column); highest and lowest values for each attribute are highlighted.

Attributes	RebA		CC-00276		CC-00293		Aspartame		Sucrose	
Appearance Time	4.05	a	3.45	B	3.19	c	2.39	d	1.41	e
Carbonation	0.00	a	0.00	A	0.00	a	0.00	a	0.00	a
Smoothness	6.48	c	6.91	B	7.03	b	7.10	b	7.50	a
Smoothness Aftertaste	6.16	d	6.57	C	6.63	bc	6.84	b	7.18	a
Bitter Taste	1.53	a	0.87	B	0.93	b	0.78	b	0.00	c
Bitter Aftertaste	1.11	a	0.74	B	0.80	b	0.49	c	0.00	d
Sour Taste	2.89	a	2.76	Ab	2.80	ab	2.80	ab	2.66	b
Sour Aftertaste	1.61	a	1.58	Ab	1.54	ab	1.36	b	1.45	ab
Sweet Taste	4.55	a	4.40	a	4.53	a	4.44	a	4.51	a
Sweetness Linger	2.42	a	2.16	B	2.20	b	1.64	c	1.03	d
Licorice	0.35	a	0.15	B	0.15	b	0.00	b	0.00	b
Licorice Aftertaste	0.30	a	0.12	Bc	0.18	b	0.00	c	0.00	c

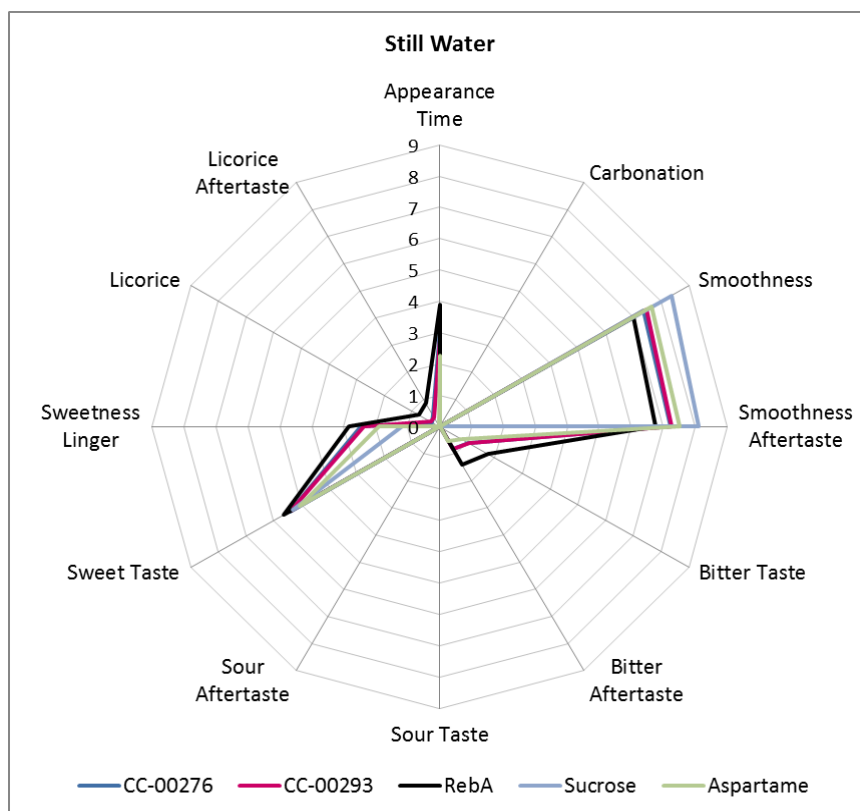


Figure 12. Spider chart summarizing Descriptive Analysis results of all attributes for all sweeteners in still water.

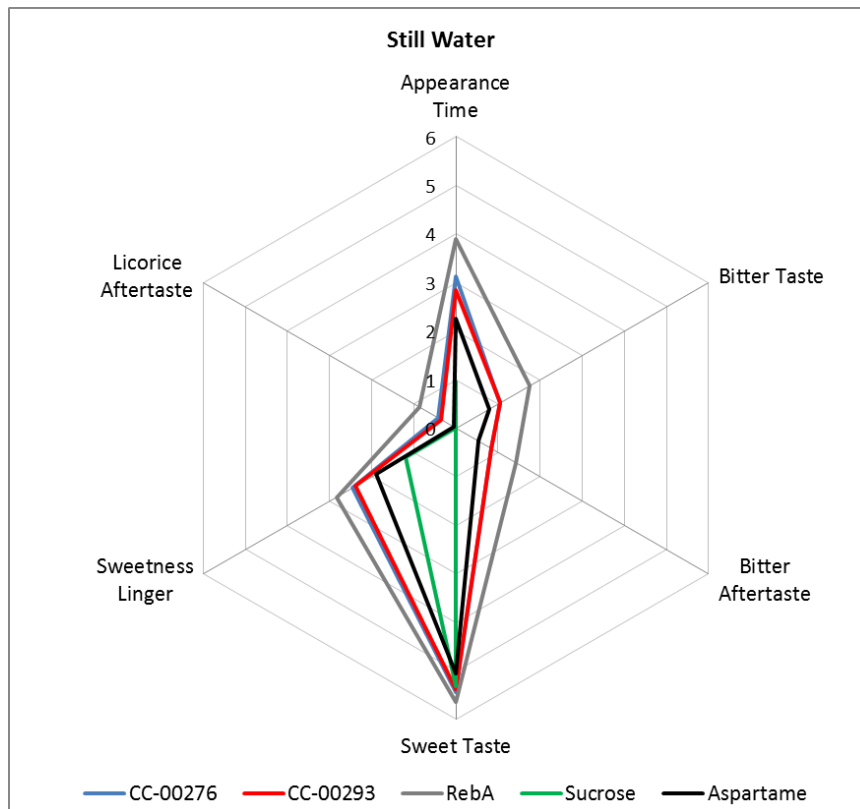


Figure 13. Spider chart summarizing Descriptive Analysis results of most salient attributes for all sweeteners in still water.

Module 1: Sweeteners and Blends to 10% SE

Sensory data on blends and their components were analyzed two ways: 1) globally (i.e., 4-factor (sweetener, sweetener level (8% SE (from Module 2) and 10% SE), matrix, and carbonation level), 2-way interaction ANOVA), to provide insight into how the variables are influencing the attributes; and, 2) by matrix, to provide actionable insights by beverage type. These analyses allow for the data to be presented by matrix and by blend, both of which are of great utility in providing guidance on these blends and investigations into future potential blends. Summarized below are the blends by matrix, followed by a summary of each attribute by blend across matrices.

In the global analysis, the sums of squares, which indicate the amount of variation resulting from a specific factor in the ANOVA, provide information on the variables of greatest importance for each attribute evaluated by DA.

Figure 14 summarizes the contribution each factor included in the global analysis of individual sweeteners at different levels (i.e., 10% SE and 8% SE (from Module 2)) has on each attribute. Figure 14 suggests that sweetener has an appreciable influence on appearance time, smoothness, smoothness aftertaste, bitter taste, bitter aftertaste, sour taste, sour aftertaste, sweet taste, sweetness linger, licorice, and licorice aftertaste.

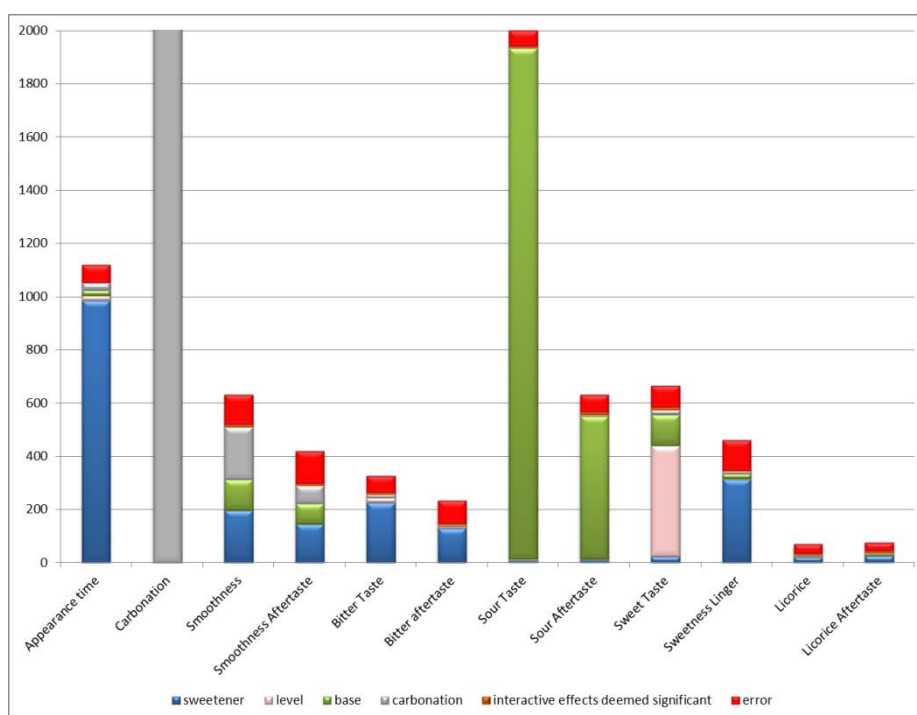


Figure 14. Sums of squares of the Analysis of Variance of the data for samples with single sweeteners showing the importance of the average effect of each system factor.

Notes: The carbonation bar is truncated (max. value 8,508, of which 8,483 is the portion due to the carbonation factor). The variables 'level' refers to either 8% SE or 10% SE.

As such, those attributes, plus sweet taste, were further examined using Tukey's HSD, which provided for comparison within each matrix between sweeteners. It is generally accepted that consumers can perceive a difference of 0.5 scale units as reported by DA. Thus, as a conservative measure samples that did not differ via Tukey's HSD are reported, and as a less conservative measure samples that did not differ via the 0.5 scale unit similarity are also indicated. Given the business need to find sweeteners and blends that emulate sucrose and APM, non-significant differences (rather than significant differences) between the sweeteners/blends and either sucrose or APM are presented highlighted in Tables 10-15. Figures 15-20 provide graphic summaries of attribute intensities elicited by all sweeteners and blends by matrix. Figures XX-XX summarize each attribute by blend over matrices.

Notes on Tables 10-15:

1) Letters refer to Tukey's homogeneous groups for comparisons of all sweeteners in this matrix for each attribute. Sweeteners/blends with the same letter do not differ significantly (to be read by row, not by column); 2) Colors highlighting means indicate they do not significantly differ from sucrose (pink), aspartame (green), or both (blue). Colors highlighting letters indicate no significant difference via Tukey's HSD. APM Total and SUC Total indicate the total number of attributes in each sweetener/blend that do not significantly differ from APM or SUC, respectively, using the 0.5 scale units criteria.

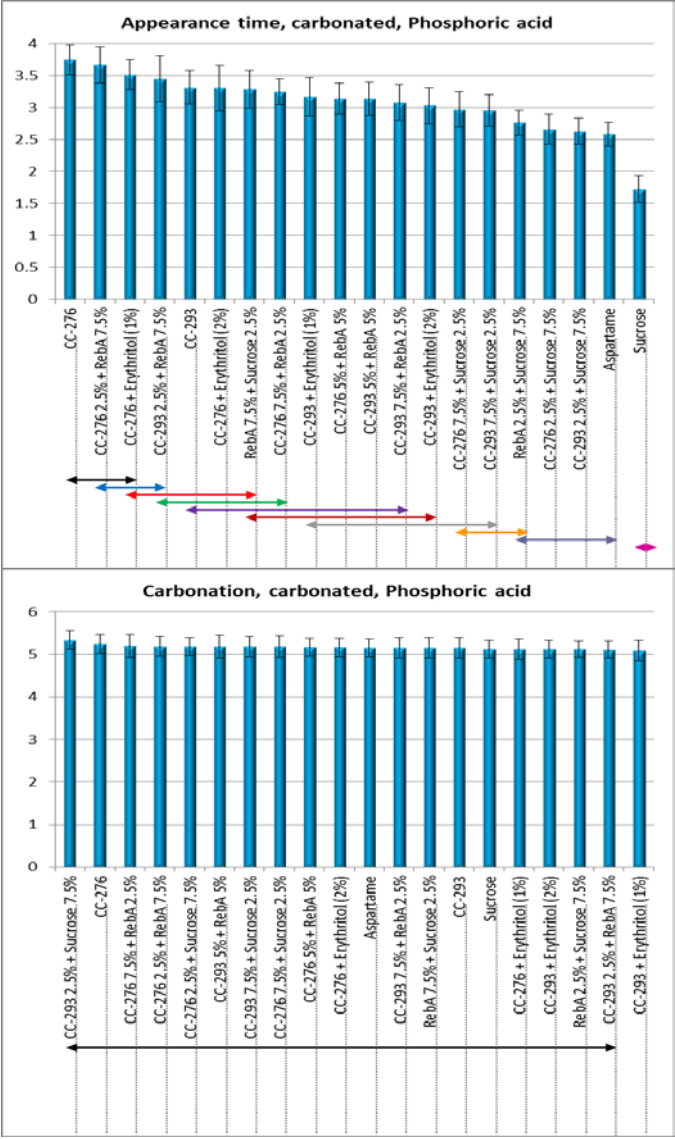
Note on Figures 15-20:

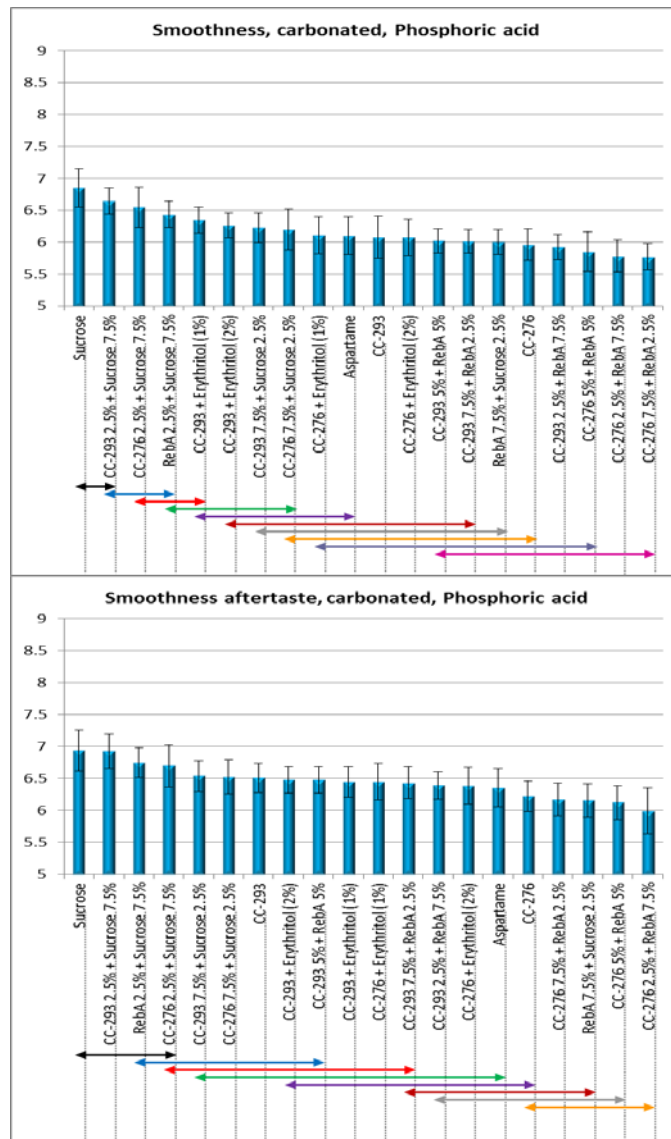
Double-arrowed lines below the bar charts indicate the results of the Tukey's HSD. Bars in the chart that are connected by a double-arrowed line below indicate that those bars do not differ significantly. The blend imparting the best sensorial level for each attribute (that does not include sucrose) within each matrix is highlighted with a yellow bar.

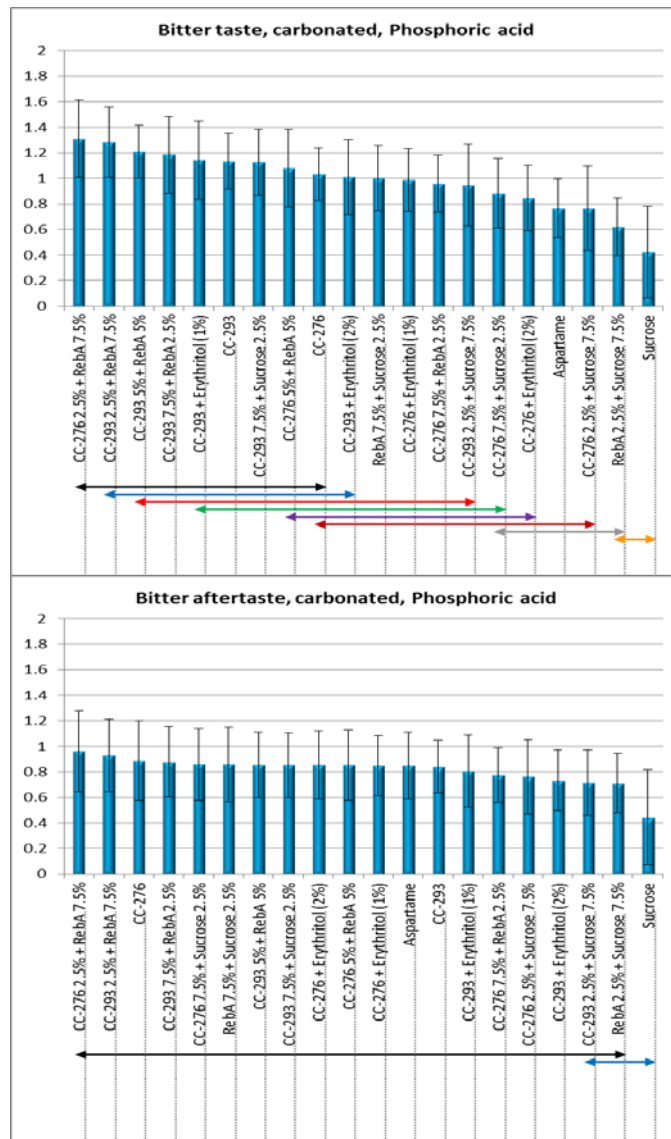


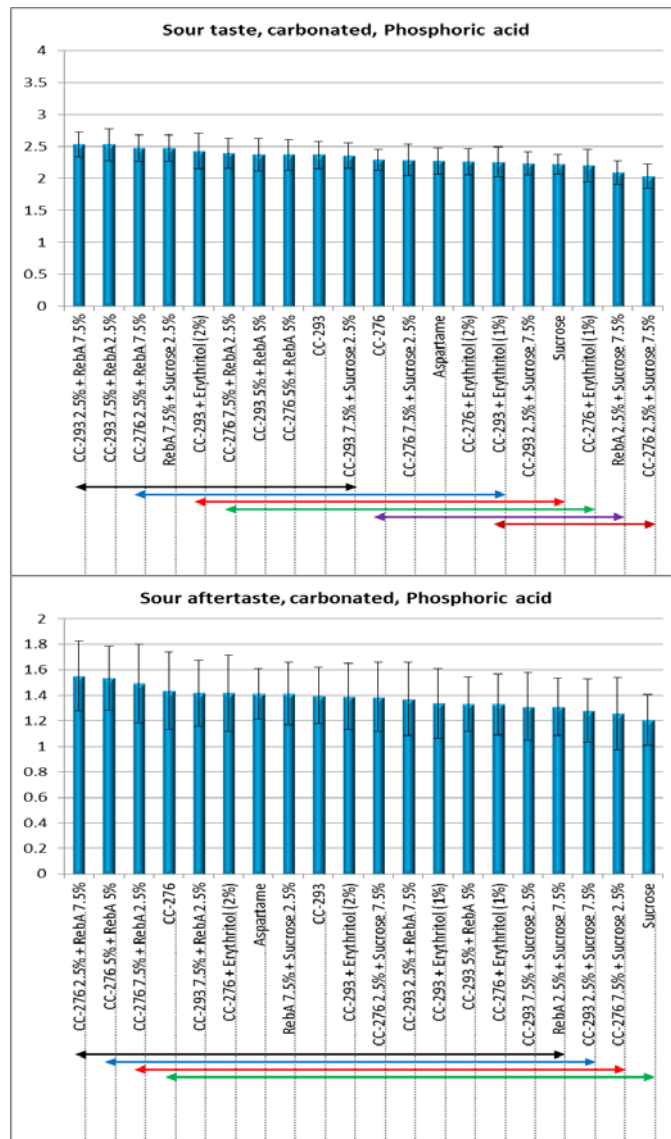
Table 10: Attribute Means and Tukey's HSD means separation results for sweeteners and their blends in sparkling phosphoric acid. Means and means separations results are presented for each attribute across all sweeteners/blends.

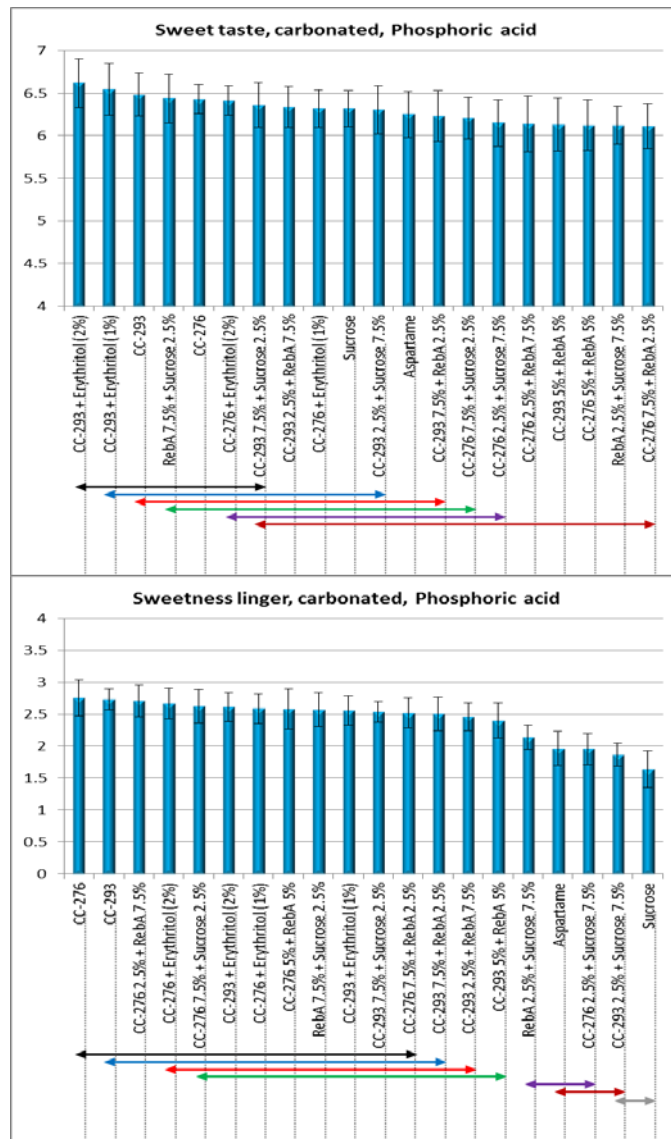
	Aspartame	CC-276	CC-276 + Erythritol (1%)	CC-276 + Erythritol (2%)	CC-276 2.5% + RebA 7.5%	CC-276 2.5% + Sucrose 7.5%	CC-276 5% + RebA 5%	CC-276 7.5% + RebA 2.5%	CC-276 7.5% + Sucrose 2.5%	CC-293	CC-293 + Erythritol (1%)	CC-293 + Erythritol (2%)	CC-293 2.5% + RebA 7.5%	CC-293 2.5% + Sucrose 7.5%	CC-293 5% + RebA 5%	CC-293 7.5% + RebA 2.5%	CC-293 7.5% + Sucrose 2.5%	RebA 2.5% + Sucrose 7.5%	RebA 7.5% + Sucrose 2.5%	Sucrose
Appearance	2.58	3.75	3.51	3.30	3.67	2.66	3.14	3.24	2.97	3.31	3.17	3.03	3.45	2.63	3.13	3.08	2.96	2.76	3.29	1.73
Time	i	a	abc	cde	ab	i	efg	def	gh	cde	efg	fg	bcd	i	efg	efg	gh	hi	cdef	j
Smoothness	6.10	5.96	6.11	6.08	5.78	6.55	5.85	5.77	6.20	6.08	6.35	6.26	5.93	6.65	6.02	6.02	6.23	6.44	6.00	6.85
	efghi	hi	efghi	efghi	i	bc	i	i	defgh	fghi	cde	def	i	ab	fghi	fghi	defg	bcd	ghi	a
Smoothness	6.35	6.22	6.45	6.38	5.99	6.70	6.12	6.17	6.53	6.50	6.45	6.48	6.39	6.92	6.48	6.43	6.54	6.75	6.16	6.93
Aftertaste	defg	efgh	cde	defg	h	abc	gh	fgh	bcd	bcd	cde	bcde	defg	a	bcde	cdef	bcd	ab	fgh	a
Bitter	0.77	1.03	0.99	0.85	1.31	0.77	1.08	0.96	0.88	1.13	1.14	1.01	1.28	0.95	1.21	1.18	1.13	0.62	1.00	0.43
Taste	fg	abcdef	cdef	efg	a	fg	abcde	cdef	defg	abcd	abcd	bcdef	ab	cdef	abc	abc	abcd	gh	cdef	h
Bitter	0.85	0.89	0.85	0.85	0.96	0.76	0.85	0.78	0.86	0.84	0.81	0.73	0.93	0.72	0.85	0.88	0.85	0.71	0.86	0.45
Aftertaste	a	a	a	a	a	a	a	a	a	a	a	a	a	ab	a	a	a	ab	a	b
Sweet	6.25	6.43	6.32	6.41	6.14	6.15	6.13	6.12	6.21	6.48	6.55	6.62	6.34	6.30	6.13	6.23	6.36	6.13	6.44	6.32
Taste	cdef	abcd	bcdef	abcde	f	ef	f	f	def	abc	ab	a	bcdef	bcdef	f	cdef	abcdef	f	abcd	bcdef
Sweetness	1.97	2.76	2.59	2.67	2.71	1.96	2.58	2.52	2.63	2.73	2.56	2.62	2.46	1.87	2.40	2.50	2.54	2.14	2.58	1.64
Linger	ef	a	abcd	abc	ab	ef	abcd	abcd	abcd	ab	abcd	abcd	cd	fg	d	bcd	abcd	e	abcd	g
Licorice	0.00	0.10	0.01	0.02	0.15	0.00	0.03	0.01	0.02	0.05	0.02	0.03	0.10	0.03	0.03	0.03	0.02	0.00	0.24	0.00
	c	bc	c	c	ab	c	c	c	c	bc	c	c	bc	c	c	c	c	c	a	c
Licorice	0.00	0.18	0.03	0.01	0.12	0.01	0.03	0.04	0.00	0.03	0.02	0.02	0.15	0.03	0.03	0.03	0.02	0.00	0.28	0.00
Aftertaste	bcd	e	de	cde	e	de	de	de	a	de	de	de	e	de	de	de	de	ab	e	bc
APM Total		7	7	7	6	9	7	7	8	7	7	8	7	7	8	7	8	9	7	
SUC Total		3	3	3	3	6	3	3	4	4	4	4	3	4	4	3	4	6	3	











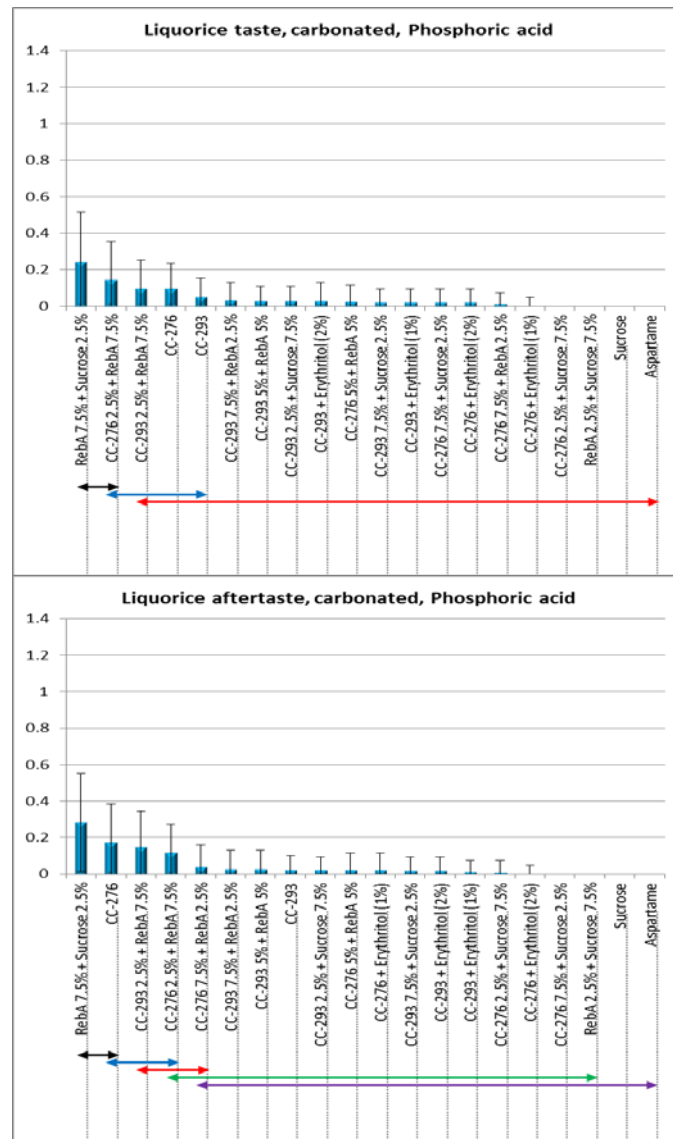
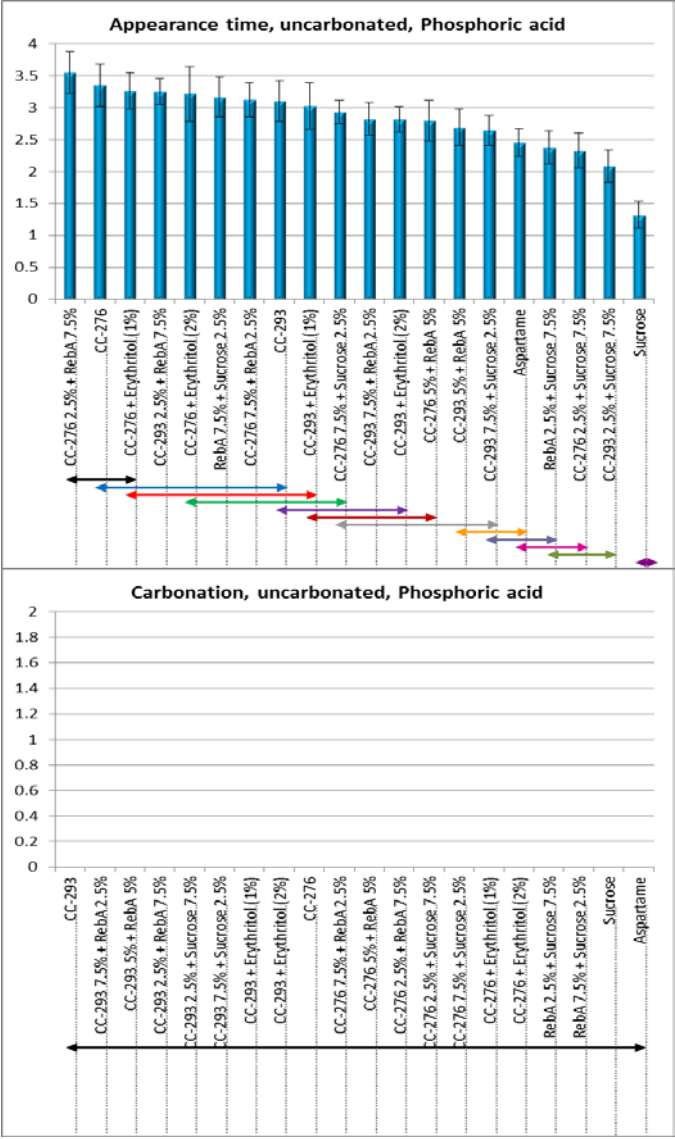
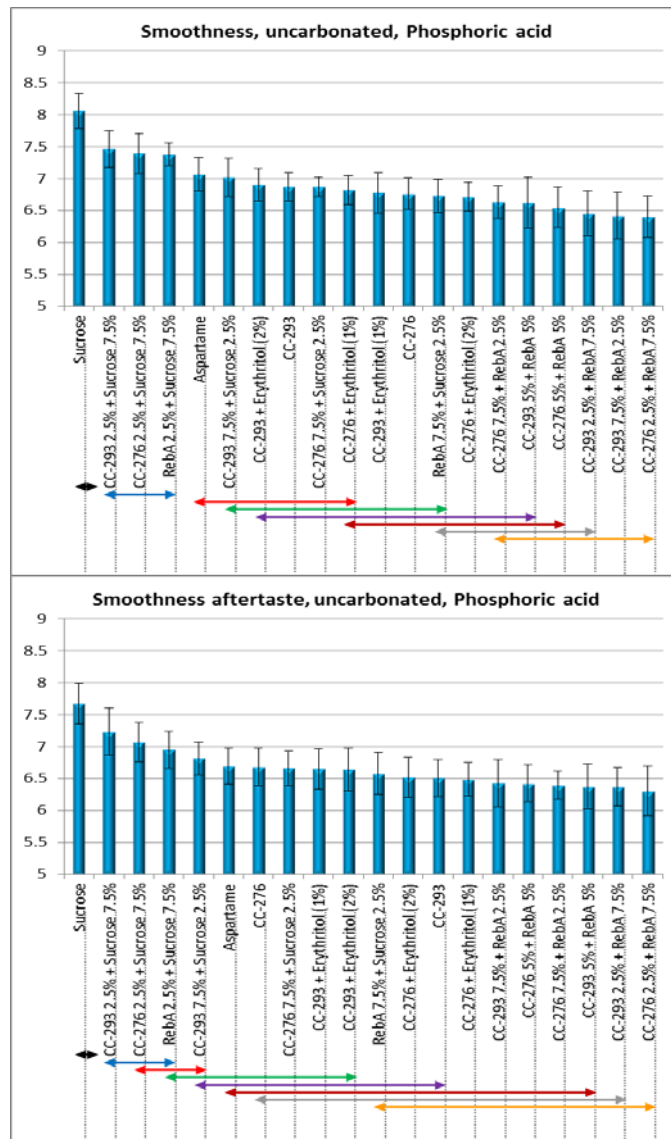


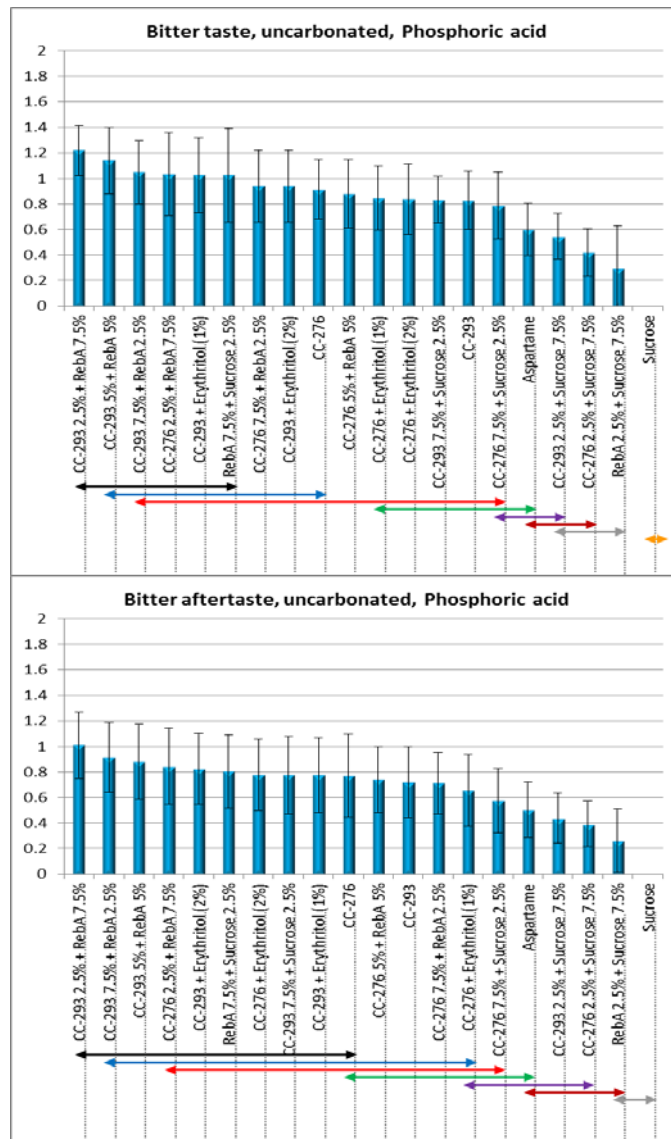
Figure 15: Means and Tukey's HSD means separation results for all sweeteners and their blends by Descriptive Analysis attribute for sparkling phosphoric acid.

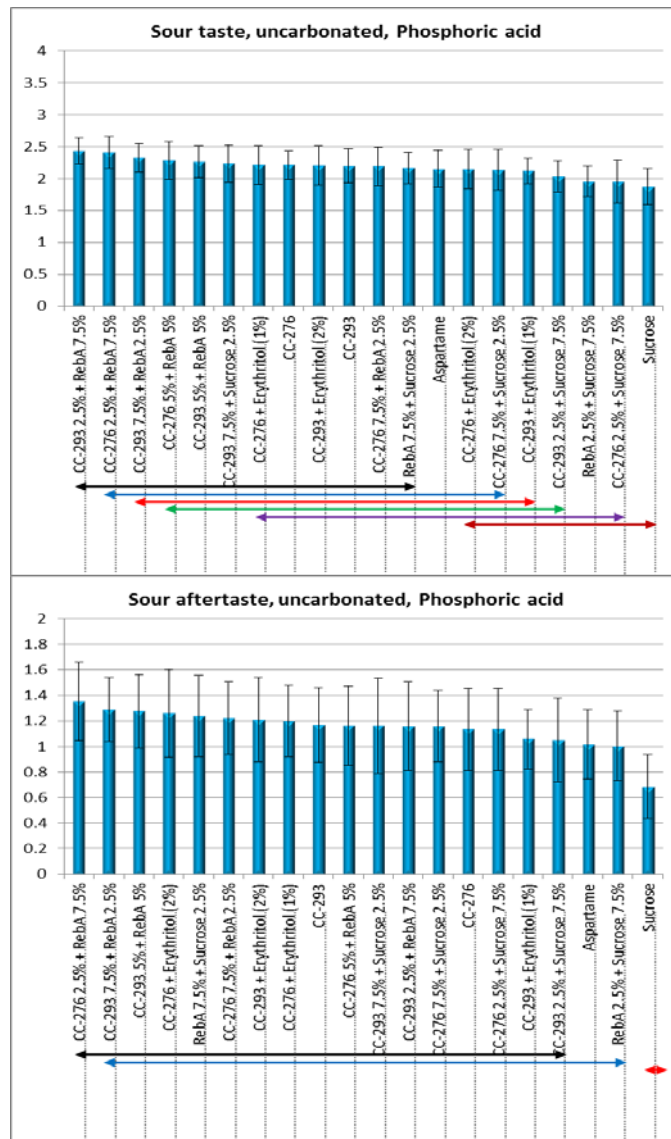
Table 11: Attribute means and Tukey's HSD means separation results for sweeteners and their blends in still phosphoric acid. Means and means separations results are presented for each attribute across all sweeteners/blends.

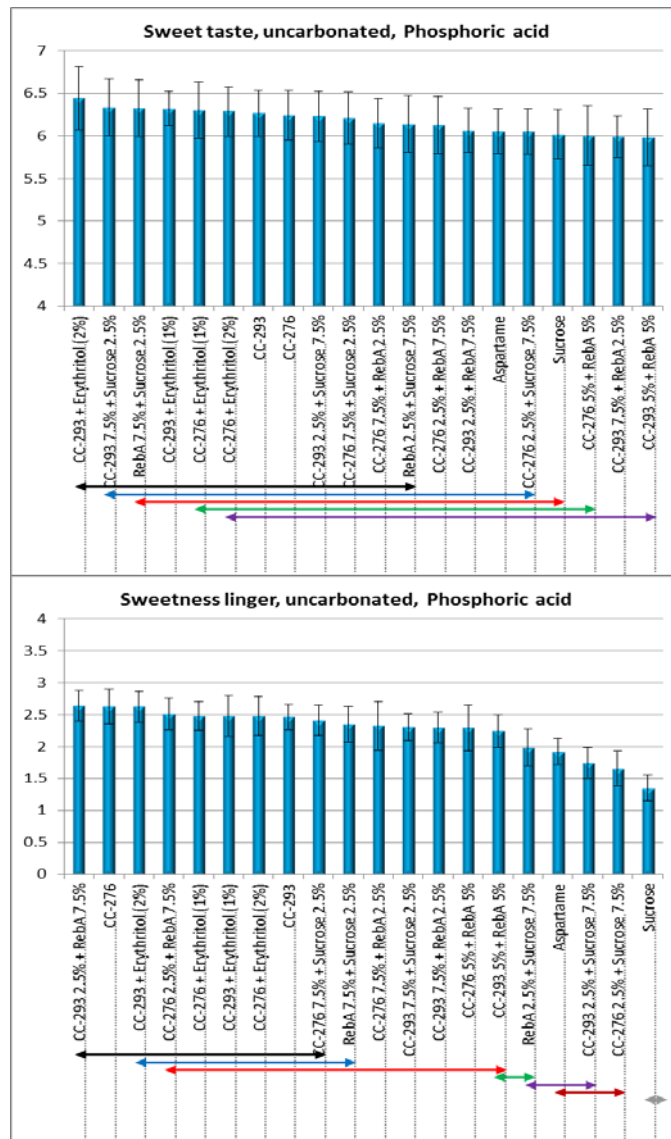
	Aspartame	276	276 + Erythritol 1%	276 + Erythritol 2%	276 2.5% + RebA 7.5%	276 2.5% + Sucrose 7.5%	276 5% + RebA 5%	276 7.5% + RebA 2.5%	276 7.5% + Sucrose 2.5%	293	293 + Erythritol 1%	293 + Erythritol 2%	293 2.5% + RebA 7.5%	293 2.5% + Sucrose 7.5%	293 5% + RebA 5%	293 7.5% + RebA 2.5%	293 7.5% + Sucrose 2.5%	RebA 2.5% + Sucrose 7.5%	RebA 7.5% + Sucrose 2.5%	Sucrose
Appearance	2.45	3 35	3.26	3.21	3.55	2.33	2.80	3.13	2 93	3.10	3.02	2.81	3 25	2.08	2.69	2.82	2.64	2.37	3.16	1.33
Time	hij	ab	abc	bcd	a	jk	fg	bcd	defg	bcde	cdef	efg	bc	k	gh	efg	ghi	ijk	bcd	l
Smoothness	7.07	6.76	6.82	6.71	6.40	7.39	6.55	6.63	6.87	6.87	6.78	6.90	6.45	7.46	6.62	6.42	7.02	7.38	6.73	8.06
	c	def	cdef	efg	h	b	fgh	efgh	cde	cde	def	cde	gh	b	efgh	h	cd	b	defg	a
Smoothness	6.69	6.68	6.49	6.52	6.30	7.06	6.42	6.39	6.66	6.51	6.65	6.64	6 37	7.23	6.37	6.43	6.81	6.95	6 58	7.67
Aftertaste	def	defg	fgh	efgh	h	bc	fgh	fgh	defg	efgh	defg	defg	gh	b	fgh	fgh	cde	bcd	efgh	a
Bitter	0.60	0 91	0.85	0.84	1.03	0.42	0.88	0.94	0.79	0.83	1.03	0.94	1 22	0.55	1.14	1.05	0.83	0.30	1.03	0.00
Taste	def	bc	cd	cd	abc	fg	c	bc	cde	cd	abc	bc	a	efg	ab	abc	cd	g	abc	h
Bitterness	0.50	0.77	0.65	0.78	0.84	0.39	0.74	0.71	0 58	0.72	0.78	0.82	1.01	0.44	0.88	0.91	0.78	0.26	0.80	0.00
Aftertaste	def	abcd	bcde	abc	abc	ef	bcd	bcd	cde	bcd	abc	abc	a	ef	ab	ab	abc	fg	abc	g
Sweet	6.05	6 24	6.30	6.29	6.13	6.05	6.00	6.15	6 21	6.26	6 32	6.44	6.07	6.23	5.98	5.99	6.34	6.14	6 33	6.02
Taste	bcde	abcde	abcd	abcde	bcde	bcde	de	abcde	abcde	abcde	abc	a	bcde	abcde	e	e	ab	abcde	abc	cde
Sweetness	1.92	2.63	2.48	2.48	2.51	1.66	2.29	2.33	2.41	2.46	2.48	2.62	2.63	1.74	2.24	2.29	2.30	1.98	2 35	1.35
Linger	ef	a	abc	abc	abc	f	c	c	abc	abc	abc	ab	a	ef	cd	c	c	de	bc	g
Licorice	0.00	0.16	0.02	0.02	0.23	0.01	0.01	0.02	0.05	0.15	0.02	0.02	0 25	0.02	0.02	0.02	0.06	0.03	0 53	0.00
Taste	e	bc	e	de	b	e	e	de	cde	bcd	de	e	b	e	de	e	cde	cde	a	e
Licorice	0.00	0.09	0.03	0.03	0.22	0.01	0.03	0.03	0.05	0.12	0.02	0.03	0 30	0.01	0.02	0.03	0.01	0.03	0 55	0.00
Aftertaste	d	d	d	d	bc	d	d	d	d	cd	d	d	b	d	d	d	d	d	a	d
APM Total		7	7	7	6	9	8	8	9	7	7	8	5	8	8	8	9	9	6	
SUC Total		3	3	3	3	6	3	3	3	3	3	3	3	6	3	3	3	5	1	











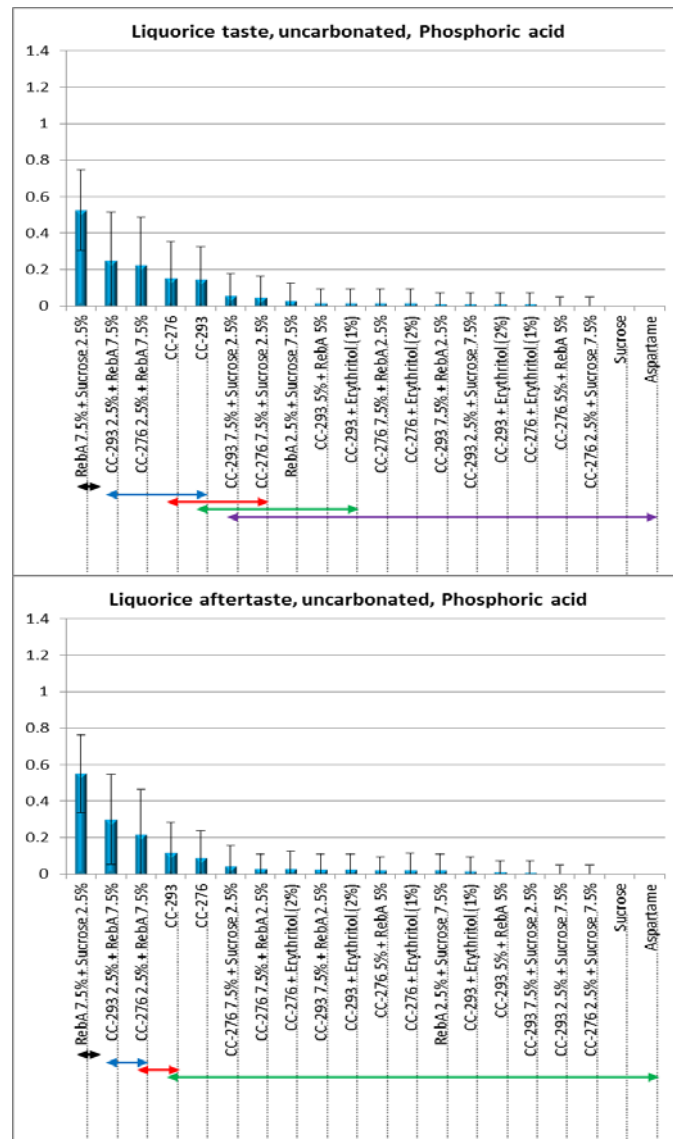
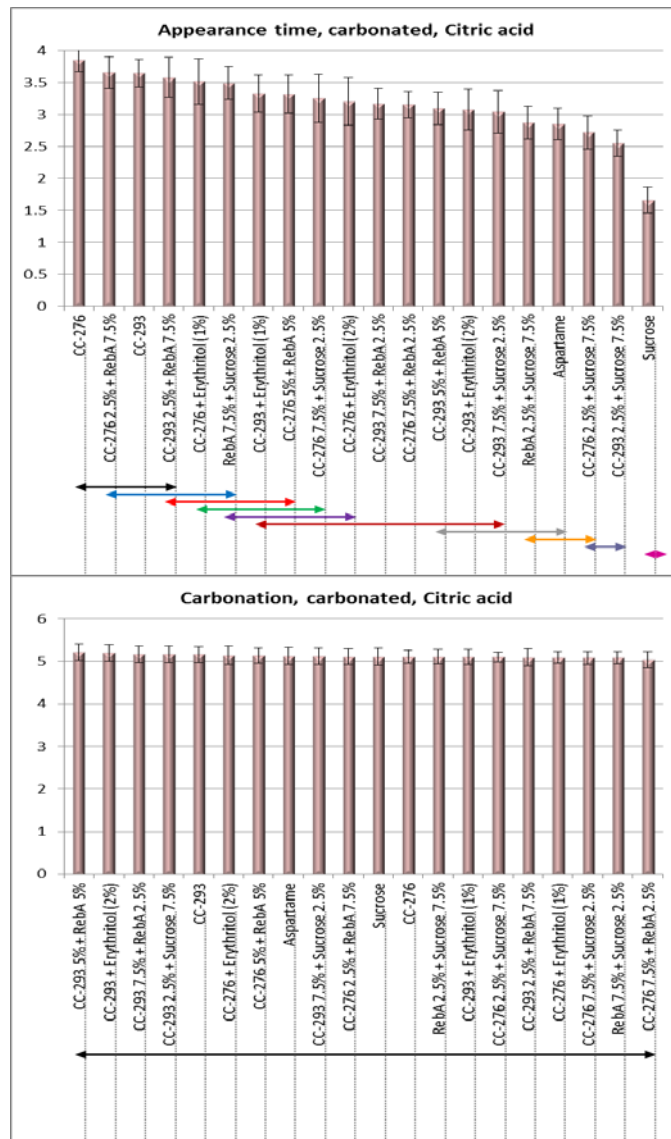
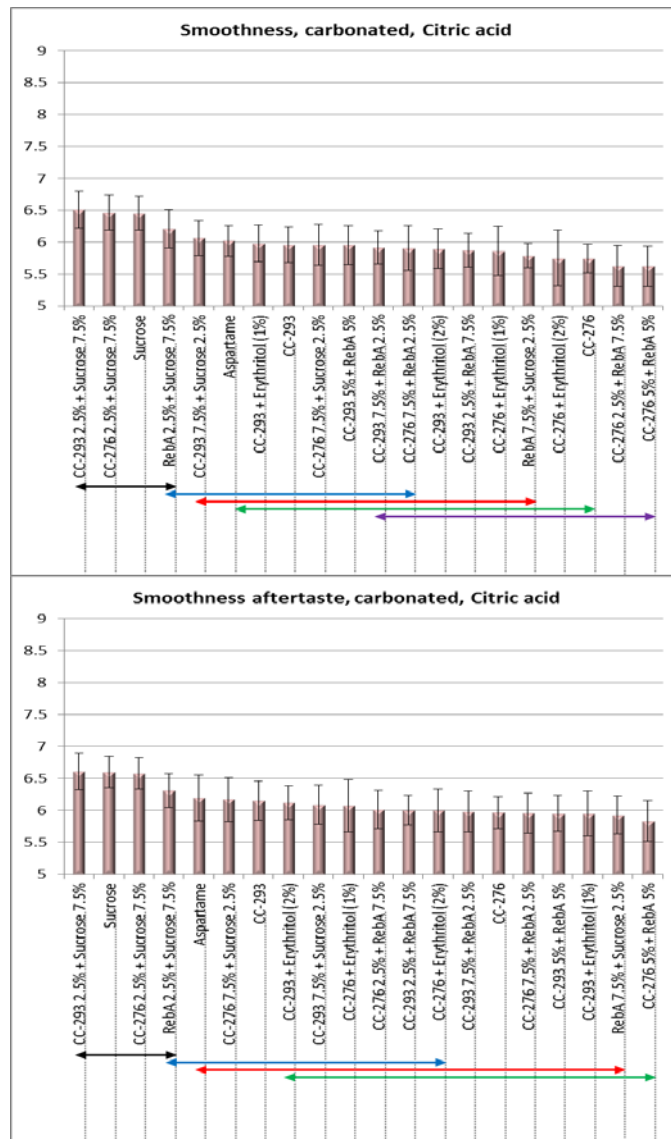


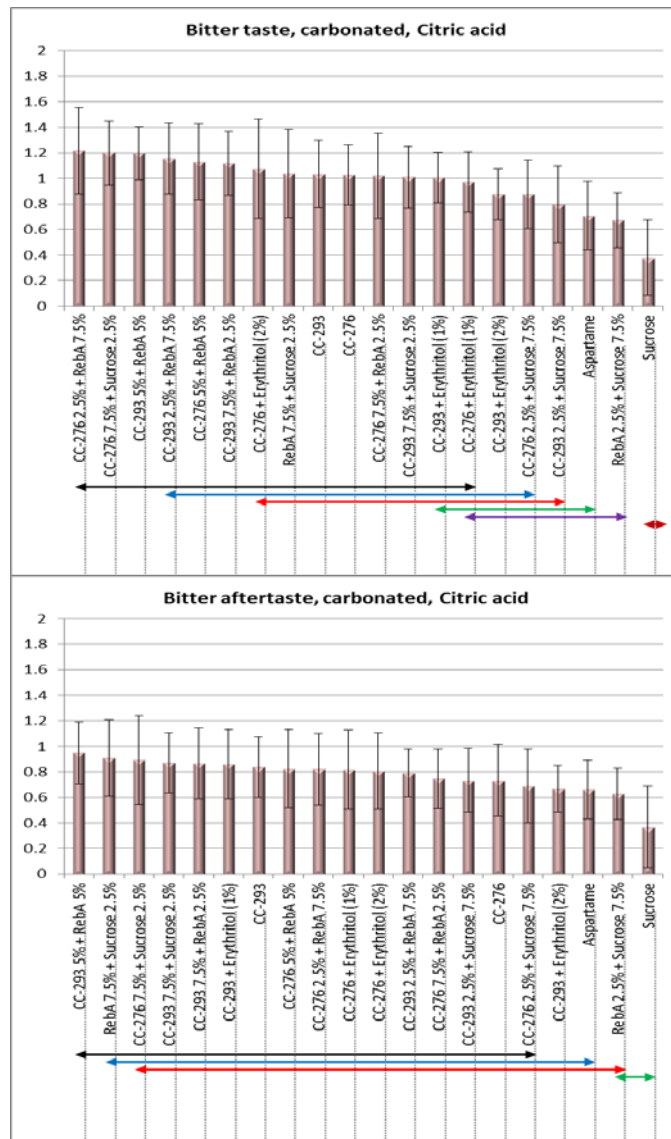
Figure 16: Means and Tukey's HSD means separation results for all sweeteners and their blends by Descriptive Analysis attribute for still phosphoric acid.

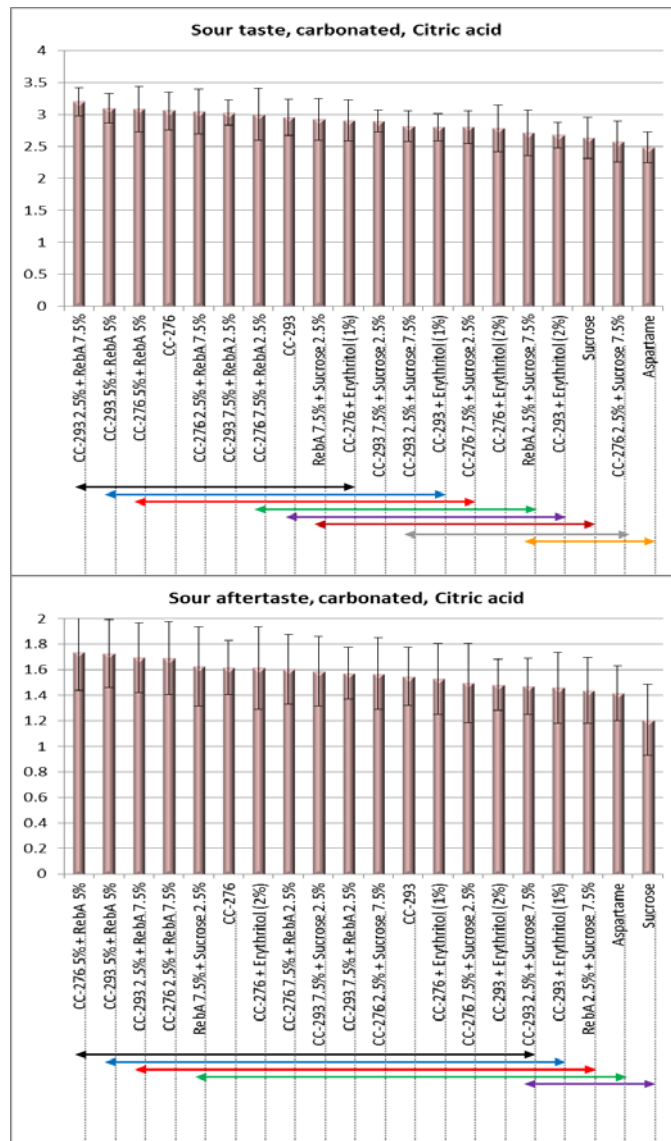
Table 12: Attribute means and Tukey's HSD means separation results for sweeteners and their blends in sparkling citric acid. Means and means separations results are presented for each attribute across all sweeteners/blends.

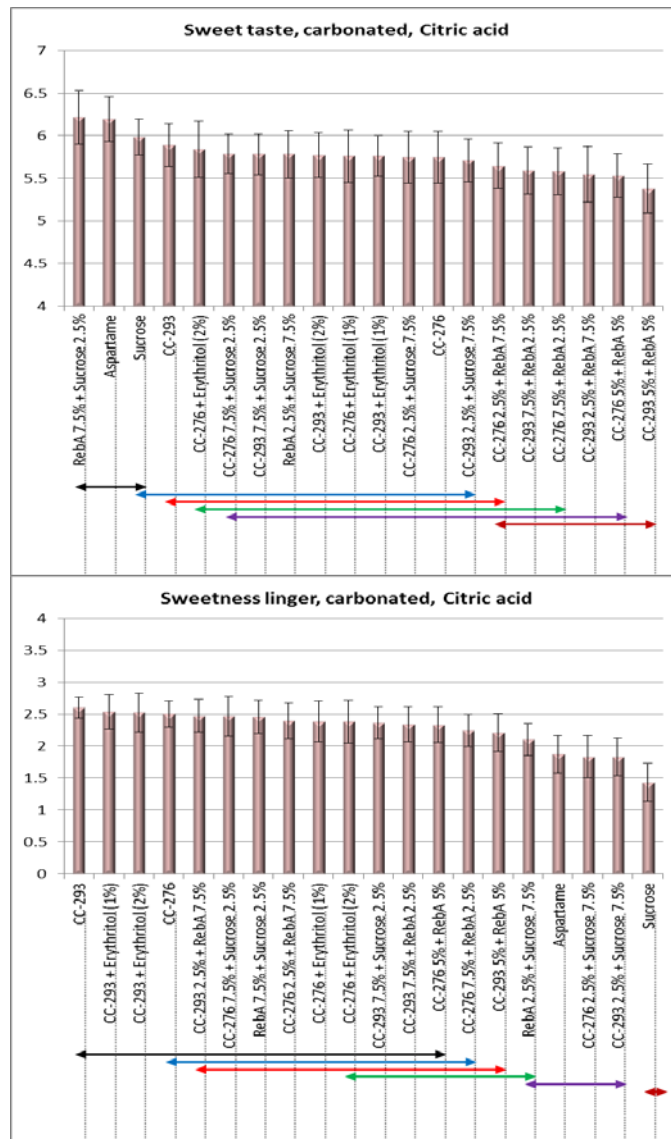
	Aspartame	CC-276	CC-276 + Erythritol (1%)	CC-276 + Erythritol (2%)	CC-276 2.5% + Reba 7.5%	CC-276 2.5% + Sucrose 7.5%	CC-276 5% + Reba 5%	CC-276 7.5% + Reba 2.5%	CC-276 7.5% + Sucrose 2.5%	CC-293	CC-293 + Erythritol (1%)	CC-293 + Erythritol (2%)	CC-293 2.5% + Reba 7.5%	CC-293 2.5% + Sucrose 7.5%	CC-293 5% + Reba 5%	CC-293 7.5% + Reba 2.5%	CC-293 7.5% + Sucrose 2.5%	Reba 2.5% + Sucrose 7.5%	Reba 7.5% + Sucrose 2.5%	Sucrose
Appearance	2.85	3.85	3.52	3.20	3.65	2.72	3.32	3.16	3.25	3.65	3.33	3.08	3.58	2.55	3.10	3.17	3.04	2.87	3.49	1.66
Time	gh	a	bcd	ef	ab	hi	cdef	f	def	ab	cdef	fg	abc	i	fg	f	fg	gh	bcde	j
Smoothness	6.02	5.75	5.86	5.75	5.63	6.47	5.63	5.91	5.96	5.96	5.98	5.90	5.88	6.51	5.96	5.92	6.07	6.21	5.79	6.45
	bcd	de	cde	de	e	a	e	bcde	bcd	bcd	bcd	cde	cde	a	bcd	bcde	bc	ab	cde	a
Smoothness	6.19	5.96	6.07	6.00	6.01	6.58	5.83	5.95	6.17	6.15	5.95	6.12	6.00	6.61	5.95	5.98	6.08	6.30	5.93	6.60
Aftertaste	bc	cd	bcd	bcd	bcd	a	d	cd	bc	bc	cd	bcd	bcd	a	cd	cd	bcd	ab	cd	a
Bitter	0.71	1.03	0.97	1.08	1.22	0.88	1.13	1.02	1.20	1.03	1.00	0.88	1.15	0.80	1.20	1.12	1.01	0.68	1.04	0.38
Taste	de	abc	abcd	abc	a	bcde	ab	abc	a	abc	abc	bcde	ab	cde	a	ab	abc	e	abc	f
Bitter	0.66	0.73	0.82	0.81	0.82	0.69	0.83	0.75	0.89	0.84	0.86	0.67	0.79	0.73	0.95	0.87	0.87	0.63	0.91	0.37
Aftertaste	bc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	bc	abc	abc	a	abc	abc	cd	ab	d
Sweet	6.20	5.75	5.76	5.84	5.65	5.75	5.53	5.58	5.79	5.89	5.76	5.77	5.55	5.71	5.38	5.59	5.78	5.78	6.22	5.99
Taste	a	bcde	bcde	bcd	cdef	bcde	ef	def	bcde	bc	bcde	bcde	ef	bcde	f	def	bcde	bcde	a	ab
Sweetness	1.88	2.51	2.39	2.39	2.40	1.84	2.34	2.24	2.47	2.60	2.54	2.53	2.48	1.83	2.21	2.35	2.37	2.10	2.46	1.43
Linger	e	ab	abc	abcd	abc	e	abcd	bcd	abc	a	a	a	abc	e	cd	abcd	abcd	de	abc	f
Licorice	0.05	0.04	0.03	0.21	0.00	0.01	0.03	0.05	0.10	0.02	0.04	0.15	0.01	0.03	0.03	0.03	0.03	0.25	0.00	0.00
	cd	cd	cd	ab	d	d	cd	cd	bcd	d	cd	abc	d	cd	cd	cd	cd	a	d	d
Licorice	0.00	0.04	0.02	0.02	0.15	0.01	0.02	0.02	0.02	0.05	0.01	0.03	0.26	0.01	0.03	0.05	0.04	0.01	0.16	0.00
Aftertaste	c	c	c	c	b	c	c	c	c	c	c	c	a	c	c	c	c	c	b	c
APM Total		7	7	8	6	9	9	9	8	7	8	8	7	9	8	9	9	9	7	
SUC Total		3	3	3	3	6	3	3	5	5	4	4	3	6	3	3	5	5	3	











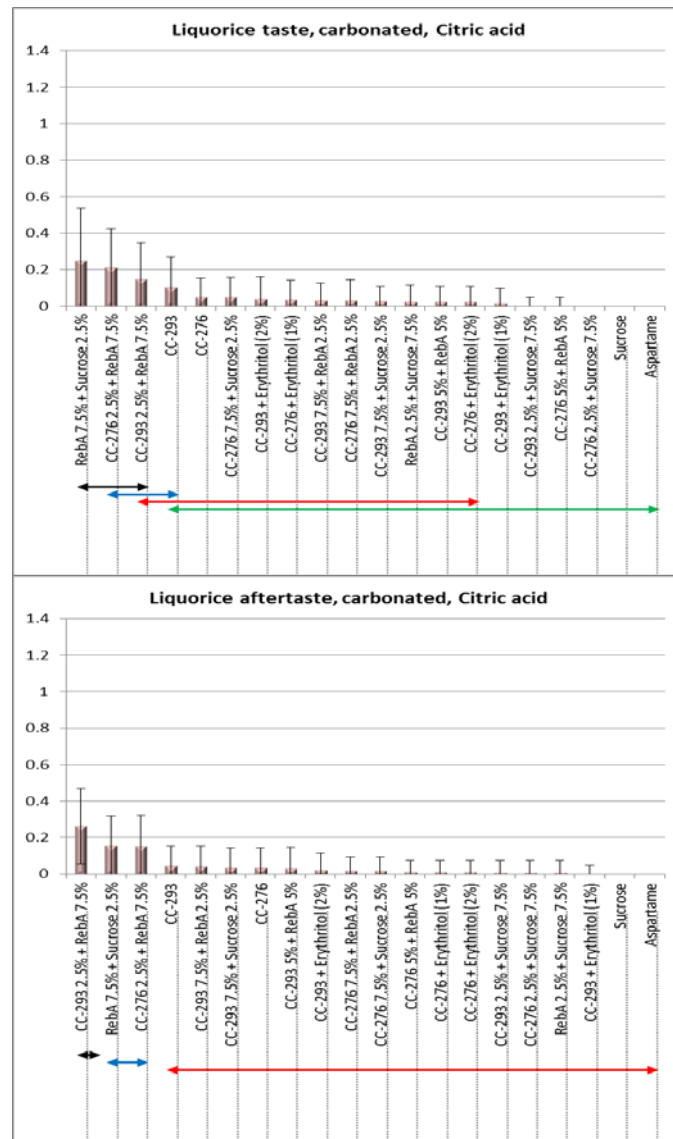
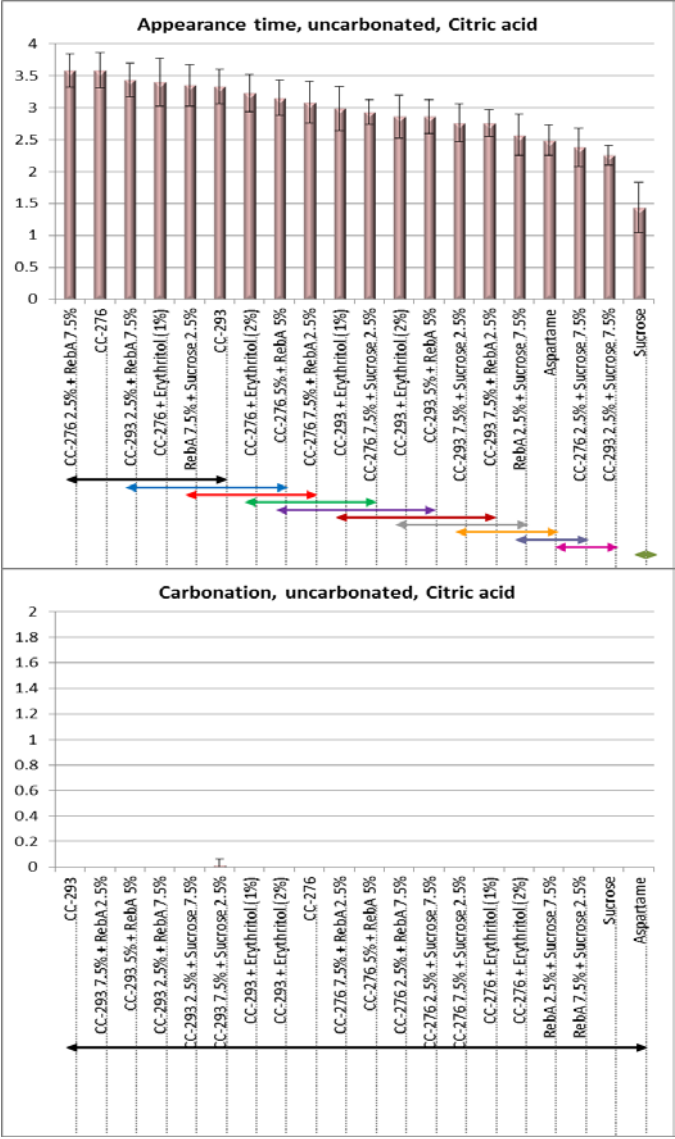
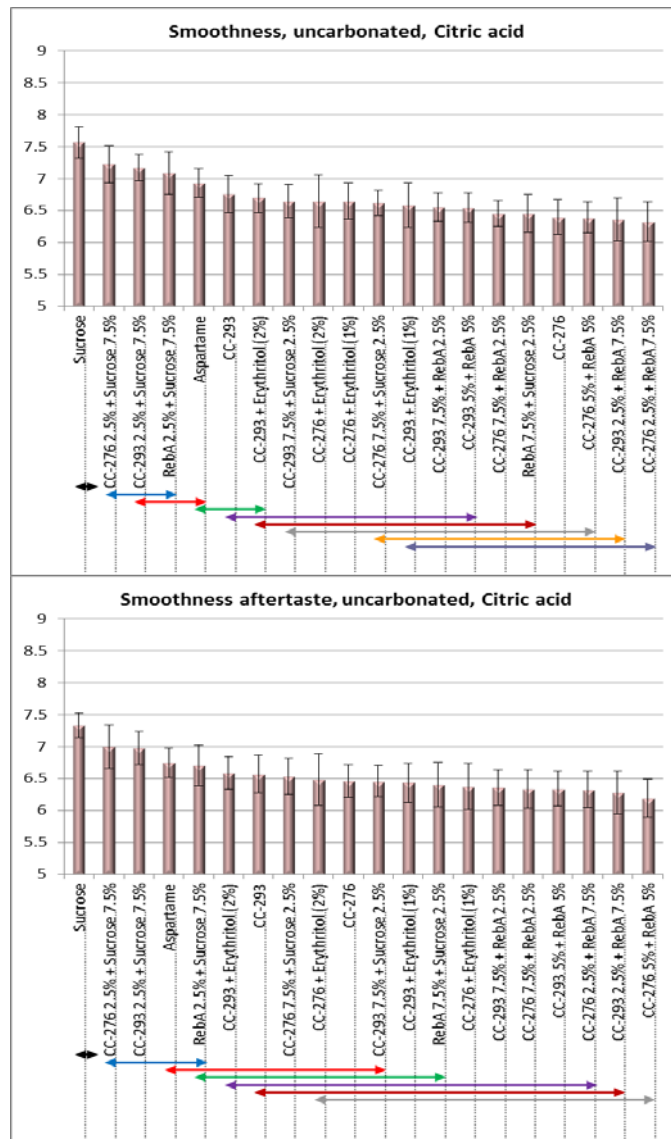


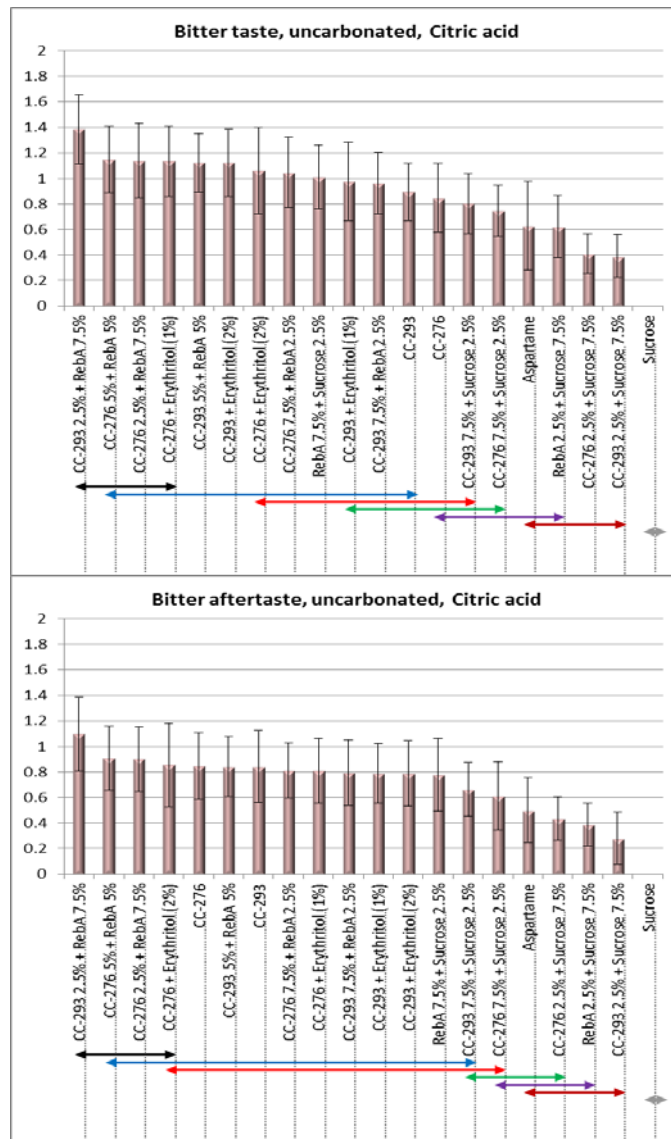
Figure 17: Means and Tukey's HSD means separation results for all sweeteners and their blends by Descriptive Analysis attribute for sparkling citric acid.

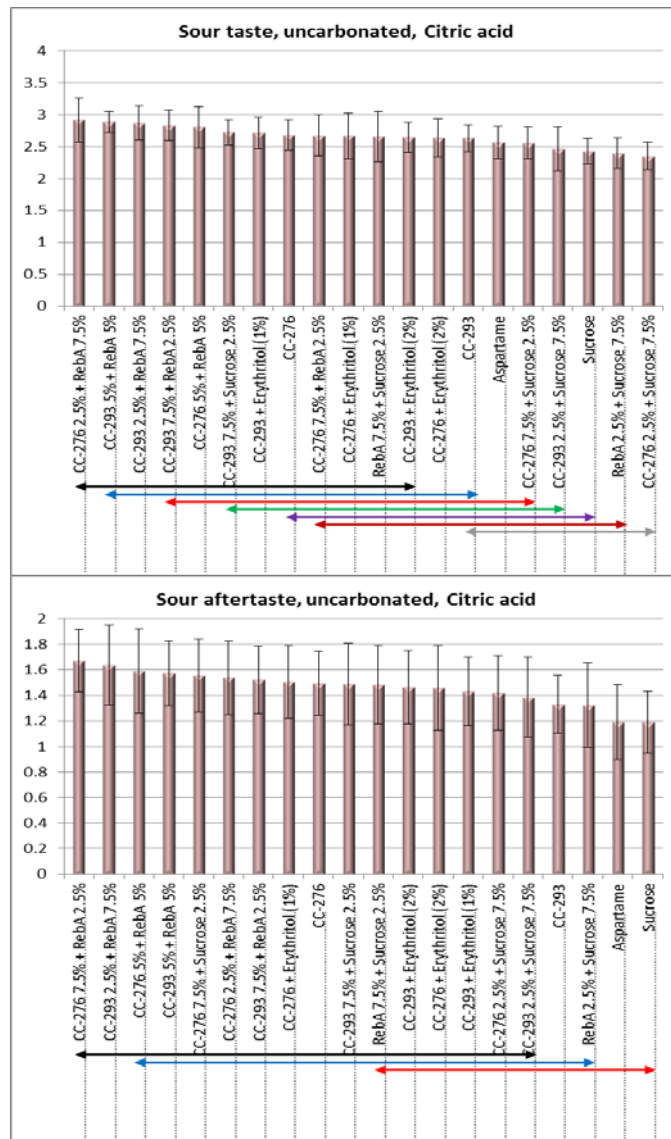
Table 13: Attribute means and Tukey's HSD means separation results for sweeteners and their blends in still citric acid. Means and means separations results are presented for each attribute across all sweeteners/blends.

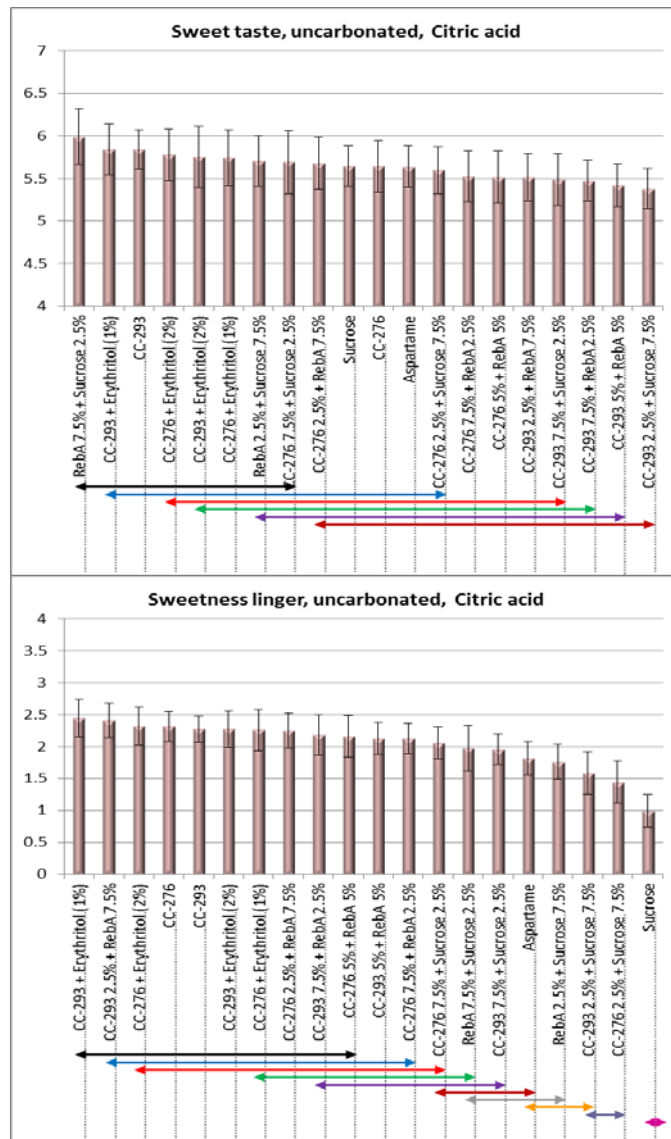
	Aspartame	CC-276	CC-276 + Erythritol (1%)	CC-276 + Erythritol (2%)	CC-276 2.5% + Reba 7.5%	CC-276 2.5% + Sucrose 7.5%	CC-276 5% + Reba 5%	CC-276 7.5% + Reba 2.5%	CC-276 7.5% + Sucrose 2.5%	CC-293	CC-293 + Erythritol (1%)	CC-293 + Erythritol (2%)	CC-293 2.5% + Reba 7.5%	CC-293 2.5% + Sucrose 7.5%	CC-293 5% + Reba 5%	CC-293 7.5% + Reba 2.5%	CC-293 7.5% + Sucrose 2.5%	Reba 2.5% + Sucrose 7.5%	Reba 7.5% + Sucrose 2.5%	Sucrose
Appearance	2.49	3.58	3.40	3.23	3.58	2.38	3.15	3.08	2.93	3.33	2.98	2.86	3.43	2.25	2.86	2.75	2.76	2.57	3.35	1.43
Time	hij	a	ab	bcd	a	ij	bcde	cde	def	abc	def	efg	ab	j	efg	fgh	fgh	ghi	abc	k
Smoothness	6.93	6.39	6.65	6.65	6.32	7.22	6.39	6.45	6.62	6.75	6.59	6.70	6.35	7.17	6.54	6.55	6.65	7.09	6.45	7.56
	cd	ghi	efg	efg	i	b	ghi	fghi	efgh	de	efghi	def	hi	bc	efghi	efghi	efg	bc	fghi	a
Smoothness	6.74	6.46	6.37	6.48	6.33	7.00	6.19	6.34	6.53	6.57	6.43	6.58	6.28	6.98	6.34	6.35	6.45	6.70	6.40	7.33
Aftertaste	bc	cdefg	efg	cdefg	efg	b	g	efg	cdef	cdef	defg	cde	fg	b	efg	efg	cdefg	bcd	defg	a
Bitter	0.63	0.85	1.13	1.06	1.14	0.41	1.15	1.05	0.75	0.90	0.98	1.12	1.38	0.39	1.12	0.96	0.80	0.63	1.01	0.00
Taste	ef	cde	ab	bc	ab	f	ab	bc	de	bcd	bcd	b	a	f	b	bcd	cde	ef	bc	g
Bitter	0.50	0.85	0.81	0.85	0.90	0.43	0.91	0.81	0.61	0.84	0.79	0.79	1.10	0.28	0.84	0.80	0.66	0.39	0.78	0.00
Aftertaste	def	bc	bc	abc	ab	def	ab	bc	cde	bc	bc	bc	a	f	bc	bc	bcd	ef	bc	g
Sweet	5.64	5.64	5.74	5.78	5.68	5.60	5.52	5.53	5.69	5.84	5.84	5.75	5.51	5.38	5.42	5.47	5.49	5.70	5.99	5.65
Taste	bcdef	bcdef	abcd	abc	bcdef	bcdef	cdef	cdef	abcde	ab	ab	abcd	cdef	f	ef	def	cdef	abcde	a	bcdef
Sweet	1.82	2.31	2.26	2.32	2.25	1.44	2.16	2.13	2.05	2.27	2.44	2.27	2.41	1.59	2.13	2.18	1.95	1.76	1.97	1.00
Linger	fgh	abc	abcd	abc	abcd	i	abcde	bcde	cdef	abc	a	abc	ab	hi	bcde	abcde	efg	gh	defg	j
Licorice	0.01	0.16	0.05	0.04	0.35	0.00	0.03	0.02	0.17	0.30	0.03	0.03	0.38	0.00	0.03	0.03	0.16	0.02	0.45	0.00
	cd	bcd	cd	cd	a	d	cd	cd	bc	ab	cd	cd	a	d	cd	cd	bcd	cd	a	d
Licorice	0.00	0.10	0.03	0.03	0.21	0.01	0.03	0.01	0.11	0.09	0.01	0.04	0.30	0.02	0.02	0.03	0.06	0.03	0.45	0.00
Aftertaste	d	cd	d	d	bc	d	d	d	cd	cd	d	d	b	d	d	d	d	d	a	d
APM Total		7	8	8	6	9	5	8	9	8	7	9	5	9	9	9	9	9	8	
SUC Total		3	3	3	3	7	3	3	3	3	3	3	3	6	3	3	3	5	3	











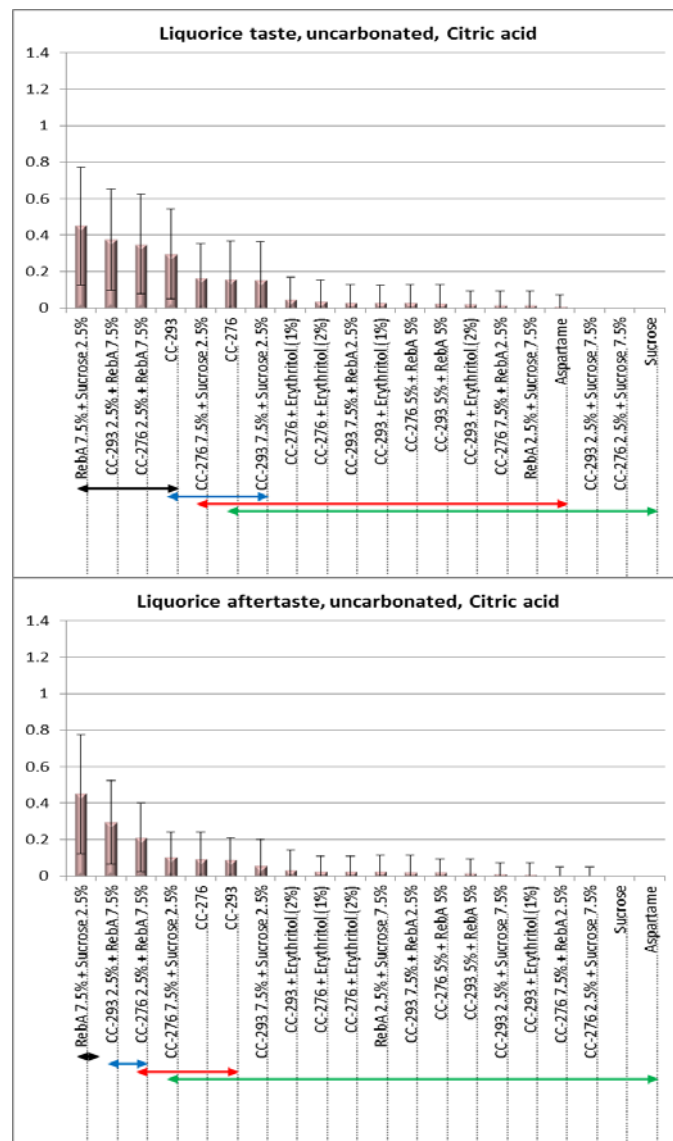
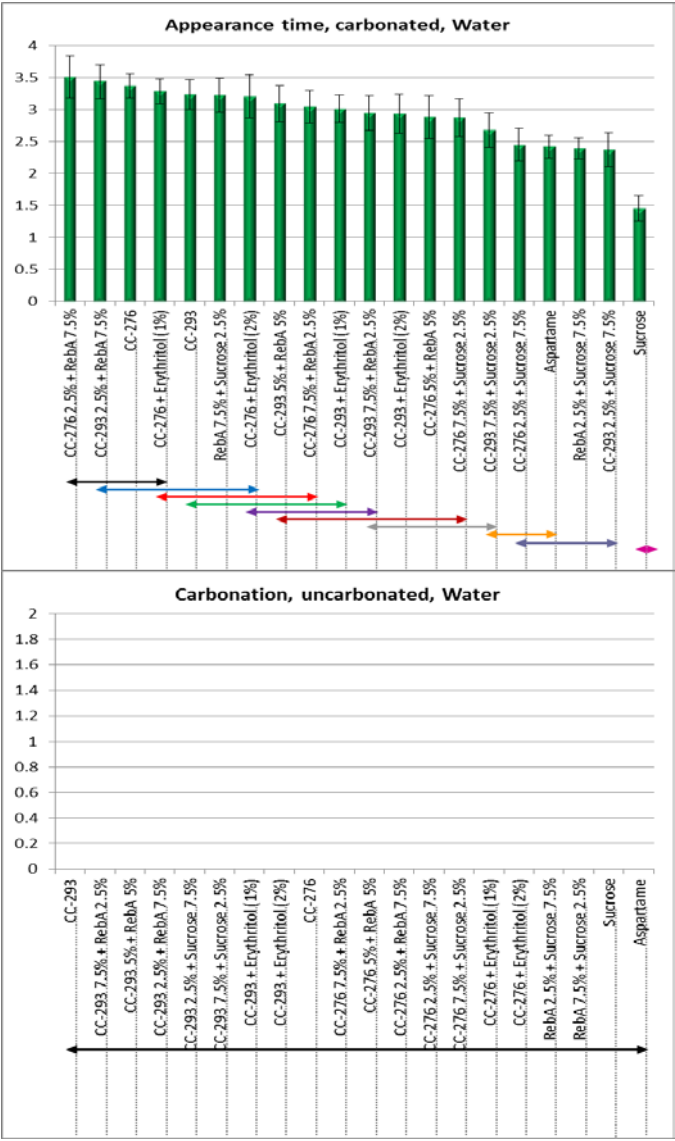
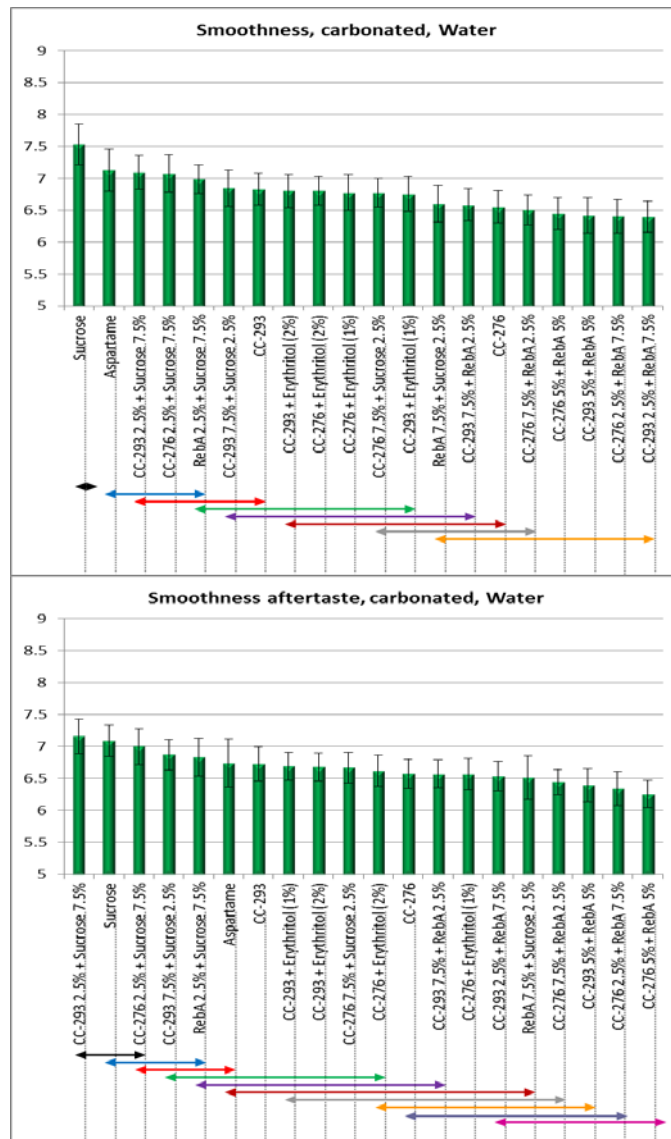


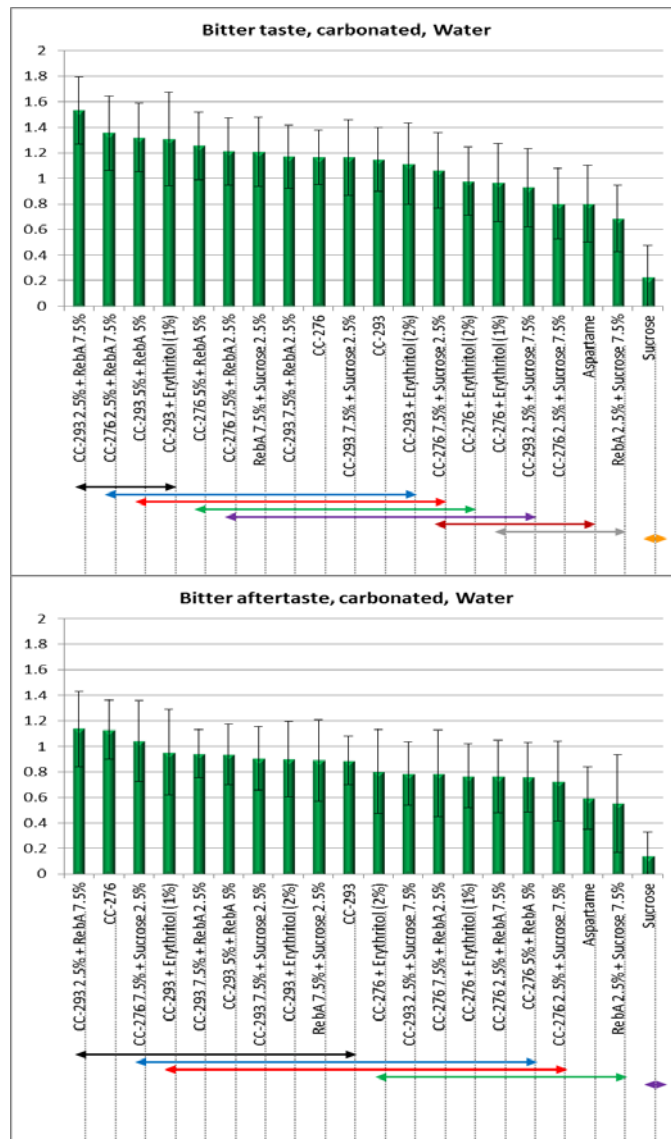
Figure 18: Means and Tukey's HSD means separation results for all sweeteners and their blends by Descriptive Analysis attribute for still citric acid.

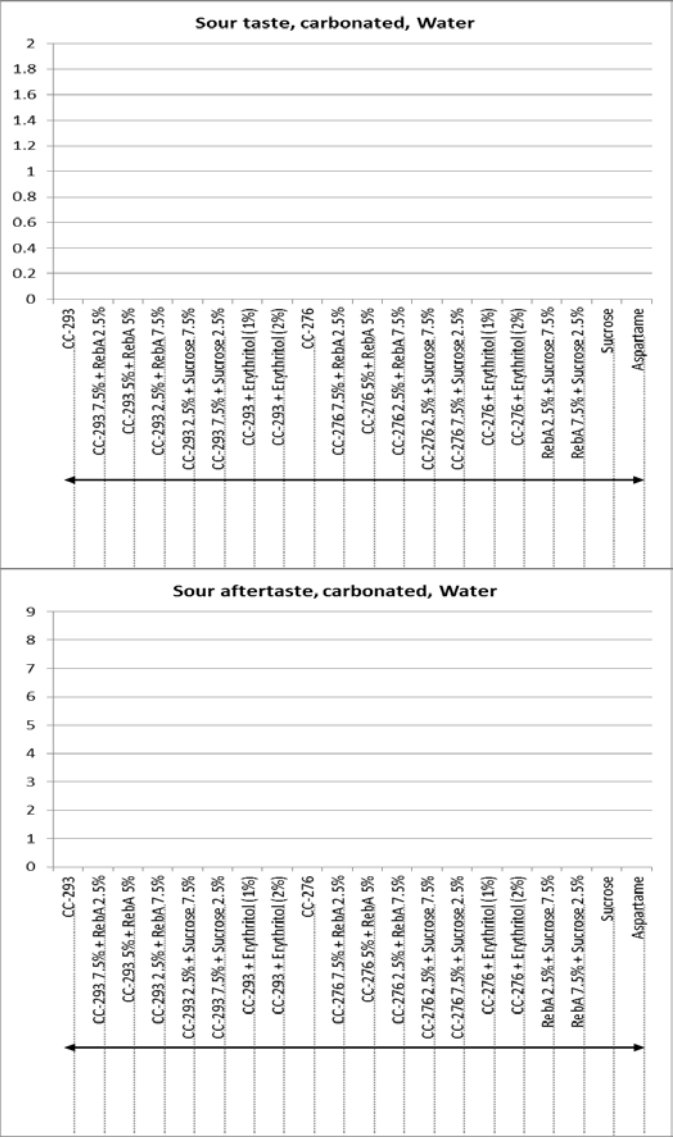
Table 14: Attribute means and Tukey's HSD means separation results for sweeteners and their blends in sparkling water. Means and means separations results are presented for each attribute across all sweeteners/blends.

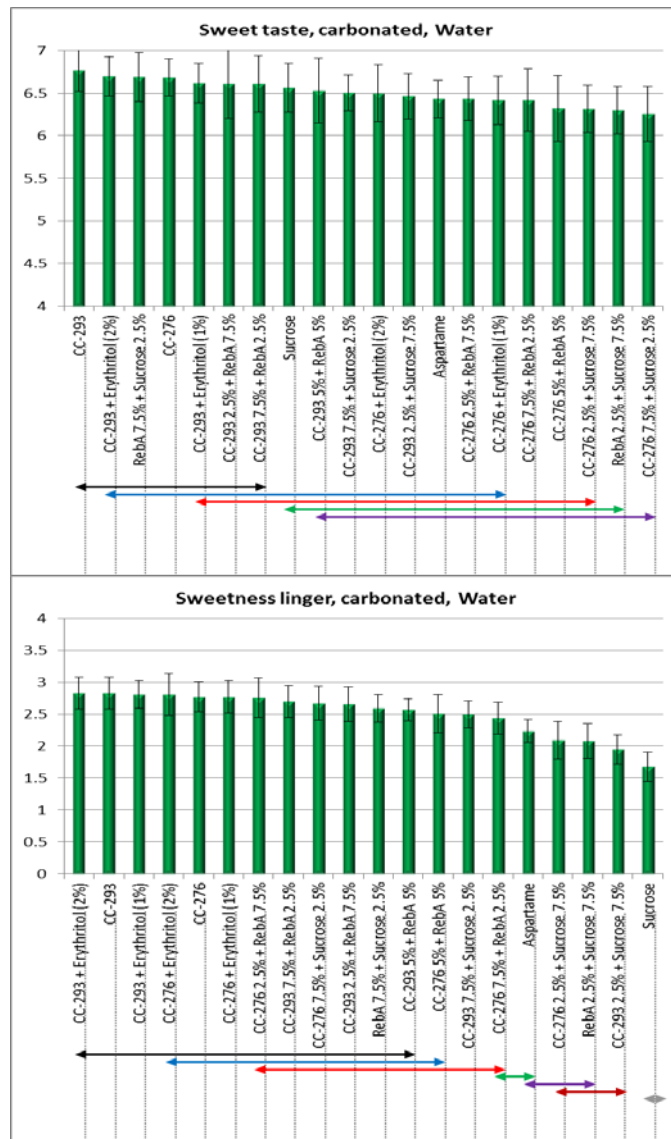
	Aspartame	CC-276	CC-276 + Erythritol (1%)	CC-276 + Erythritol (2%)	CC-276 2.5% + Reba 7.5%	CC-276 2.5% + Sucrose 7.5%	CC-276 5% + Reba 5%	CC-276 7.5% + Reba 2.5%	CC-276 7.5% + Sucrose 2.5%	CC-293	CC-293 + Erythritol (1%)	CC-293 + Erythritol (2%)	CC-293 2.5% + Reba 7.5%	CC-293 2.5% + Sucrose 7.5%	CC-293 5% + Reba 5%	CC-293 7.5% + Reba 2.5%	CC-293 7.5% + Sucrose 2.5%	Reba 2.5% + Sucrose 7.5%	Reba 7.5% + Sucrose 2.5%	Sucrose
Appearance	2.42	3.37	3.29	3.20	3.51	2.45	2.88	3.04	2.87	3.23	3.01	2.93	3.44	2.38	3.09	2.94	2.68	2.39	3.23	1.45
Time	hi	ab	abc	bcde	a	hi	fg	cdef	fg	bcd	def	fg	ab	i	cdef	efg	gh	i	bcd	j
Smoothness	7.13	6.55	6.78	6.80	6.41	7.08	6.45	6.50	6.77	6.83	6.76	6.80	6.40	7.09	6.42	6.59	6.85	6.99	6.60	7.54
	b	fgh	def	def	h	bc	h	gh	defg	cde	defg	def	h	bc	h	efgh	cde	bcd	efgh	a
Smoothness	6.74	6.57	6.56	6.62	6.34	7.00	6.26	6.44	6.67	6.72	6.69	6.68	6.53	7.15	6.39	6.57	6.87	6.83	6.51	7.08
Aftertaste	cdef	efghi	fghi	defgh	ij	abc	j	ghij	defg	def	defg	defg	fghi	a	hij	efghi	bcd	bcde	fghij	ab
Bitter	0.80	1.17	0.97	0.98	1.35	0.80	1.25	1.21	1.06	1.15	1.31	1.11	1.53	0.93	1.32	1.17	1.16	0.69	1.21	0.23
Taste	fg	bcde	efg	def	ab	fg	abcd	bcde	cdef	bcde	abc	bcde	a	efg	abc	bcde	bcde	g	bcde	h
Bitter	0.60	1.13	0.77	0.80	0.76	0.73	0.76	0.79	1.04	0.89	0.95	0.90	1.14	0.79	0.94	0.94	0.90	0.55	0.89	0.14
Aftertaste	d	a	bcd	bcd	bcd	cd	bcd	bcd	ab	abc	abc	abc	a	bcd	abc	abc	abc	d	abc	e
Sweet	6.43	6.68	6.42	6.50	6.43	6.31	6.32	6.42	6.25	6.77	6.62	6.70	6.61	6.46	6.53	6.61	6.50	6.30	6.69	6.56
Taste	bcde	ab	bcde	abcde	bcde	cde	cde	bcde	e	a	abc	abc	abc	abcde	abcde	abc	abcde	de	ab	abcd
Sweetness	2.24	2.77	2.77	2.81	2.76	2.09	2.51	2.44	2.68	2.83	2.81	2.83	2.66	1.95	2.58	2.70	2.50	2.08	2.59	1.68
Linger	de	ab	ab	a	ab	ef	bc	cd	abc	a	a	a	abc	f	abc	abc	c	ef	abc	g
Licorice	0.00	0.17	0.17	0.08	0.35	0.00	0.08	0.11	0.05	0.21	0.03	0.01	0.45	0.03	0.03	0.15	0.03	0.01	0.67	0.00
	e	de	de	de	bc	e	de	de	de	cd	e	e	b	e	e	de	e	e	a	e
Licorice	0.00	0.20	0.18	0.18	0.47	0.02	0.02	0.11	0.05	0.25	0.04	0.01	0.48	0.04	0.03	0.06	0.07	0.05	0.76	0.00
Aftertaste	f	cd	cde	cde	b	ef	ef	cdef	def	c	def	ef	b	def	def	def	def	def	a	f
APM Total		5	7	7	5	9	8	7	9	7	6	7	5	9	6	7	9	9	5	
SUC Total		3	3	3	1	5	3	3	4	4	4	4	3	6	3	3	5	5	1	











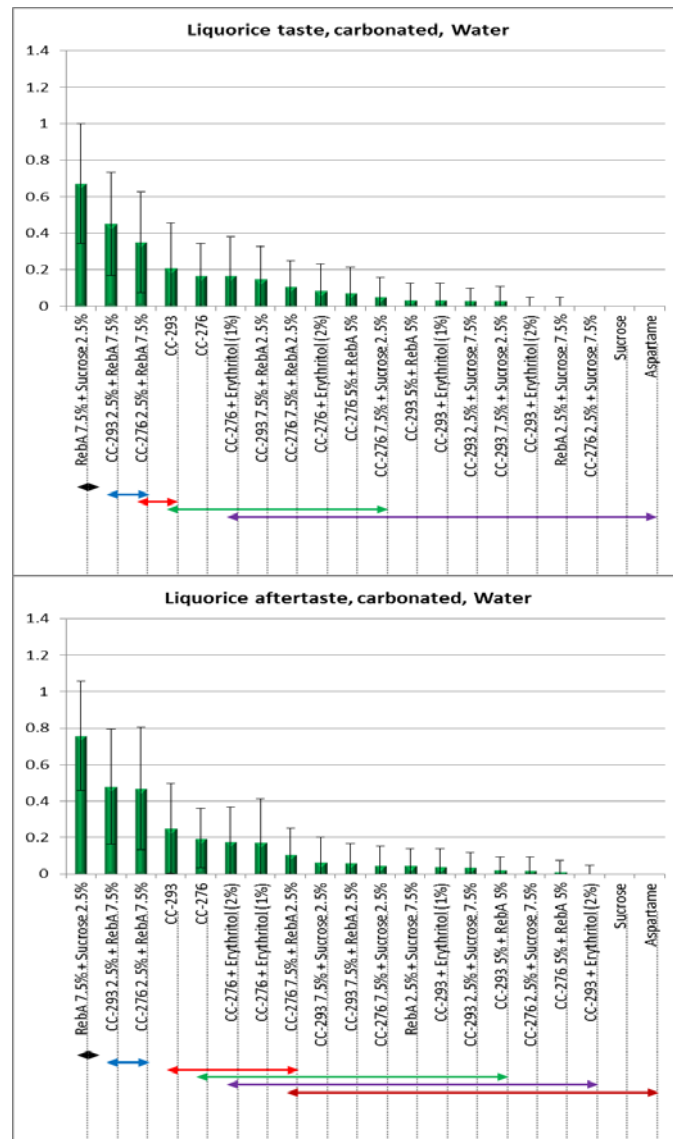
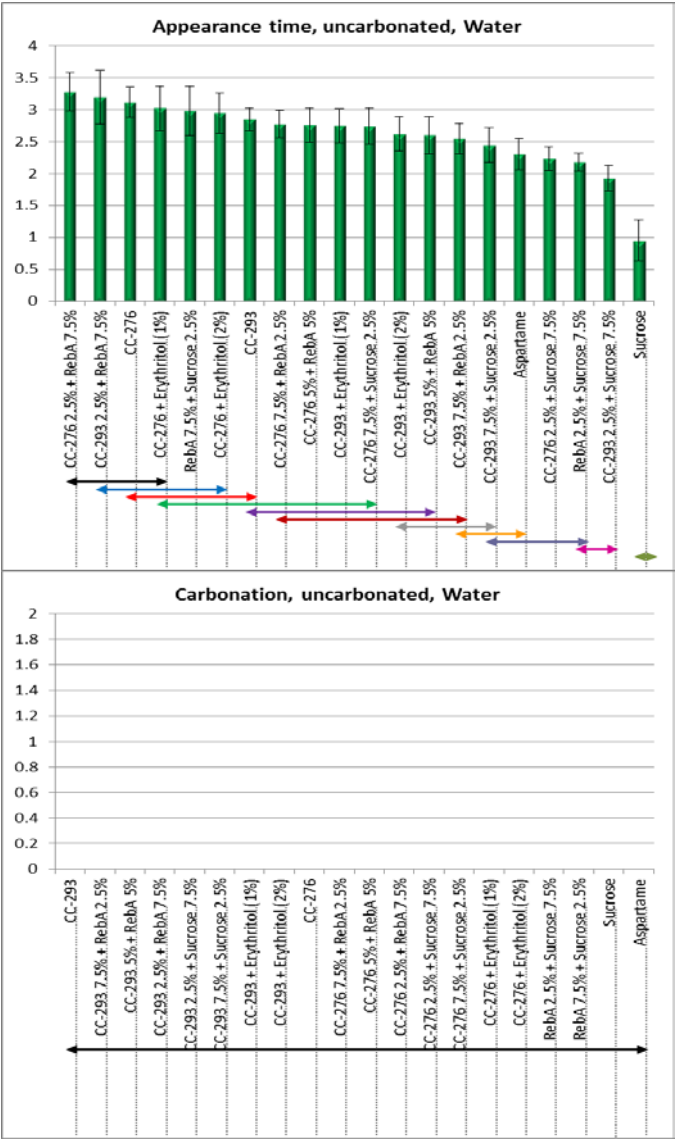
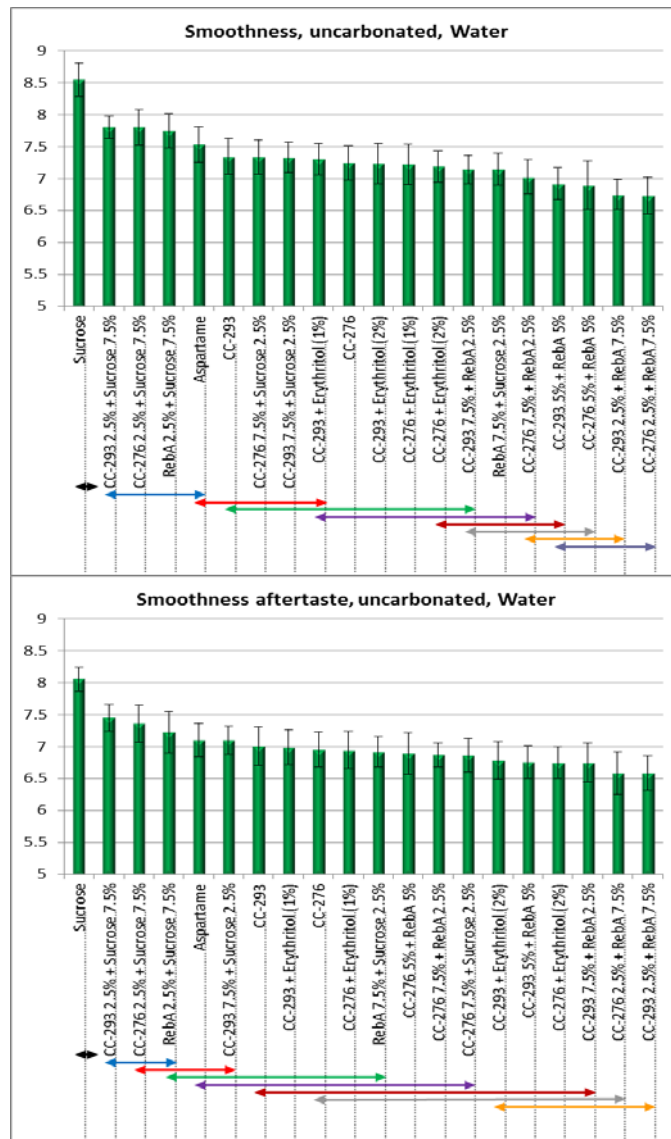


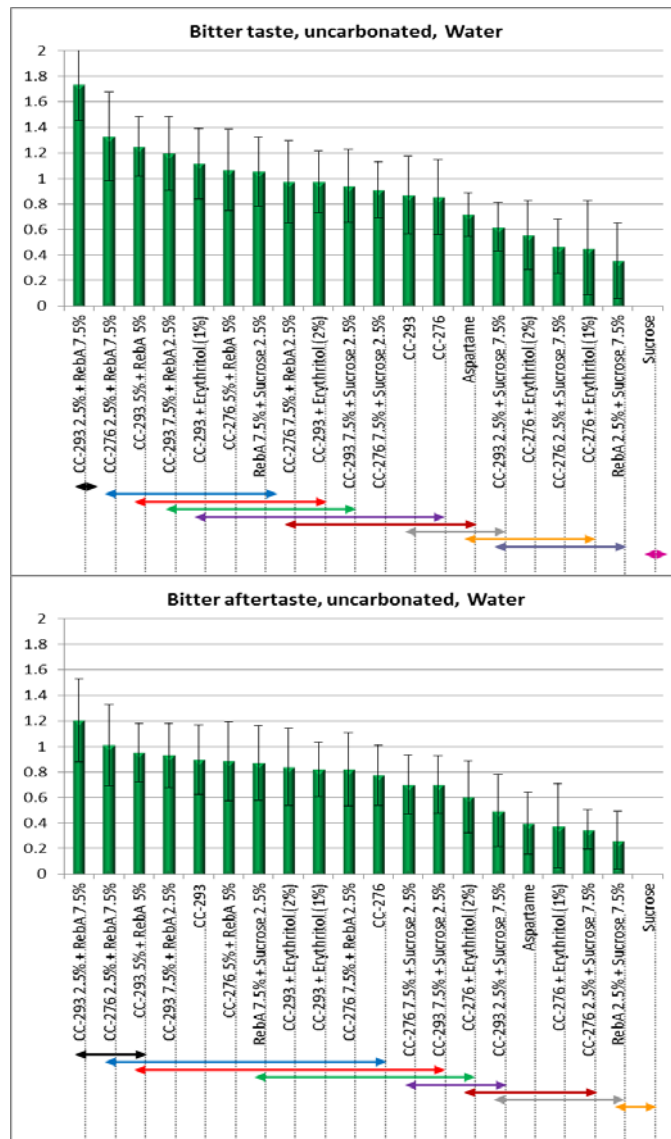
Figure 19: Means and Tukey's HSD means separation results for all sweeteners and their blends by Descriptive Analysis attribute for sparkling water.

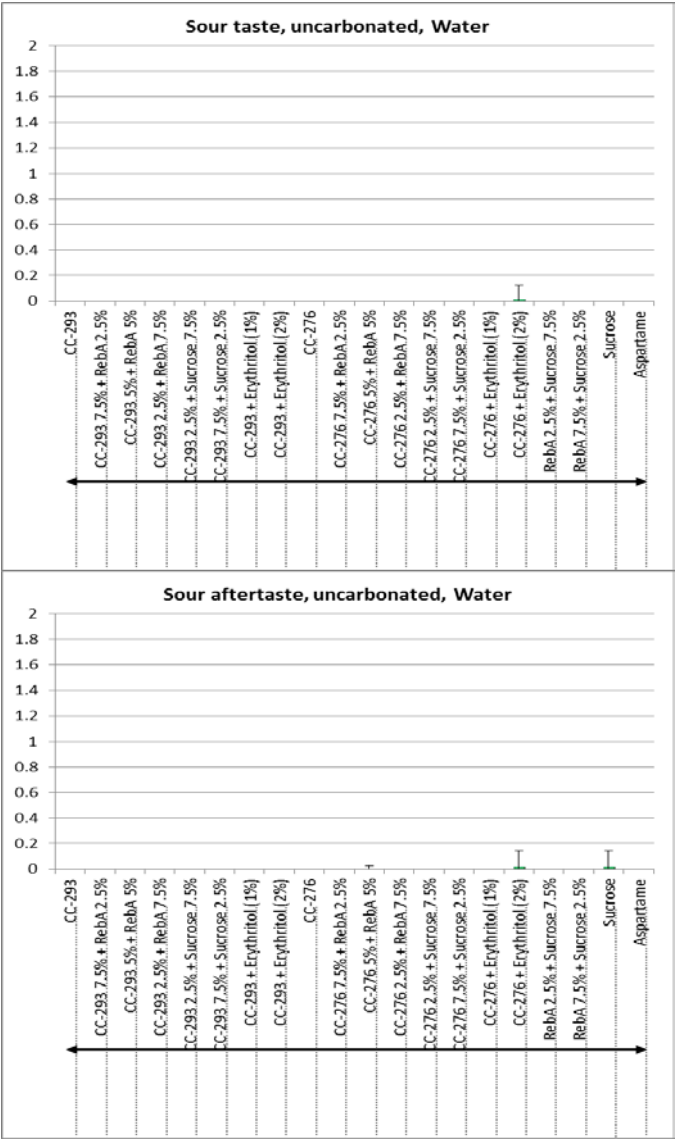
Table 15: Attribute means and Tukey's HSD means separation results for sweeteners and their blends in still water. Means and means separations results are presented for each attribute across all sweeteners/blends.

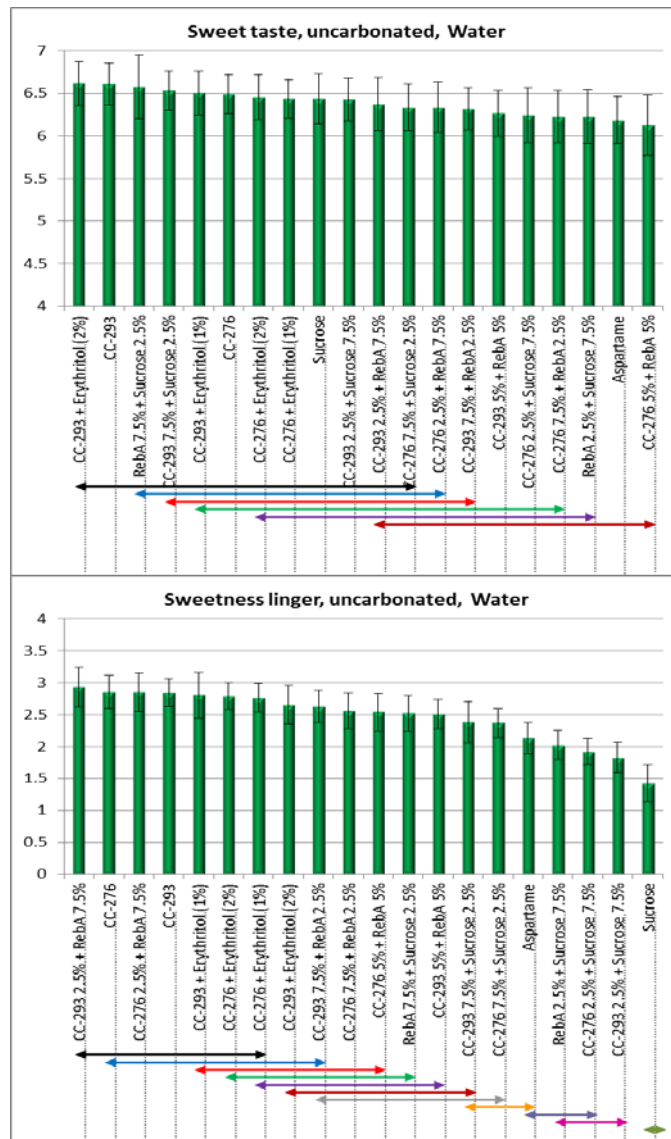
	Aspartame	CC-276	CC-276 + Erythritol (1%)	CC-276 + Erythritol (2%)	CC-276 2.5% + Reba 7.5%	CC-276 2.5% + Sucrose 7.5%	CC-276 5% + Reba 5%	CC-276 7.5% + Reba 2.5%	CC-276 7.5% + Sucrose 2.5%	CC-293	CC-293 + Erythritol (1%)	CC-293 + Erythritol (2%)	CC-293 2.5% + Reba 7.5%	CC-293 2.5% + Sucrose 7.5%	CC-293 5% + Reba 5%	CC-293 7.5% + Reba 2.5%	CC-293 7.5% + Sucrose 2.5%	Reba 2.5% + Sucrose 7.5%	Reba 7.5% + Sucrose 2.5%	Sucrose
Appearance	2.30	3.12	3.02	2.94	3.28	2.23	2.75	2.78	2.74	2.85	2.75	2.62	3.19	1.93	2.60	2.54	2.44	2.18	2.98	0.95
Time	hi	abc	abcd	bcd	a	i	def	def	def	cde	def	efg	ab	j	efg	fgh	ghi	ij	bcd	k
Smoothness	7.53	7.25	7.22	7.19	6.73	7.80	6.89	7.03	7.33	7.34	7.30	7.23	6.75	7.80	6.92	7.15	7.33	7.75	7.15	8.54
	bc	de	de	def	i	b	ghi	efgh	cd	cd	cde	de	hi	b	fghi	defg	cd	b	defg	a
Smoothness	7.10	6.95	6.94	6.75	6.58	7.36	6.89	6.87	6.86	7.01	6.99	6.78	6.58	7.45	6.75	6.75	7.10	7.23	6.92	8.05
Aftertaste	cde	def	ef	fg	g	bc	ef	ef	ef	def	def	fg	g	b	fg	fg	cde	bcd	ef	a
Bitter	0.72	0.85	0.46	0.56	1.33	0.47	1.07	0.98	0.91	0.87	1.12	0.98	1.73	0.62	1.25	1.20	0.94	0.36	1.05	0.00
Taste	fgh	efg	hi	hi	b	hi	bcde	cdef	ef	efg	bcde	cdef	a	ghi	bc	bcd	def	i	bcde	j
Bitter	0.40	0.78	0.38	0.60	1.01	0.35	0.88	0.82	0.70	0.90	0.82	0.84	1.20	0.50	0.95	0.93	0.70	0.27	0.87	0.00
Aftertaste	fg	bcd	fg	def	ab	fg	bc	bcd	cde	bc	bcd	bcd	a	efg	abc	bc	cde	gh	bcd	h
Sweet	6.18	6.49	6.43	6.45	6.33	6.24	6.13	6.23	6.34	6.61	6.50	6.61	6.37	6.43	6.26	6.32	6.53	6.22	6.58	6.43
Taste	ef	abcd	abcde	abcde	abcde	def	f	def	abcde	a	abcd	a	abcde	abcde	cdef	bcdef	abc	def	ab	abcde
Sweet	2.13	2.85	2.76	2.79	2.85	1.92	2.54	2.56	2.37	2.84	2.80	2.65	2.93	7.00	2.50	2.63	2.38	2.03	2.52	1.43
Linger	hi	ab	abcde	abcd	ab	ij	cdefg	cdefg	gh	ab	abc	bcdef	a	j	efg	bcdefg	fgh	ij	defg	k
Licorice	0.00	0.35	0.15	0.05	0.56	0.03	0.20	0.26	0.25	0.48	0.15	0.06	0.75	0.03	0.17	0.18	0.16	0.07	0.97	0.00
	f	cd	def	f	bc	f	def	de	de	c	def	ef	b	f	def	def	def	ef	a	f
Licorice	0.00	0.43	0.11	0.05	0.59	0.03	0.25	0.34	0.28	0.50	0.09	0.09	0.91	0.03	0.25	0.27	0.20	0.16	1.15	0.00
Aftertaste	j	cde	ghij	hij	c	ij	efgh	def	efg	cd	ghij	ghij	b	ij	efgh	efg	fghi	fghij	a	j
APM Total		7	7	7	1	9	7	8	9	6	7	8	1	9	6	7	9	9	5	
SUC Total		3	5	3	1	6	3	3	3	2	3	3	1	6	3	3	3	5	1	











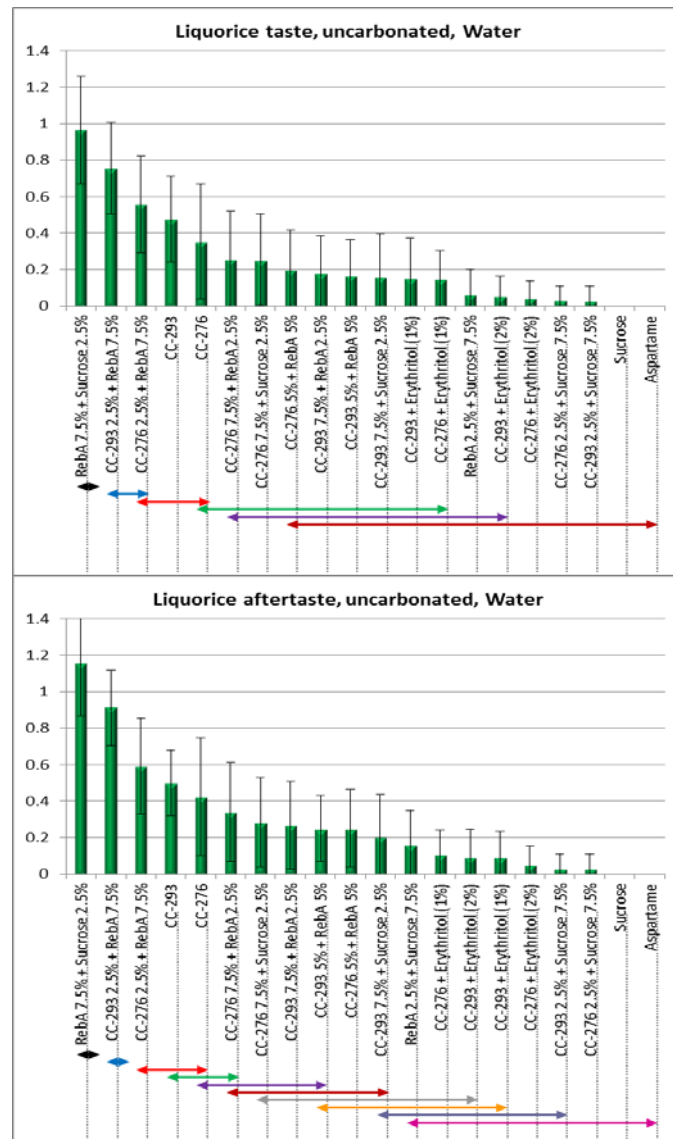
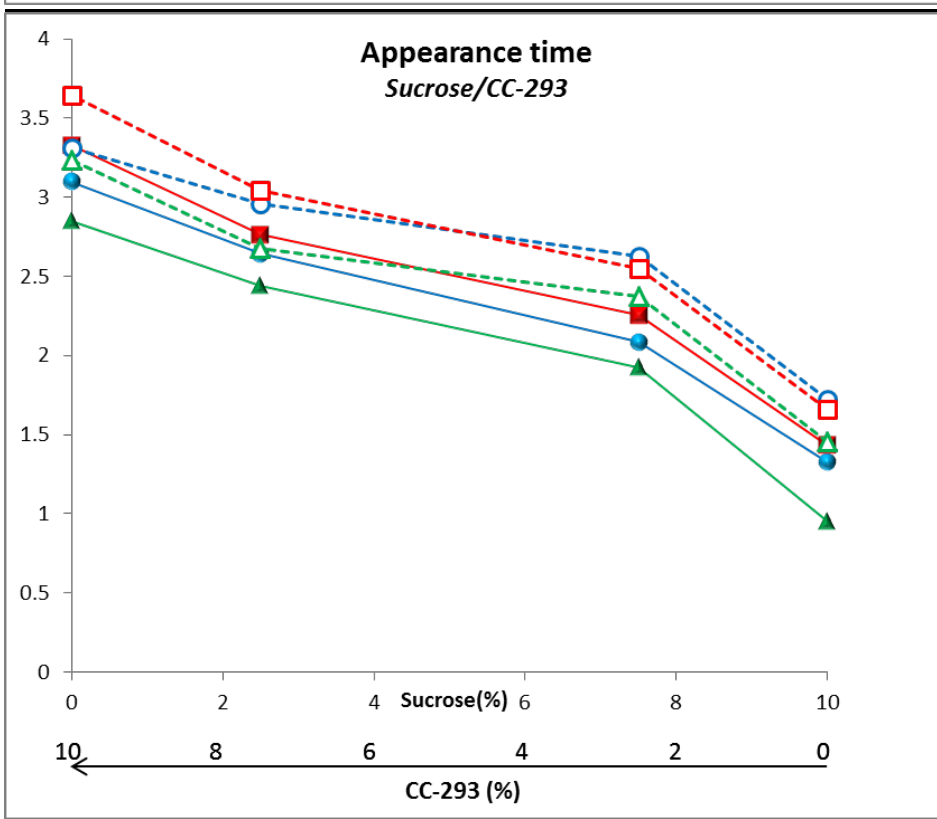
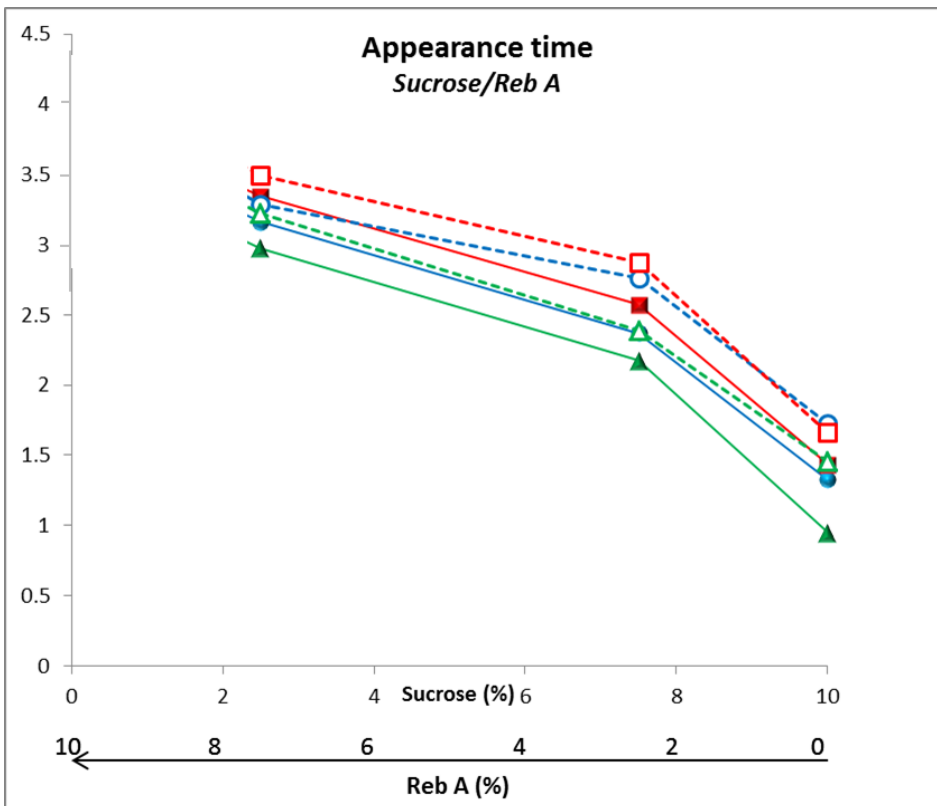


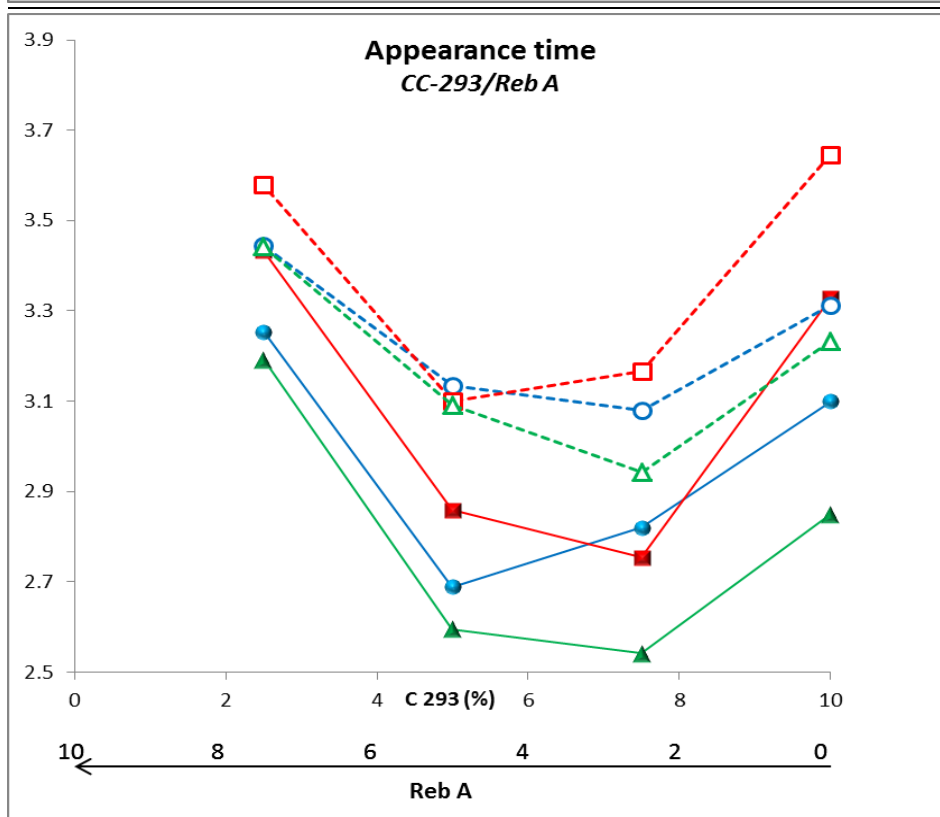
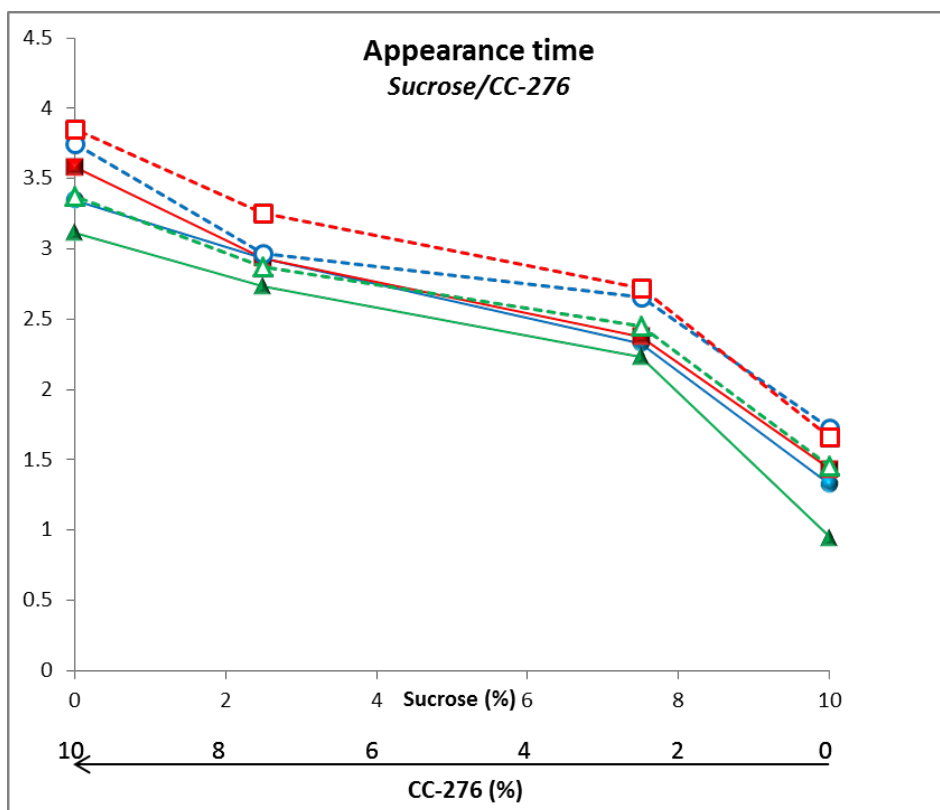
Figure 20: Means and Tukey's HSD means separation results for all sweeteners and their blends by Descriptive Analysis attribute for still water.

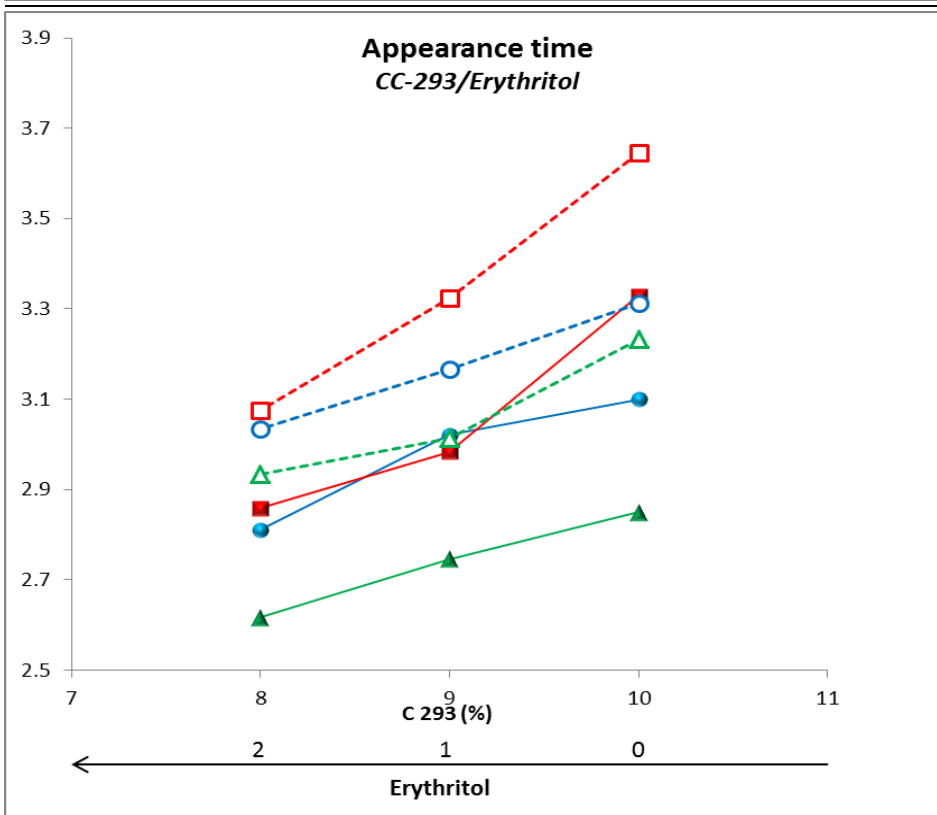
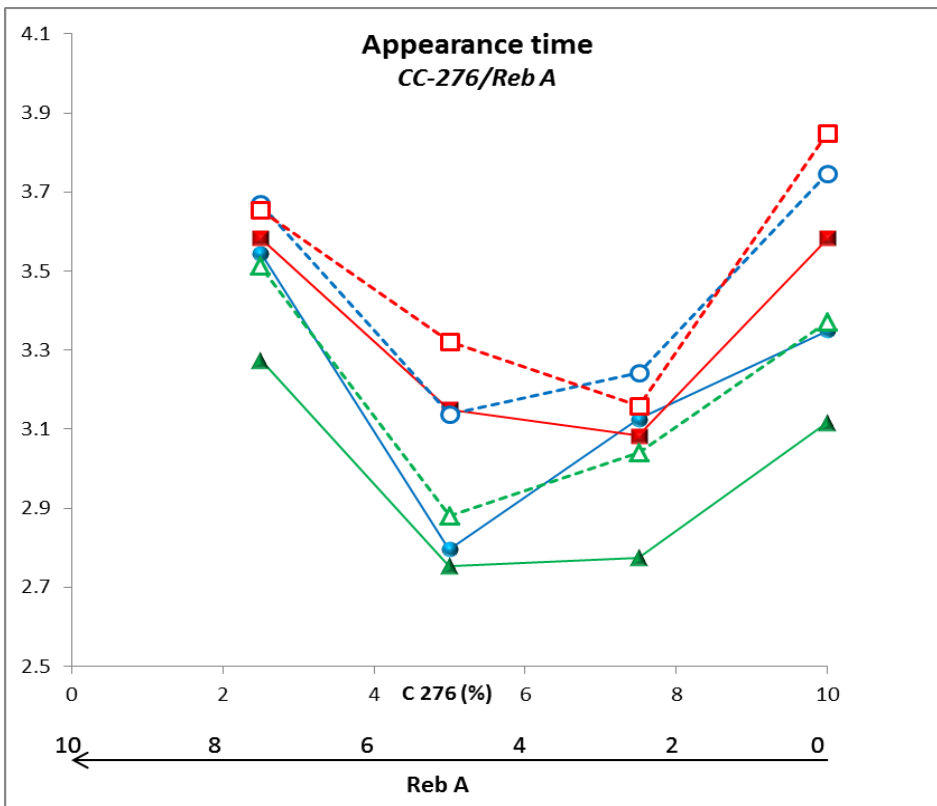
To provide an additional view of the data, blends were examined individually by attribute across matrices. Figures 21-31 are arranged by attribute and each graph summarizes the trend for a particular blend.

Notes for Figures 21-31:

- Sparkling samples = open symbols and dashed lines
- Still samples = closed symbols and solid lines
- PA samples = circles and blue color
- CA samples = squares and red color
- Water samples = triangles and green color







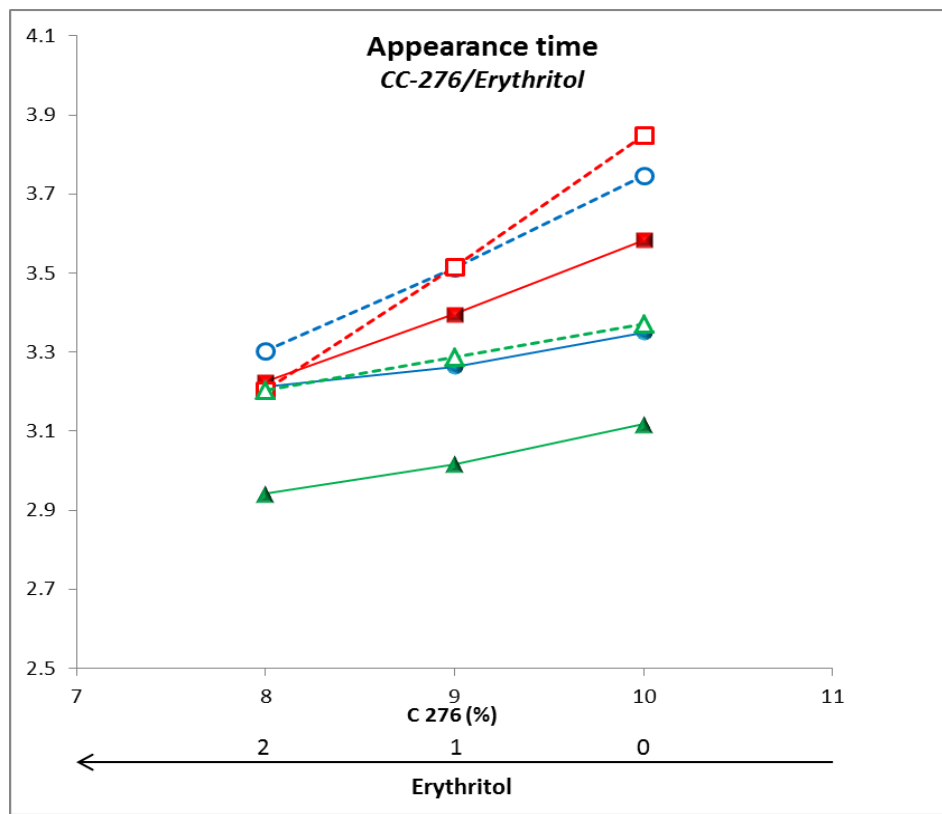
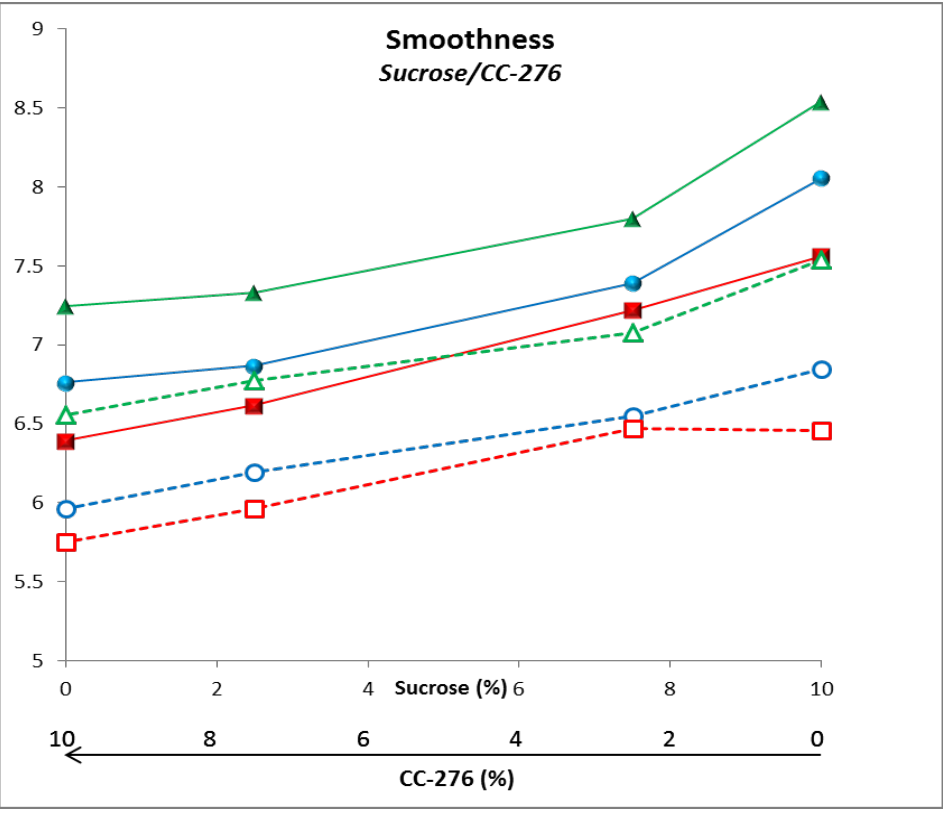
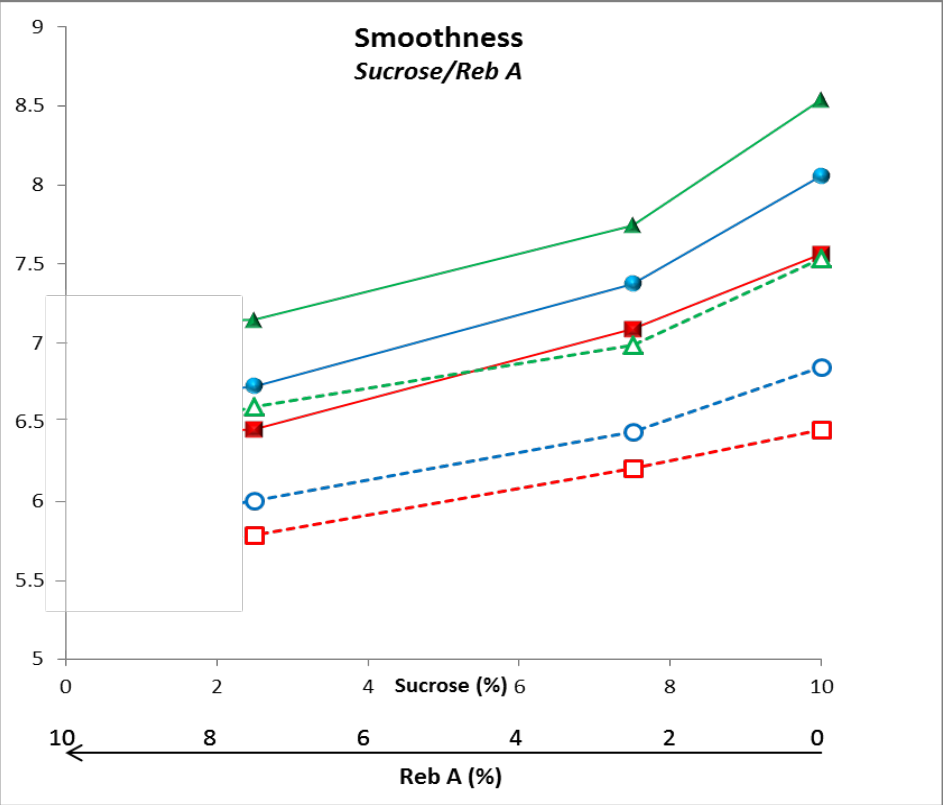
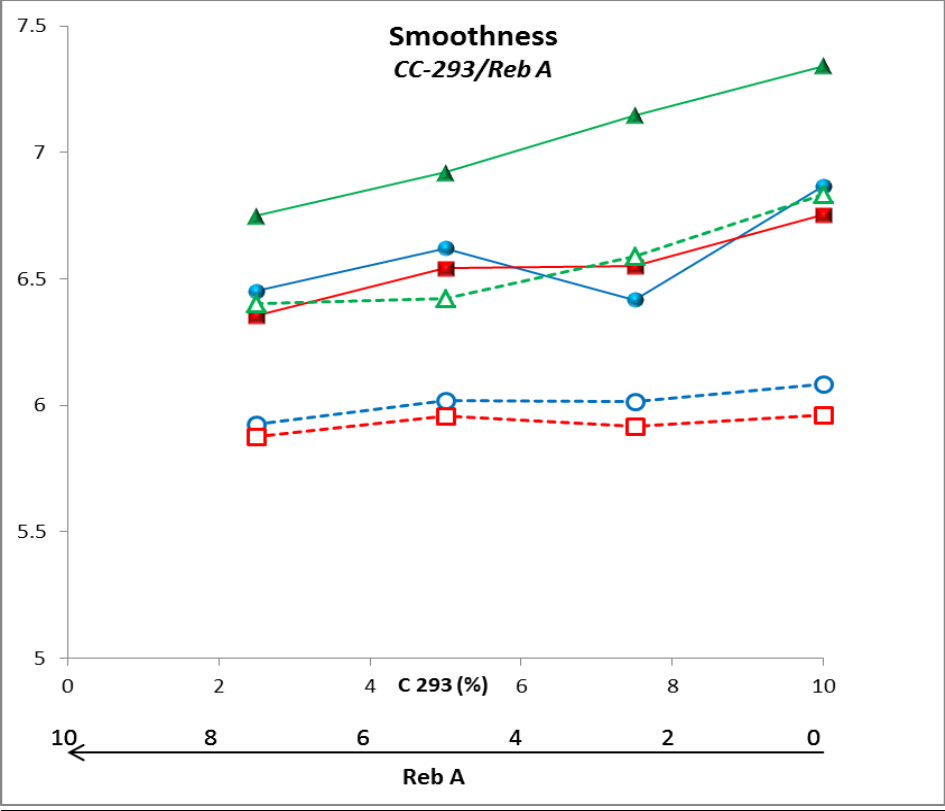
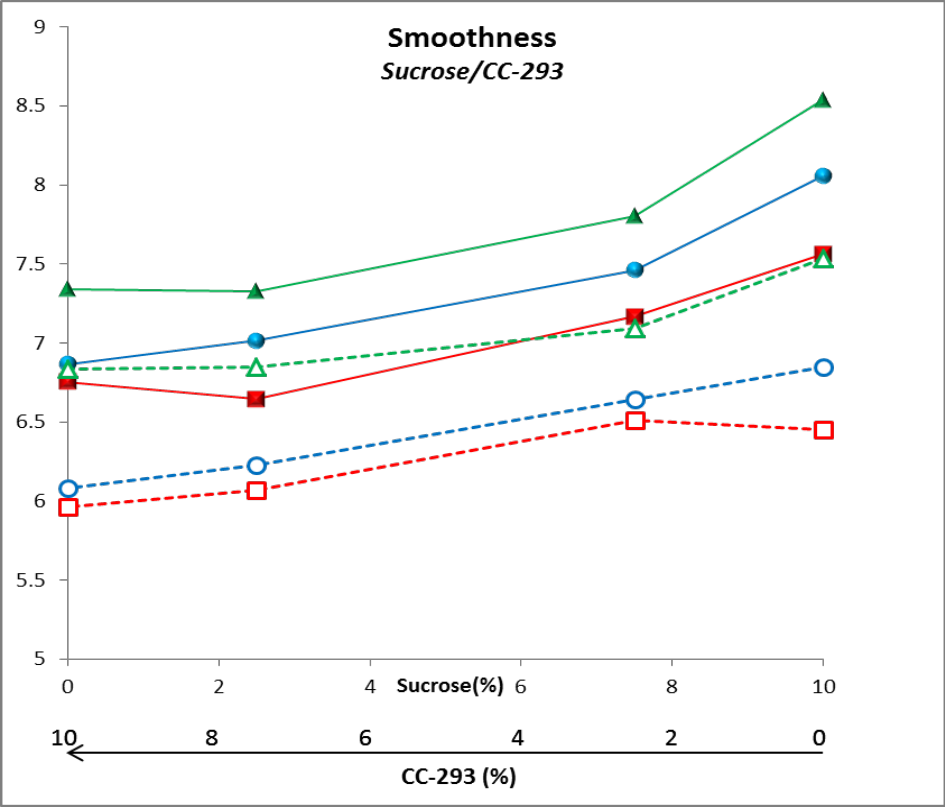
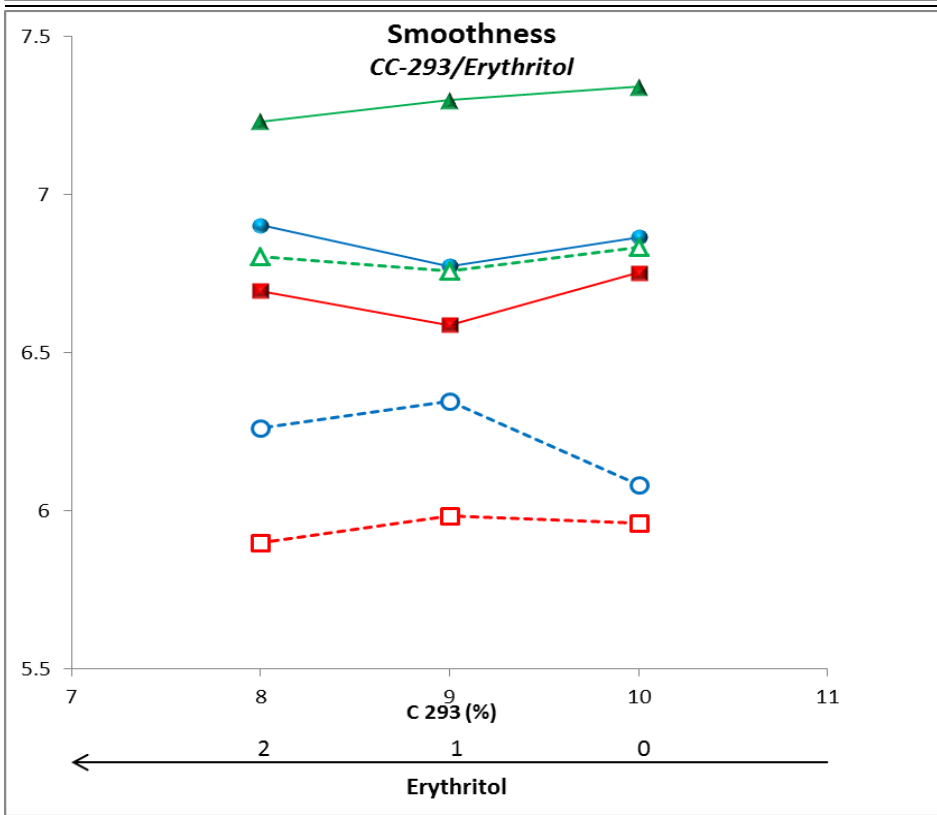
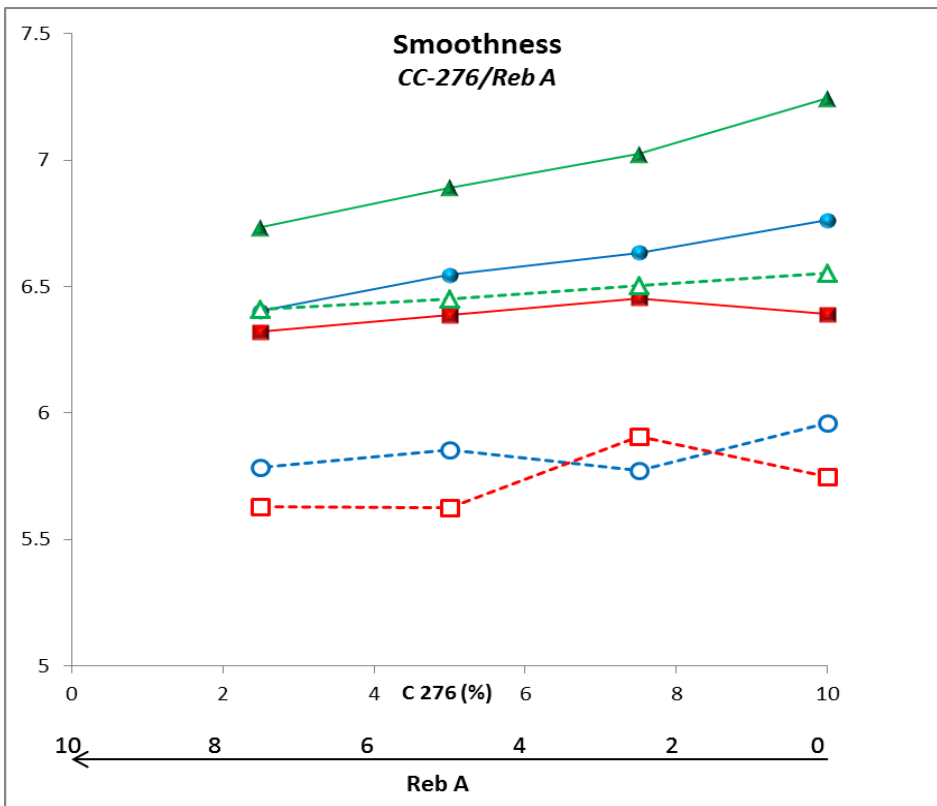


Figure 21: Mean intensities of appearance time across matrices for each blend examined.







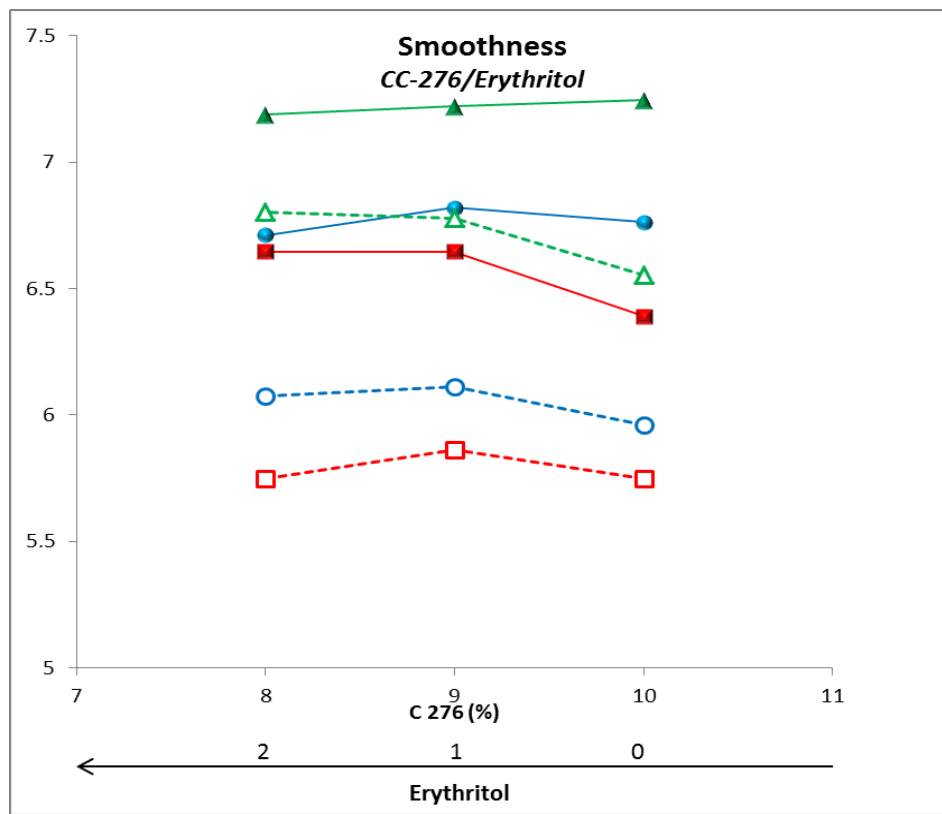
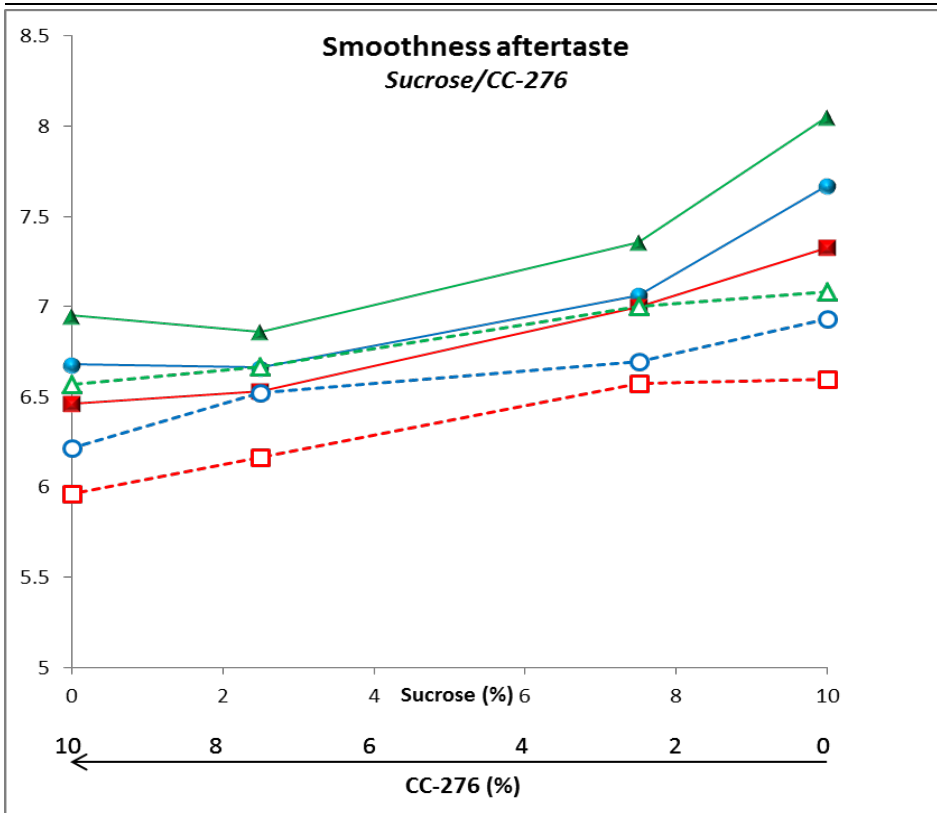
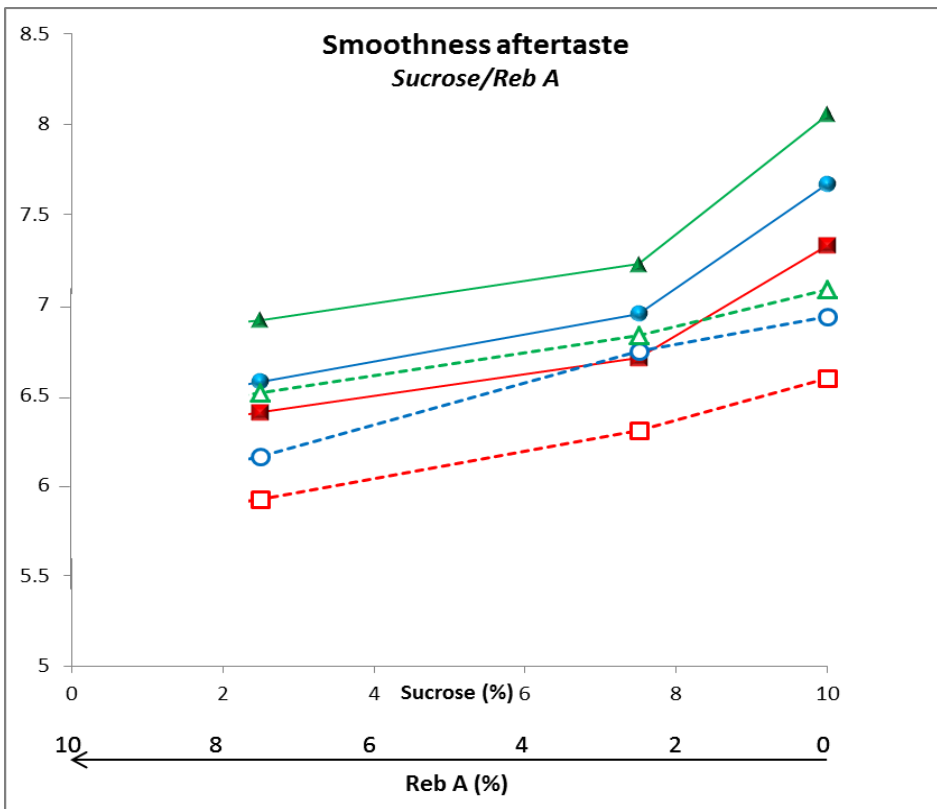
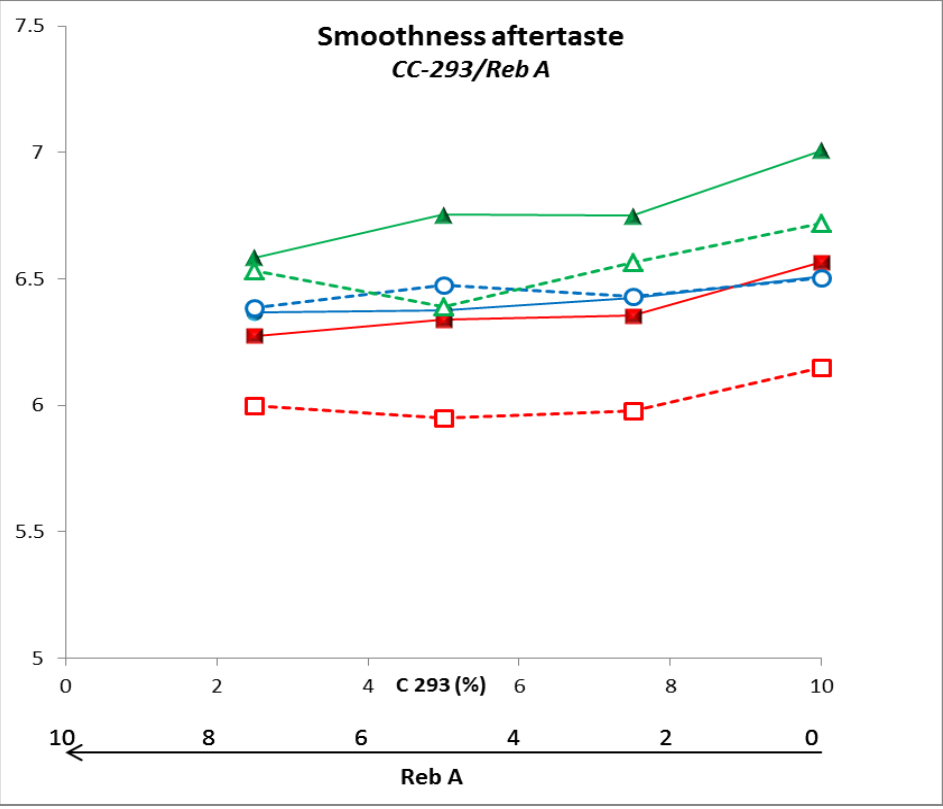
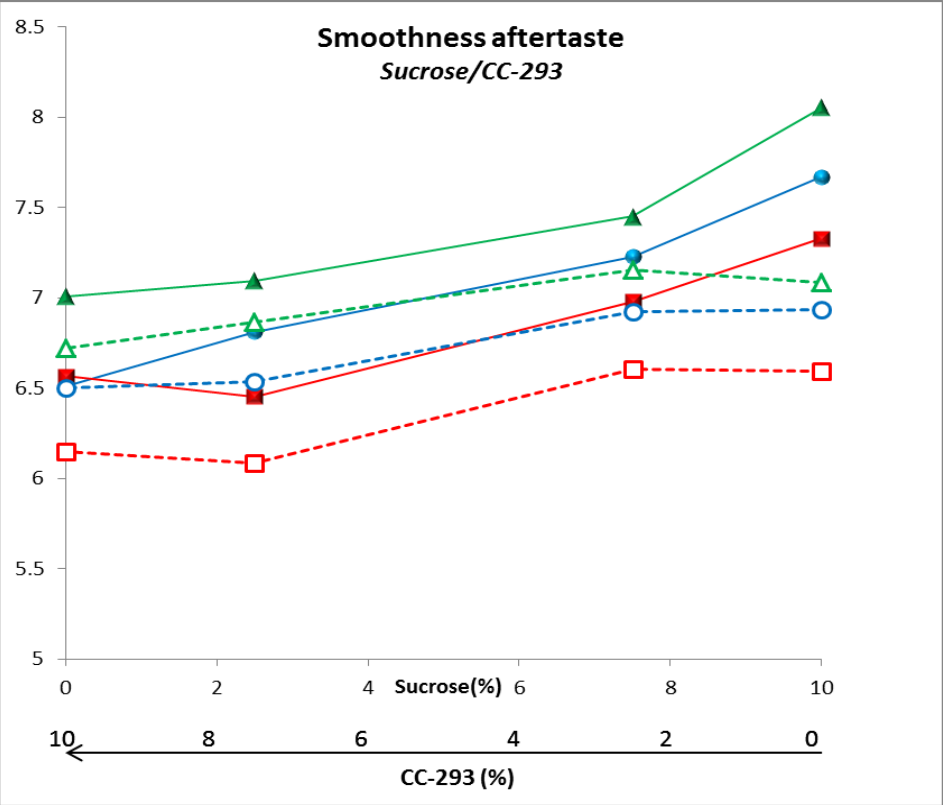
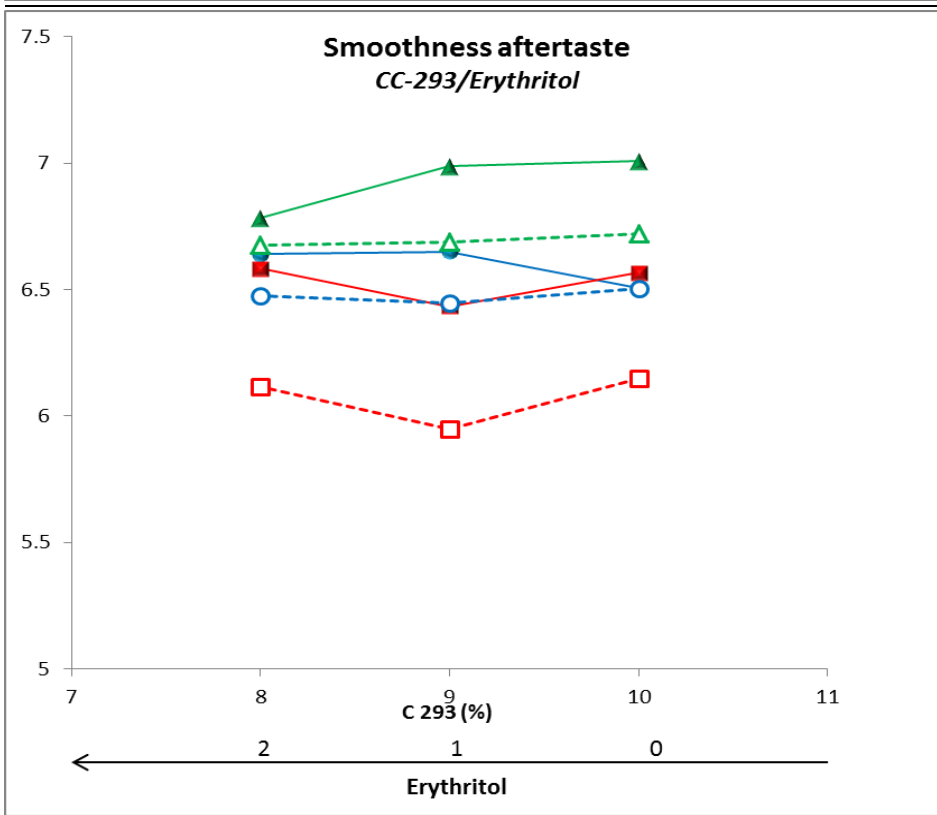
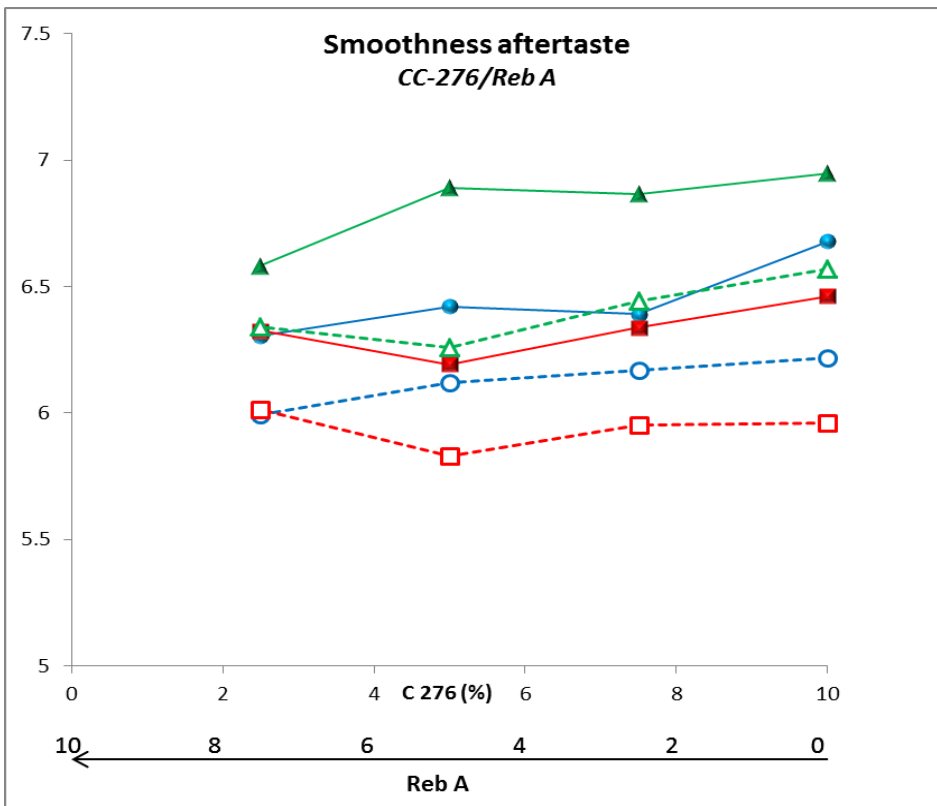


Figure 22: Mean intensities of smoothness across matrices for each blend examined.







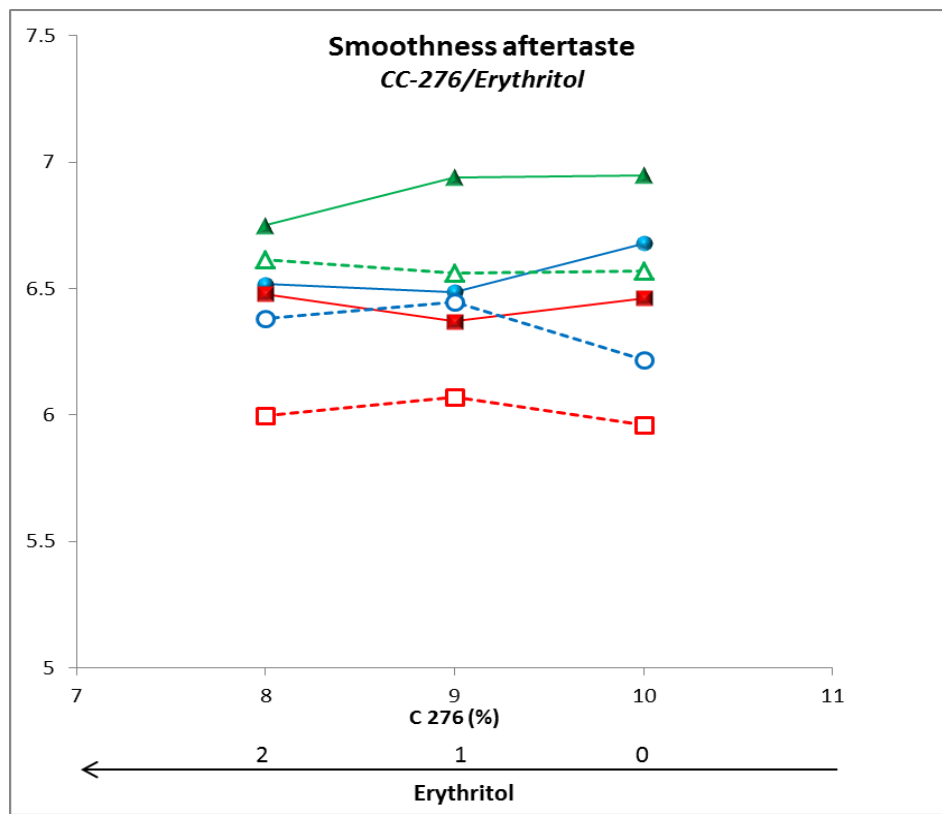
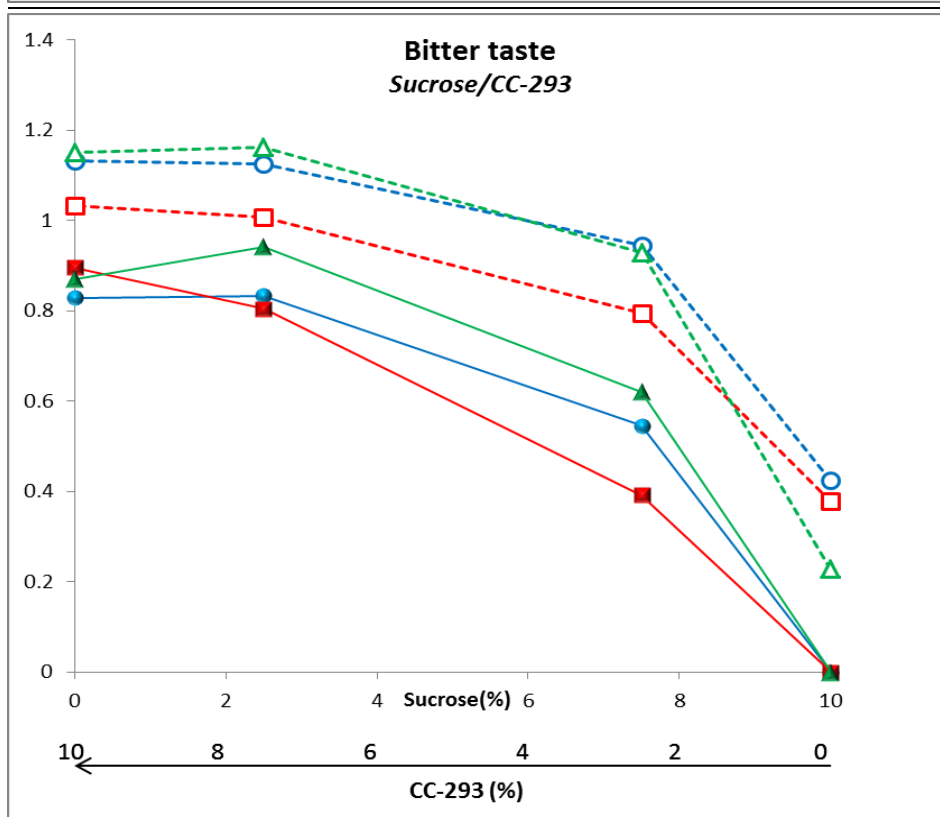
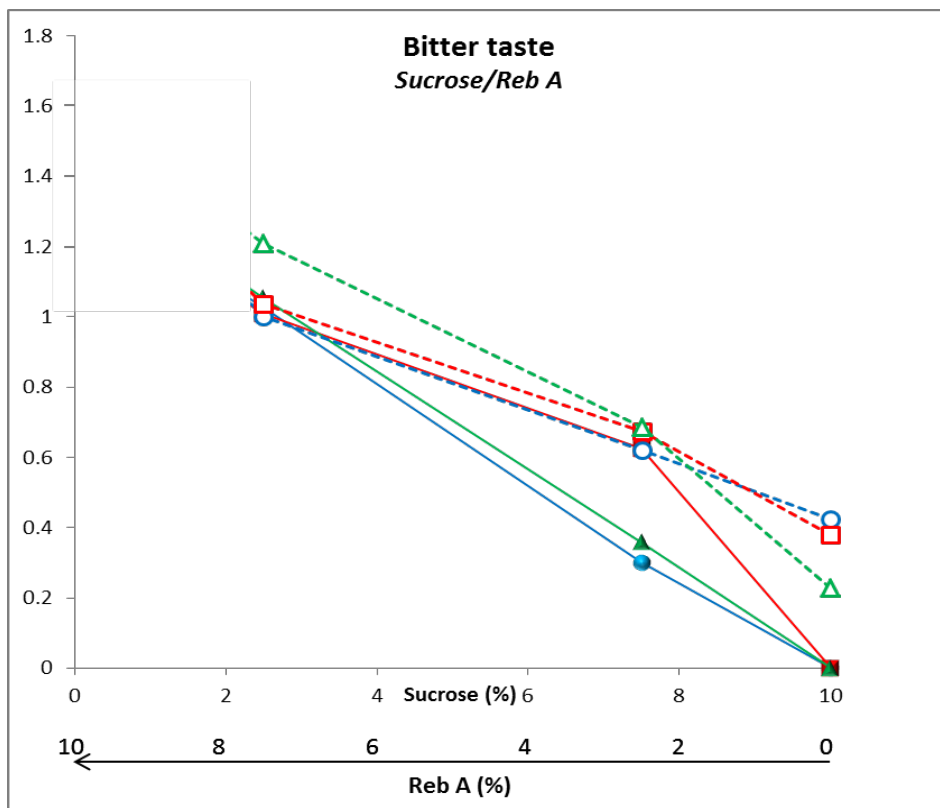
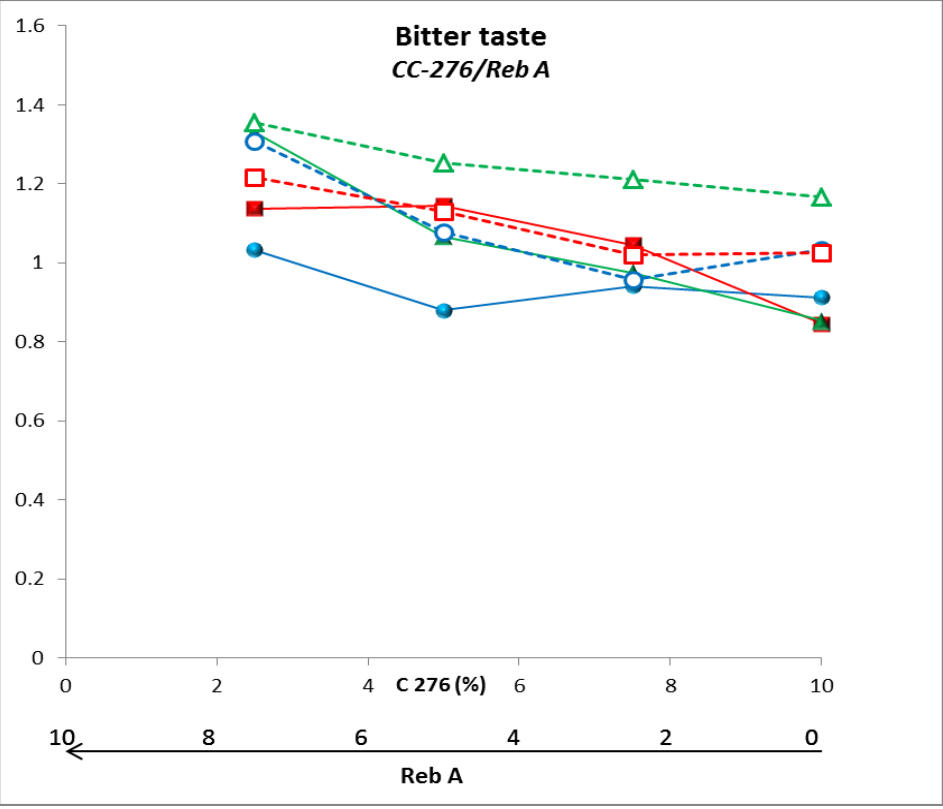
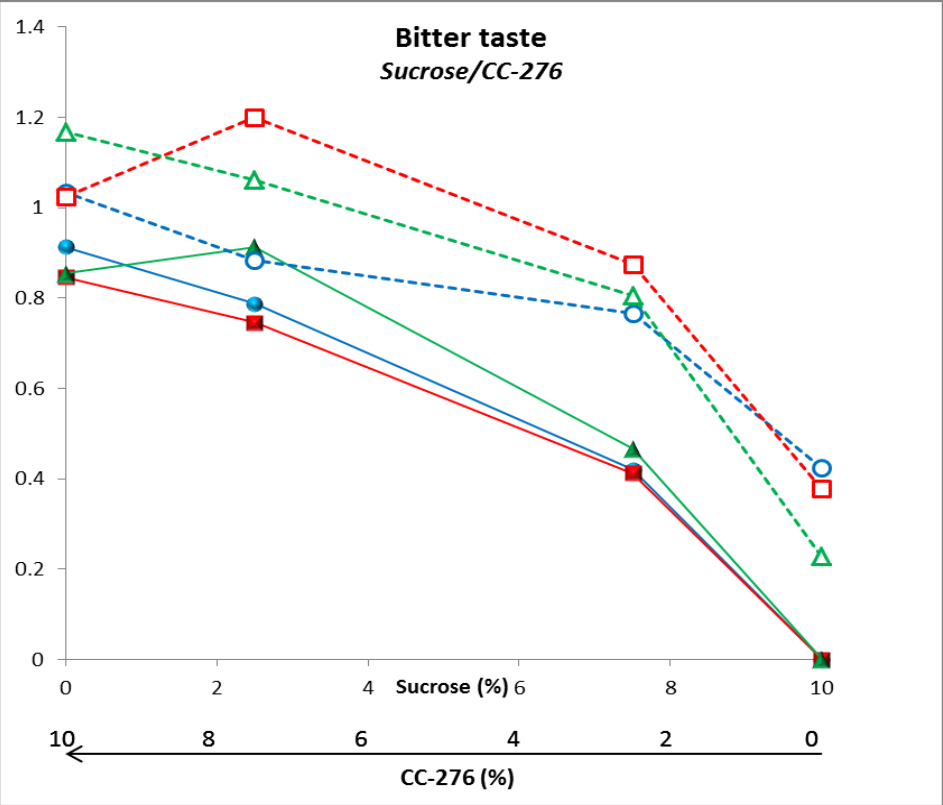


Figure 23: Mean intensities of smoothness aftertaste across matrices for each blend examined.





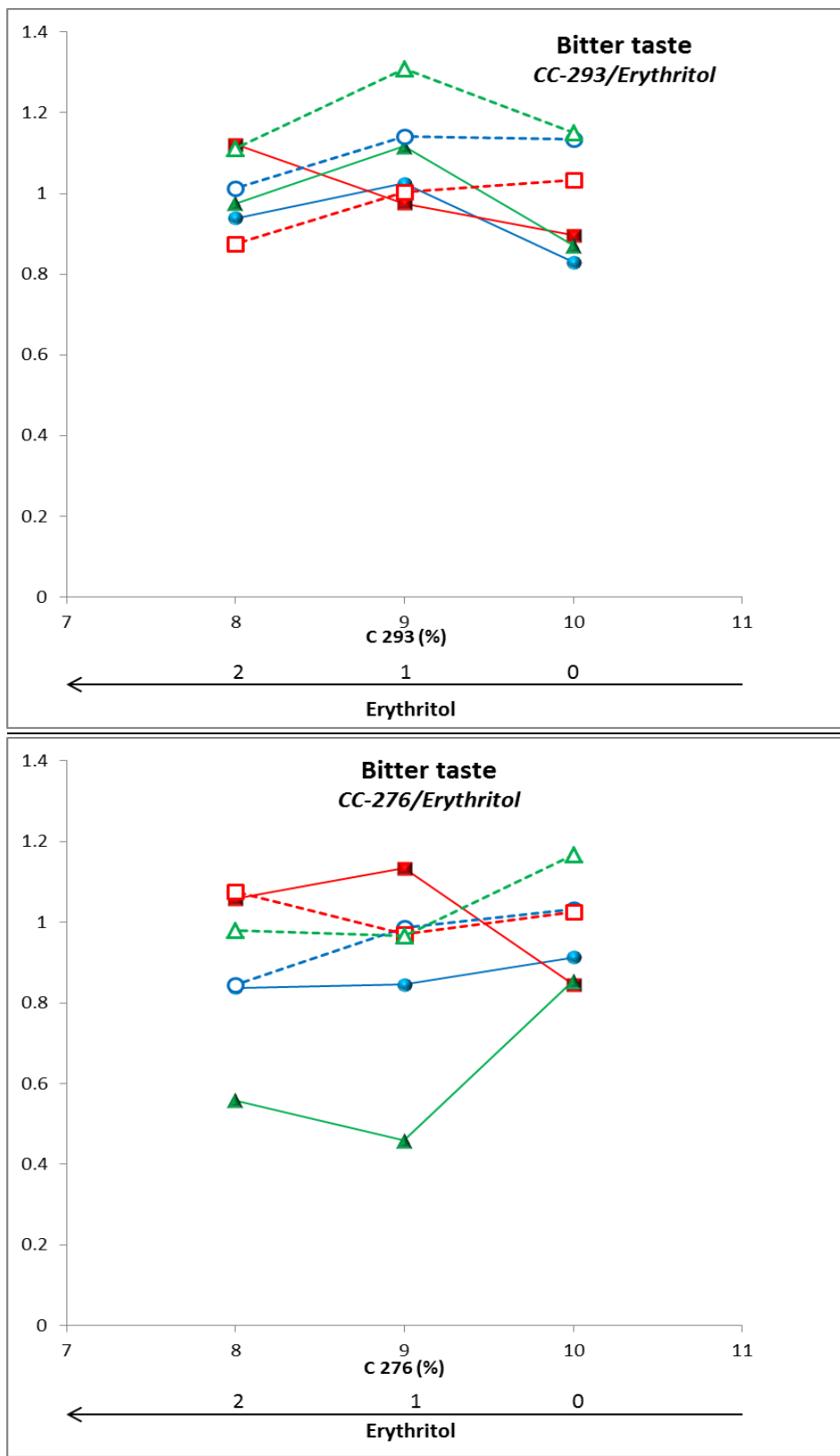
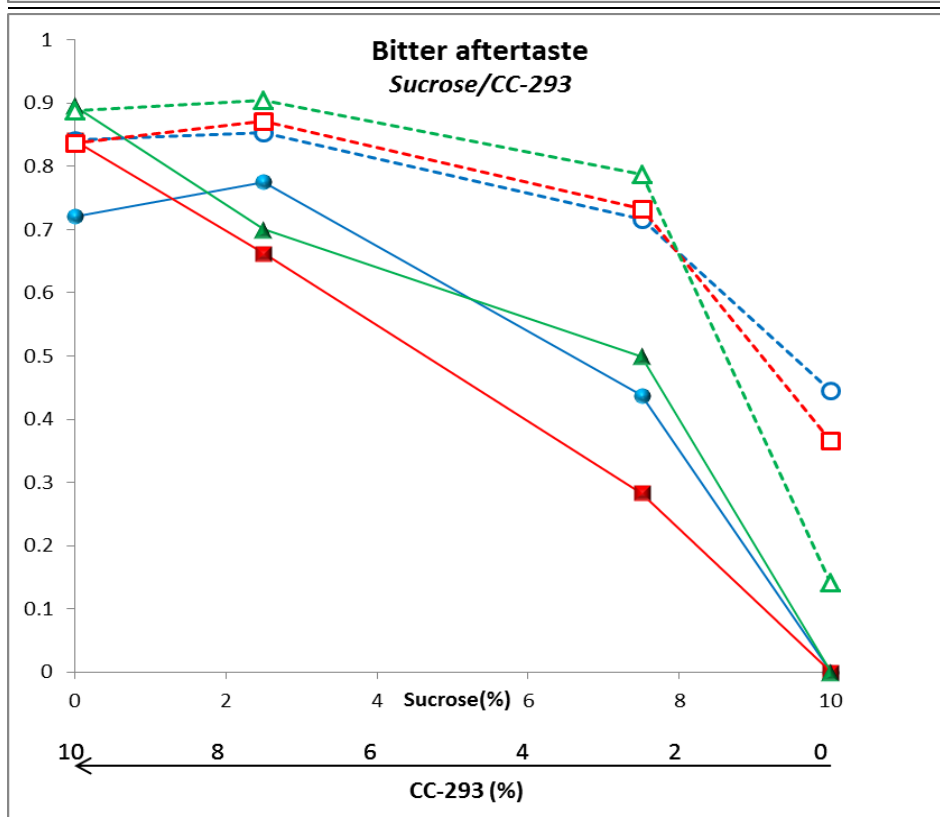
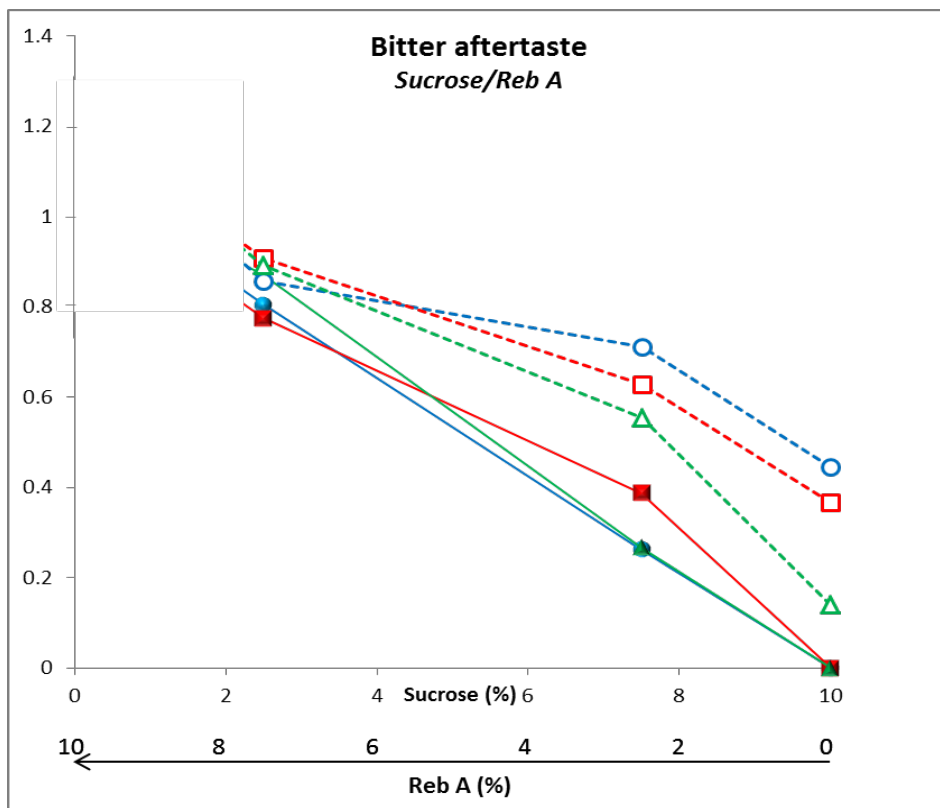
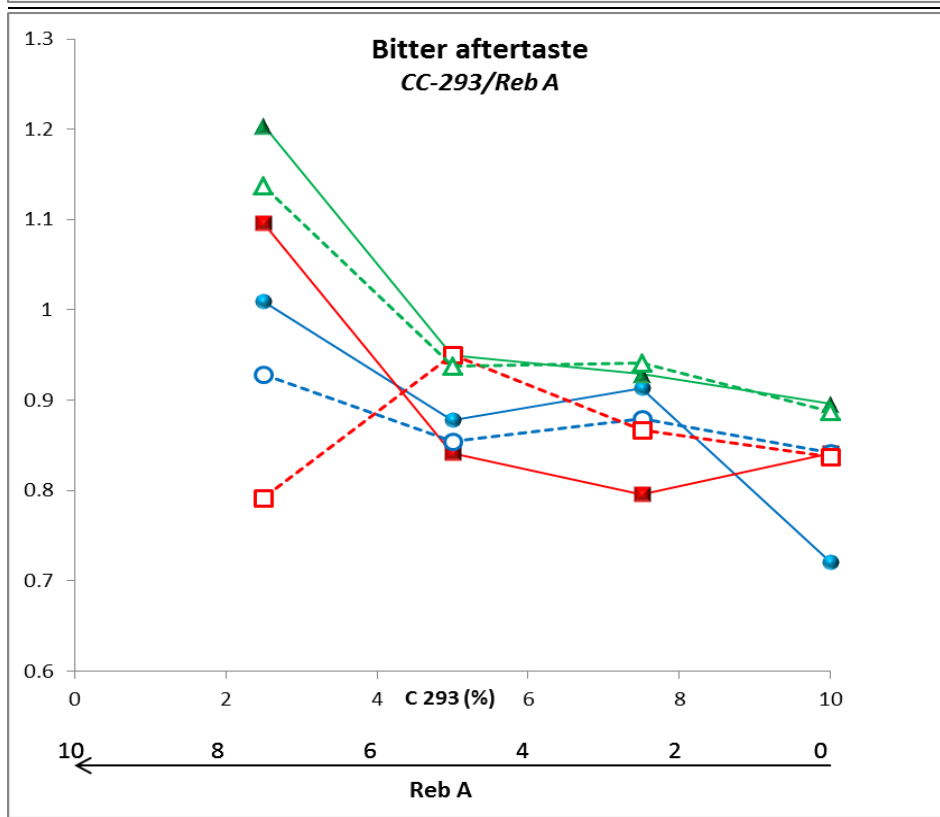
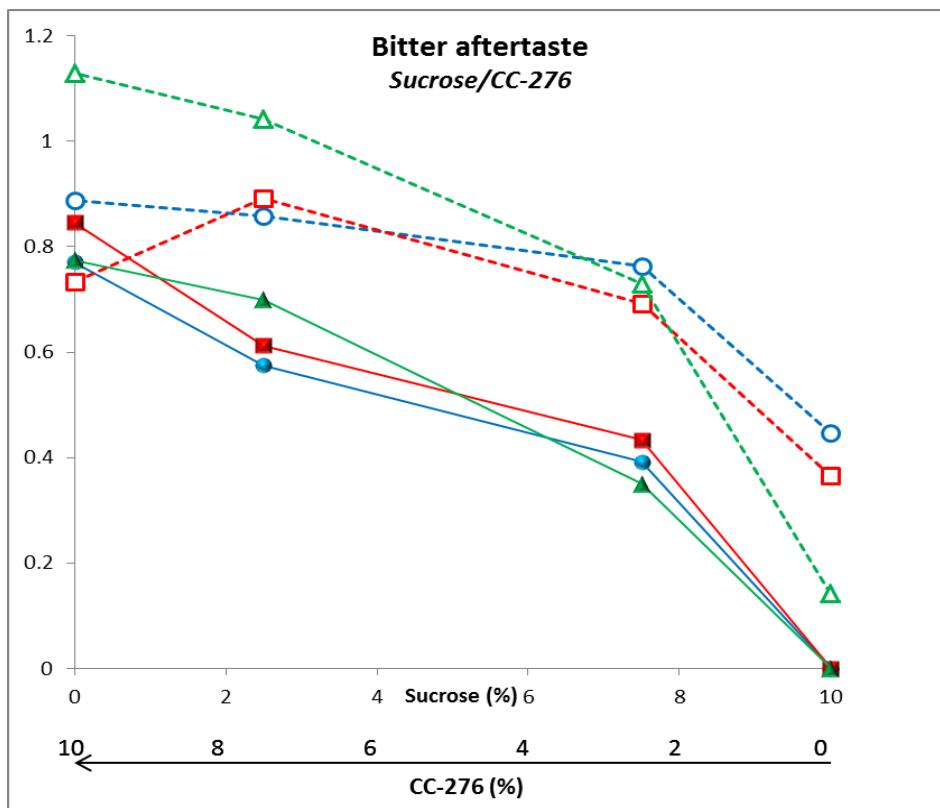
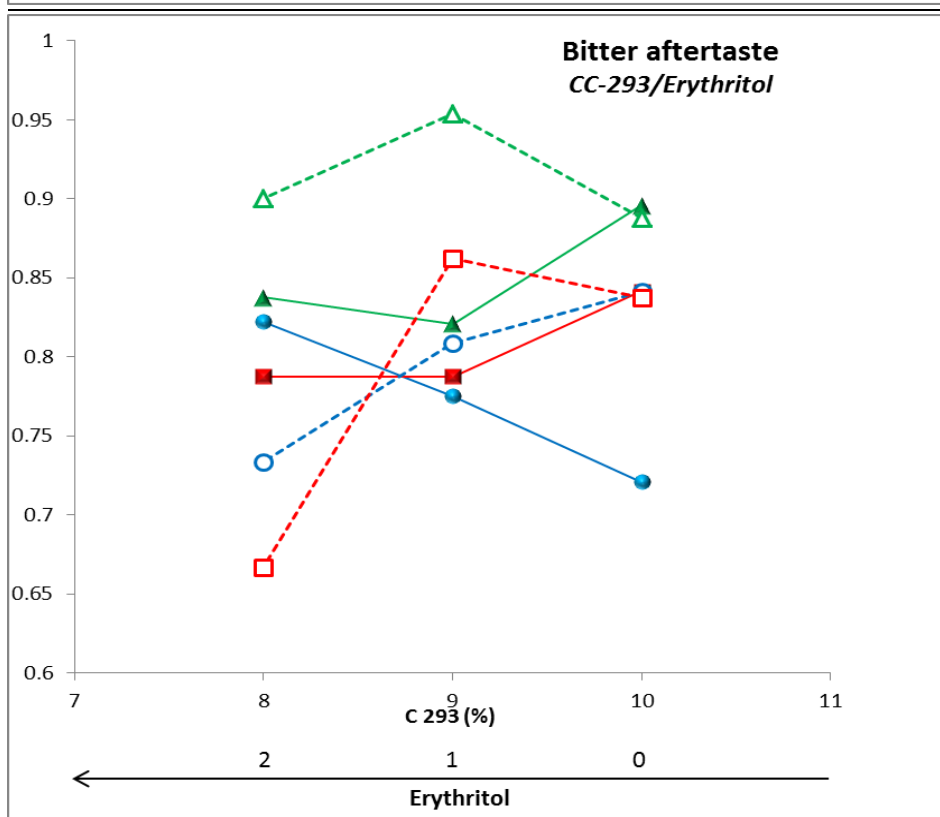
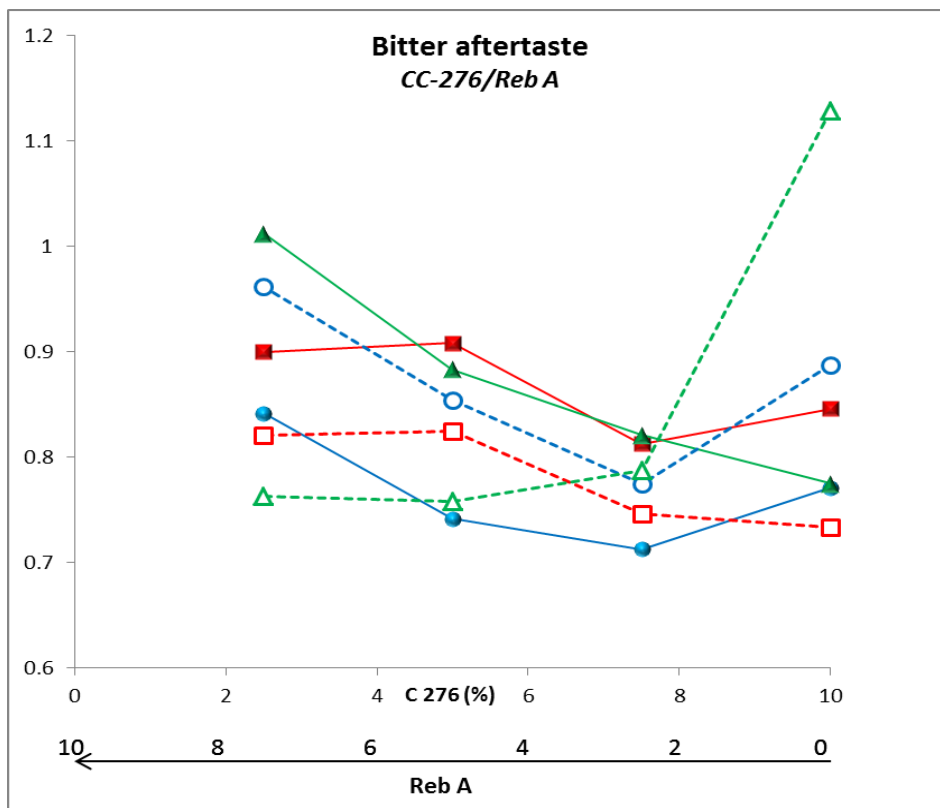


Figure 24: Mean intensities of bitter taste across matrices for each blend examined.







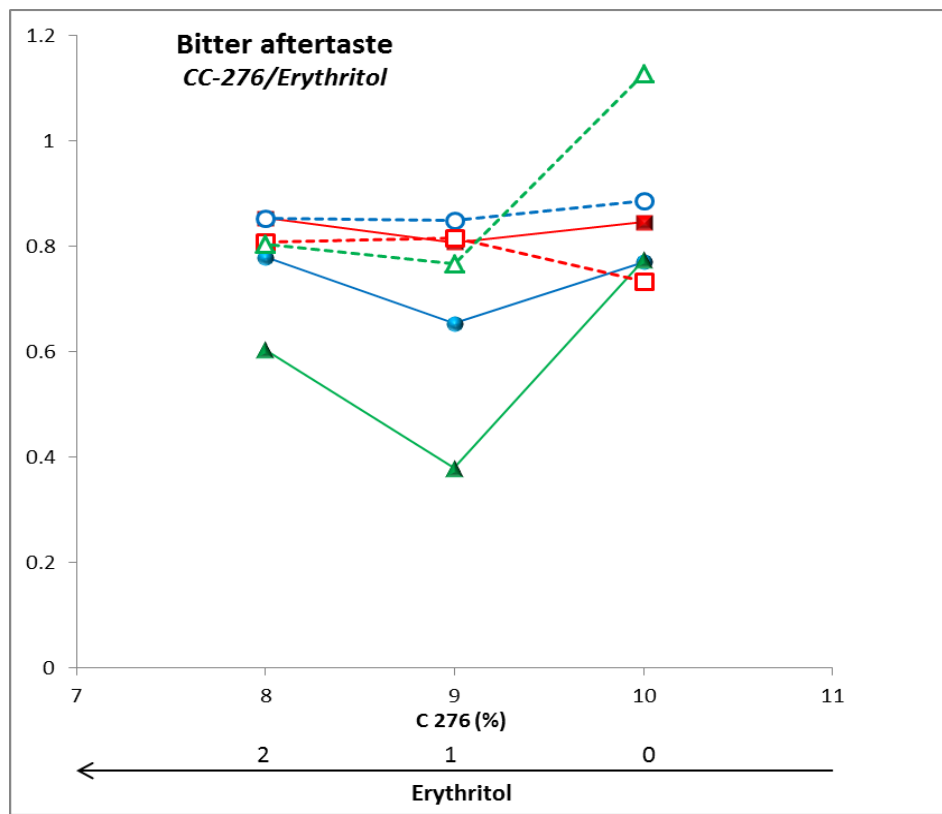
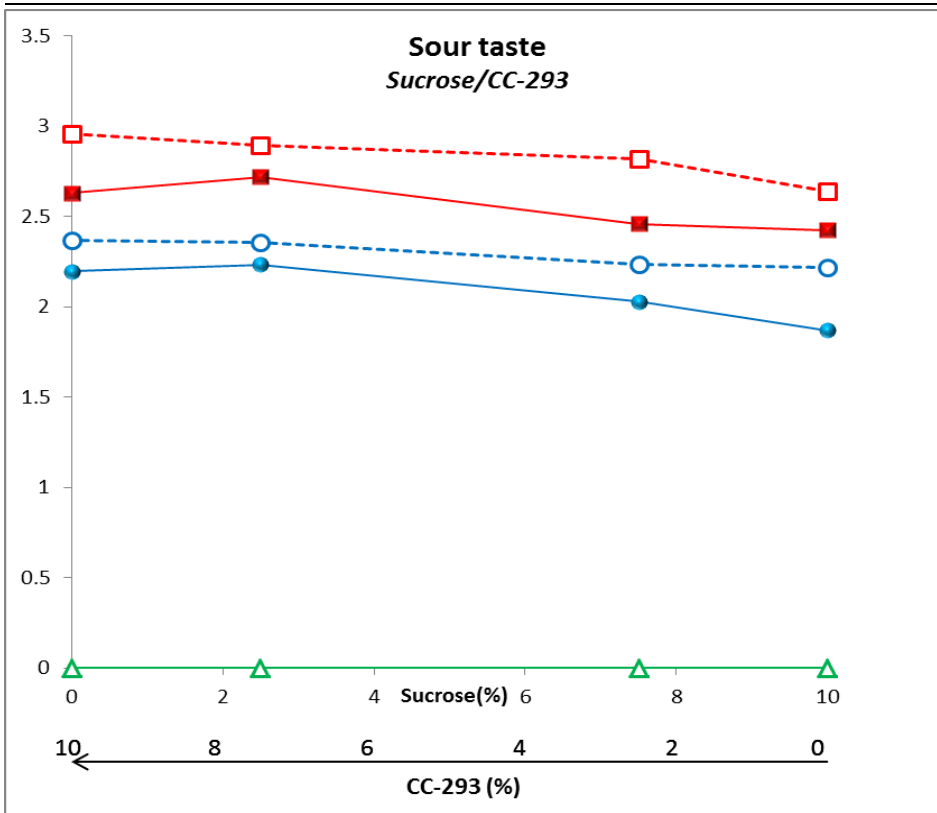
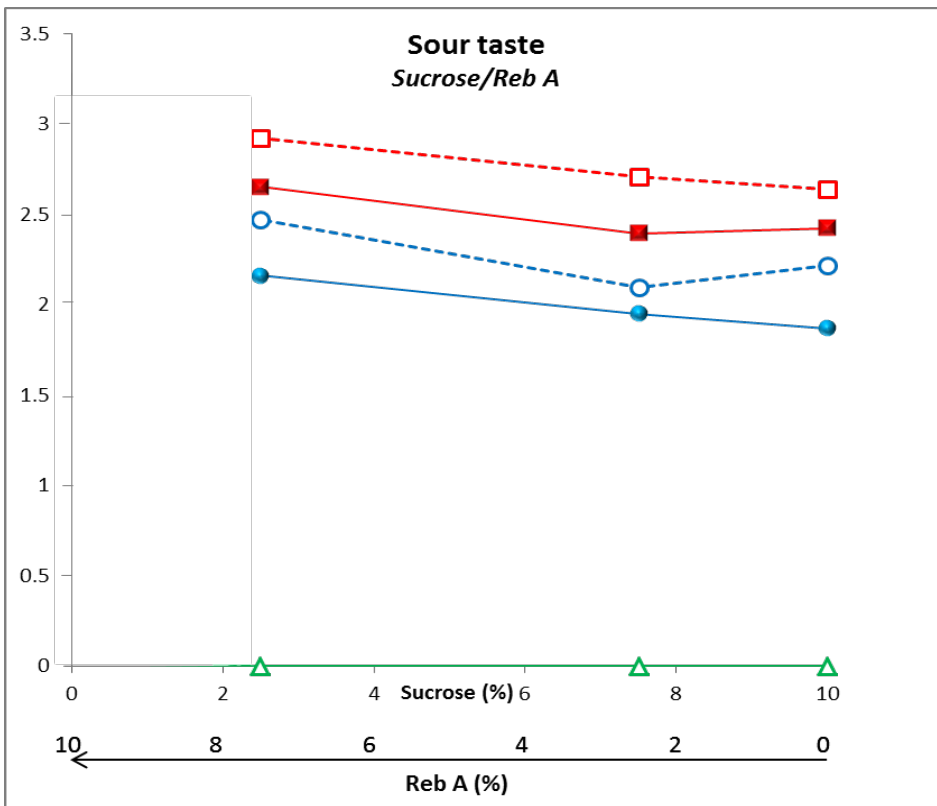
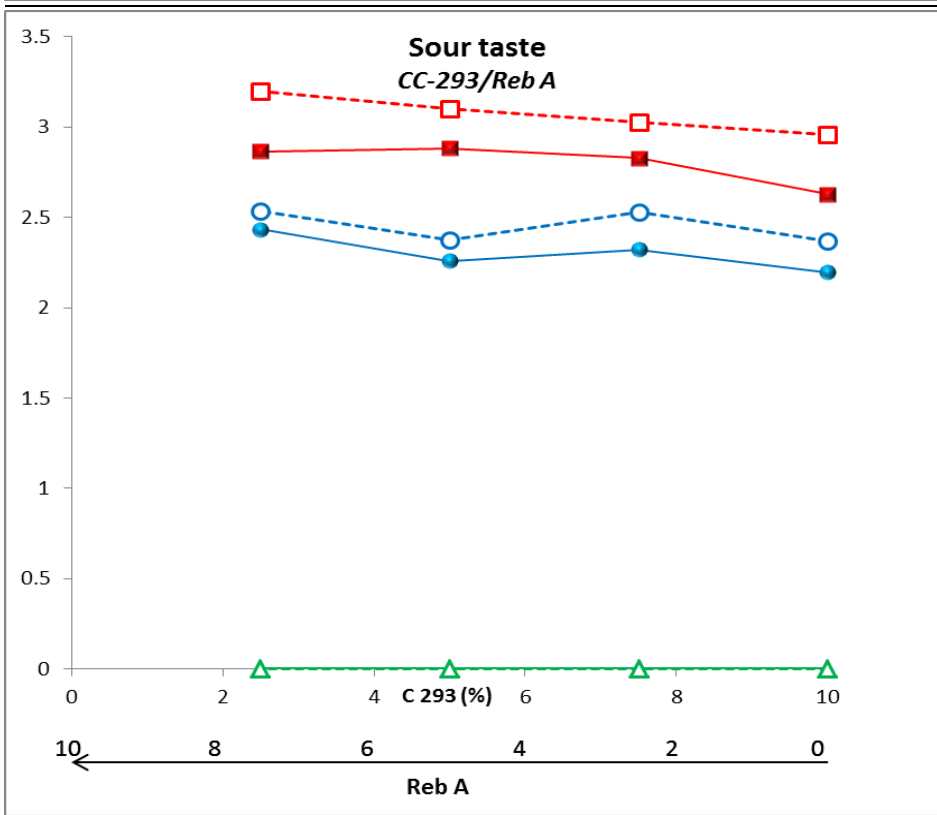
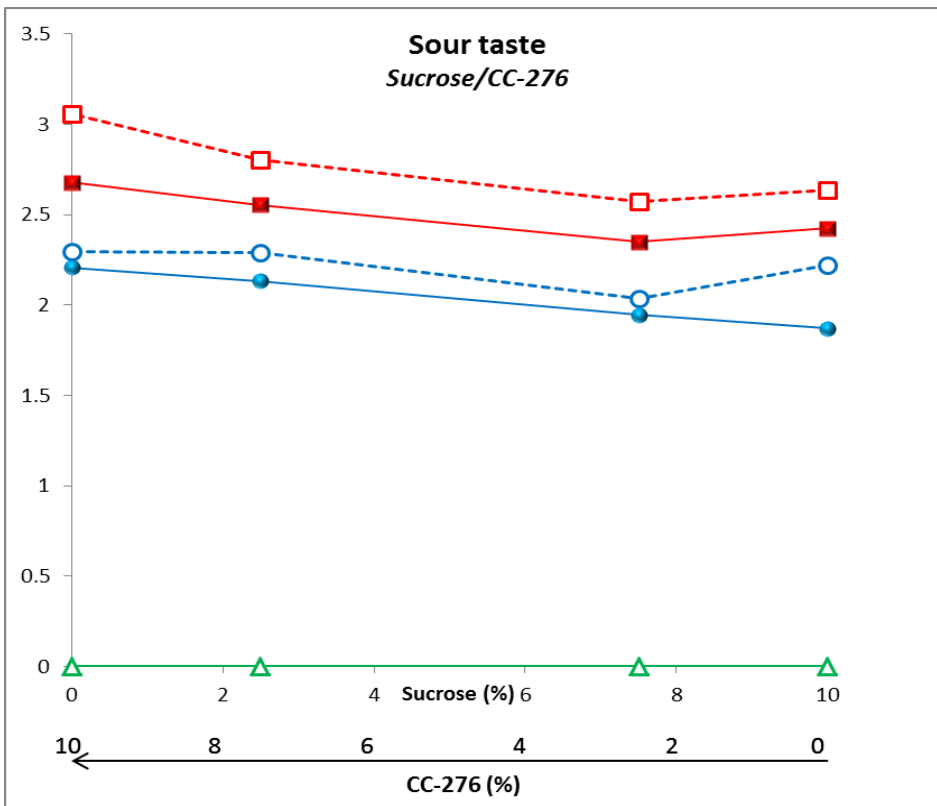
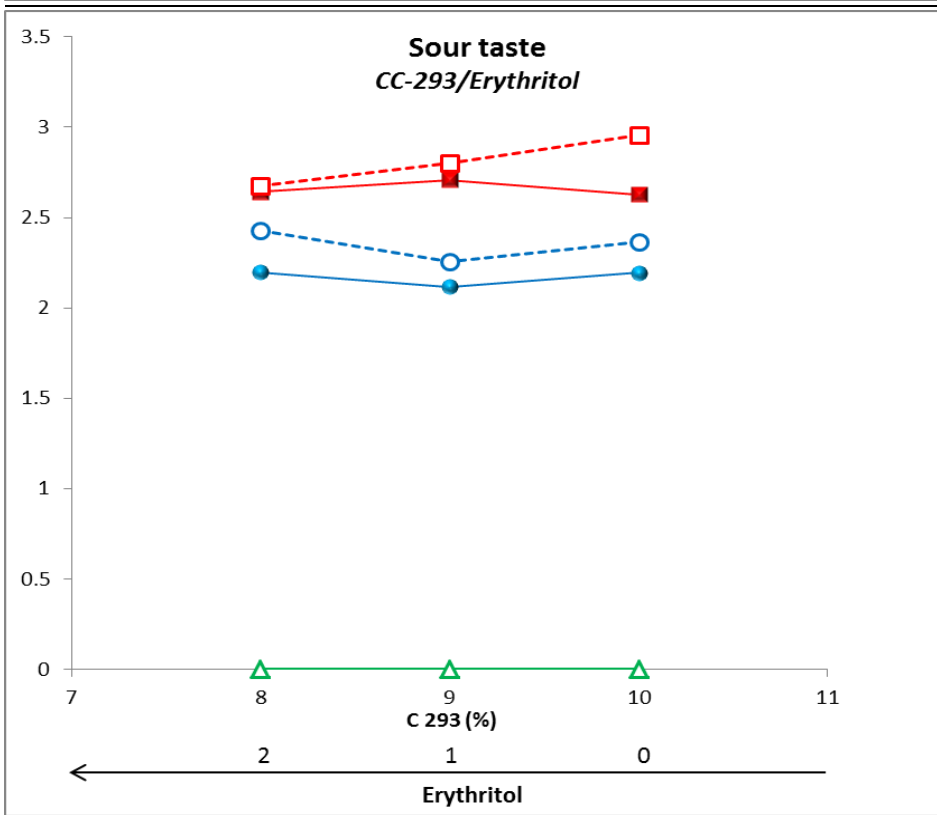
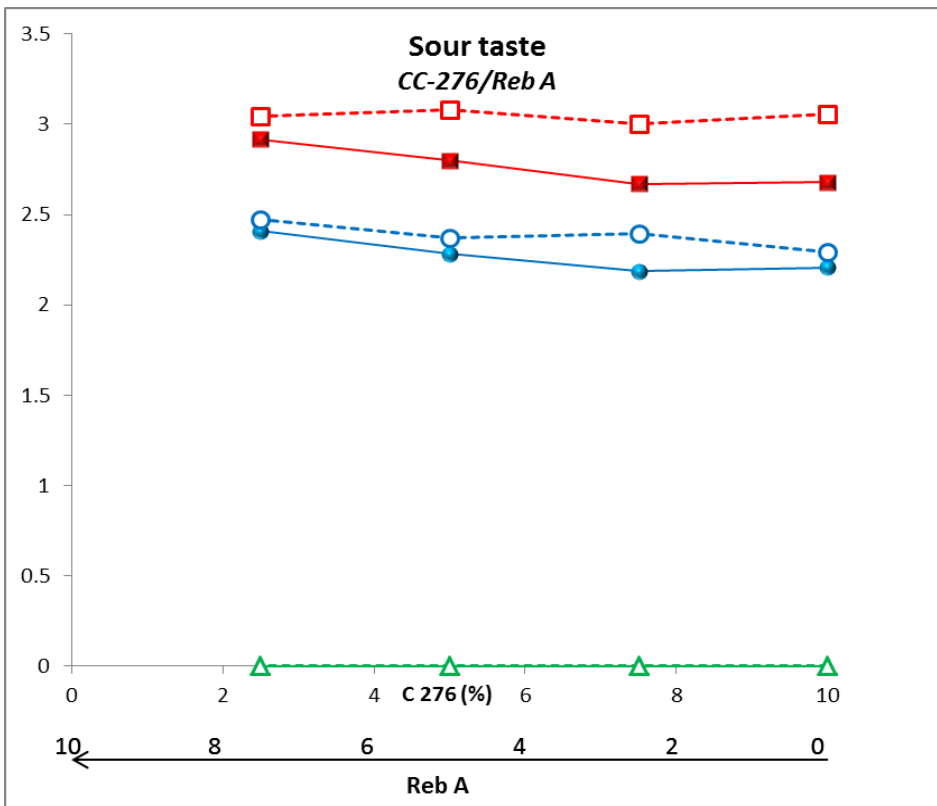


Figure 25: Mean intensities of bitter aftertaste across matrices for each blend examined.







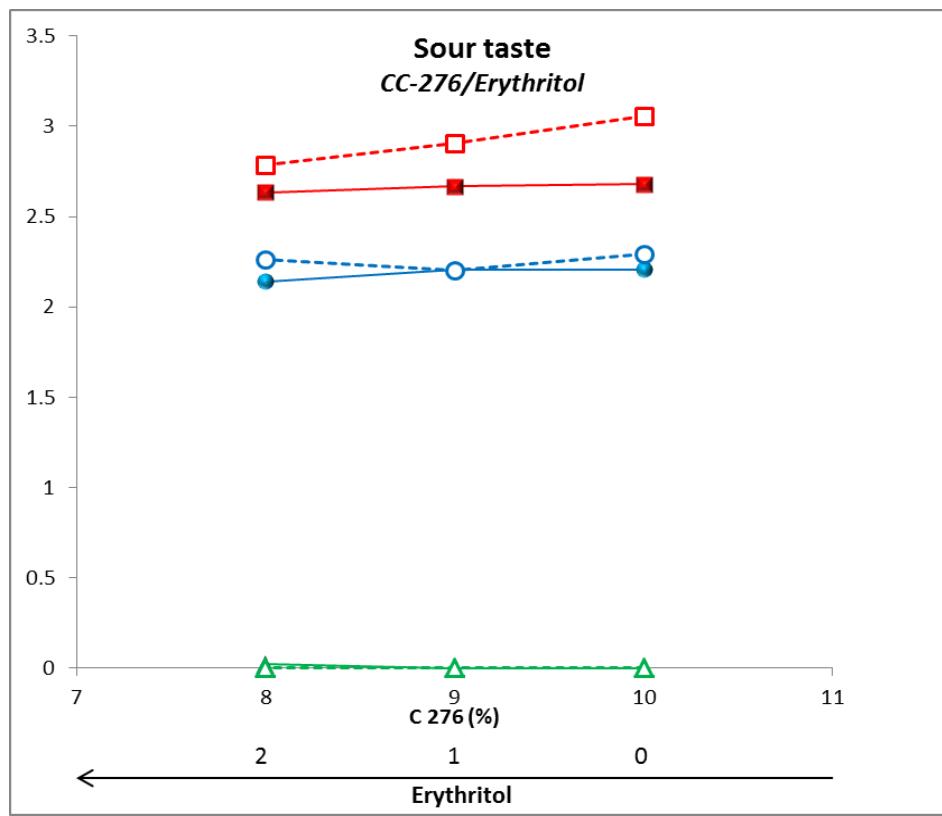
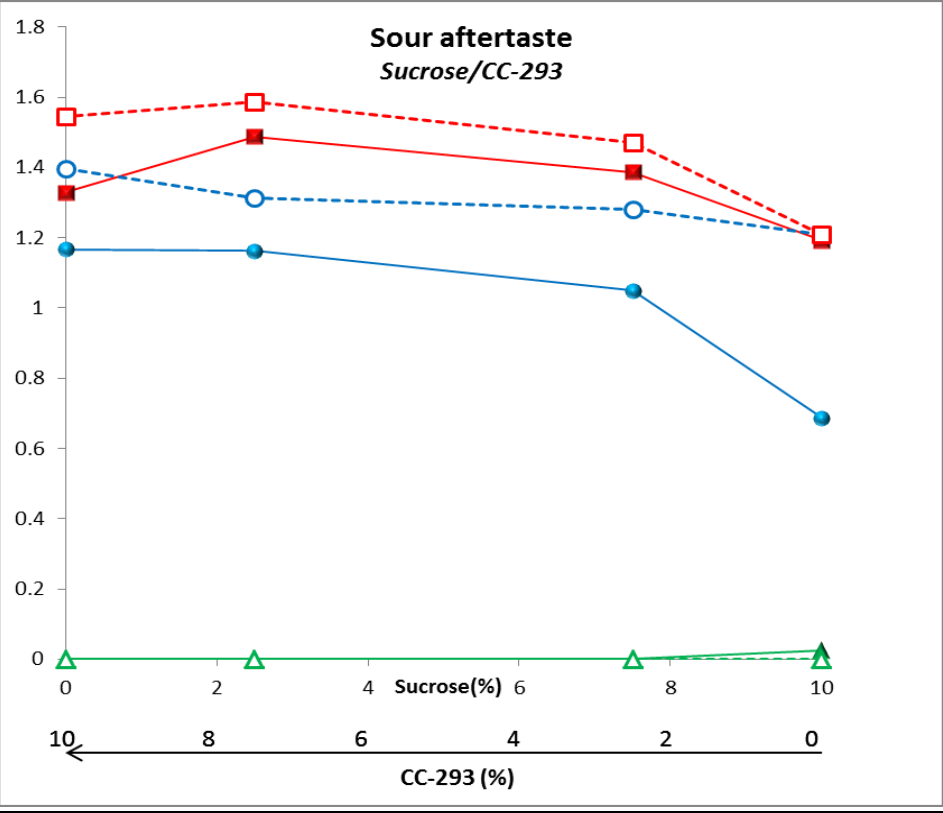
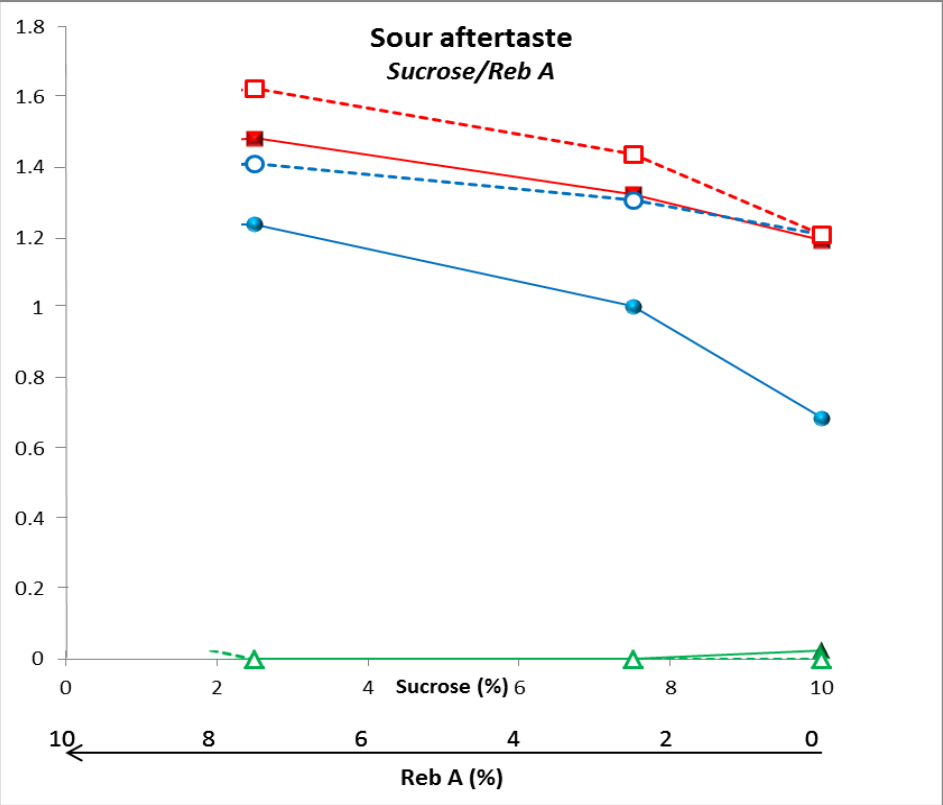
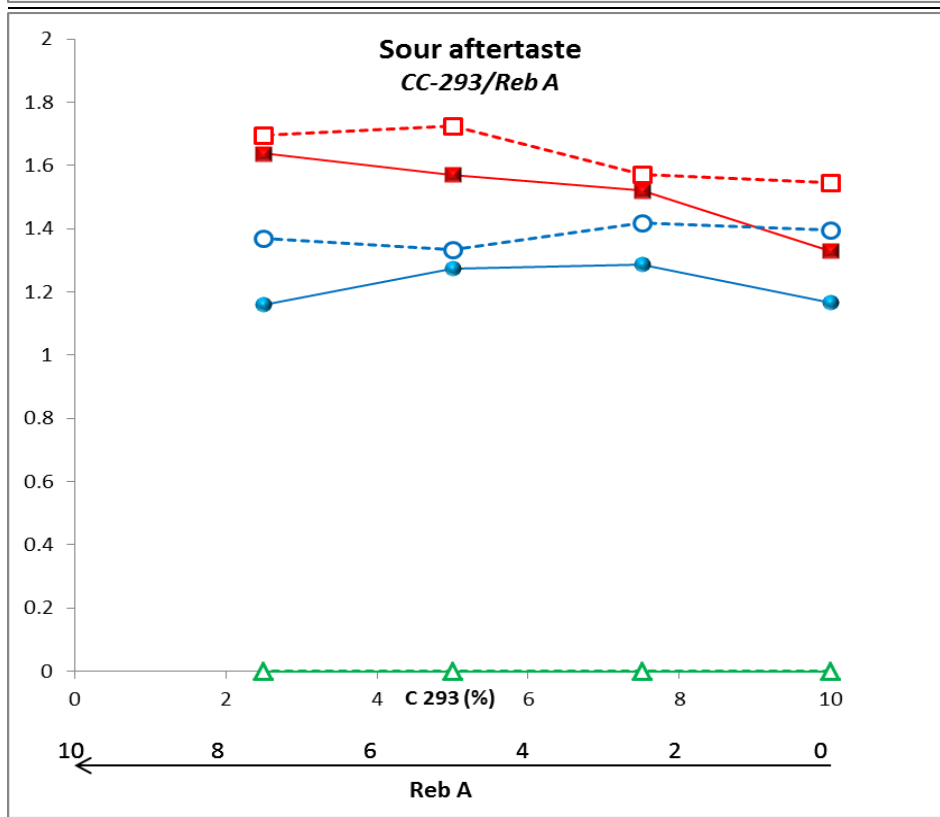
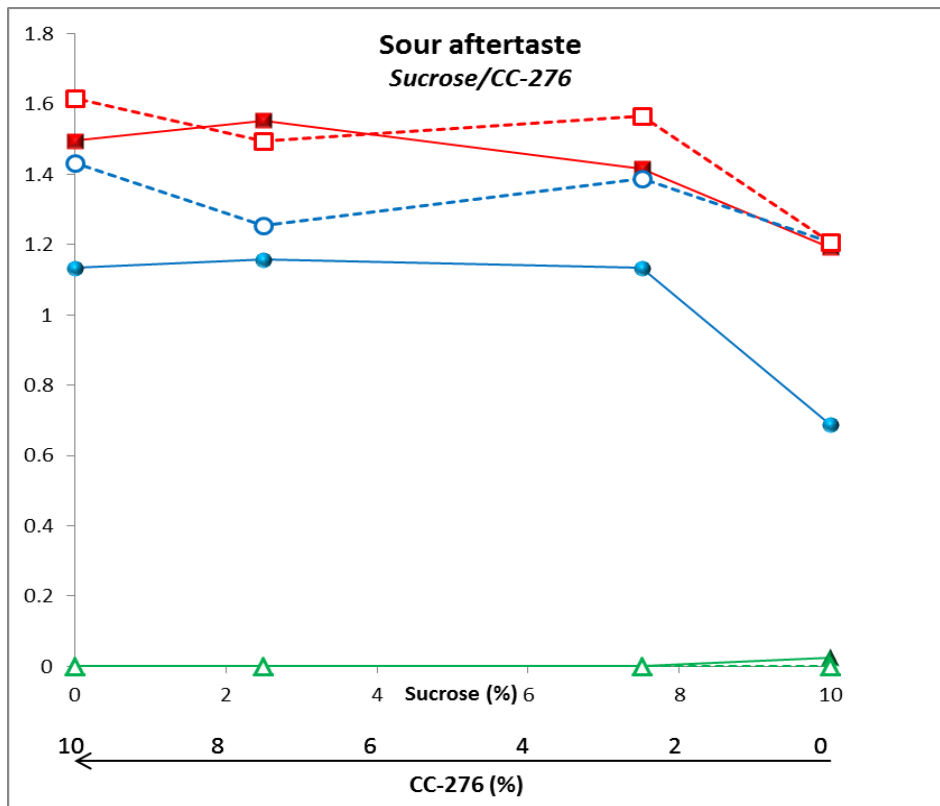
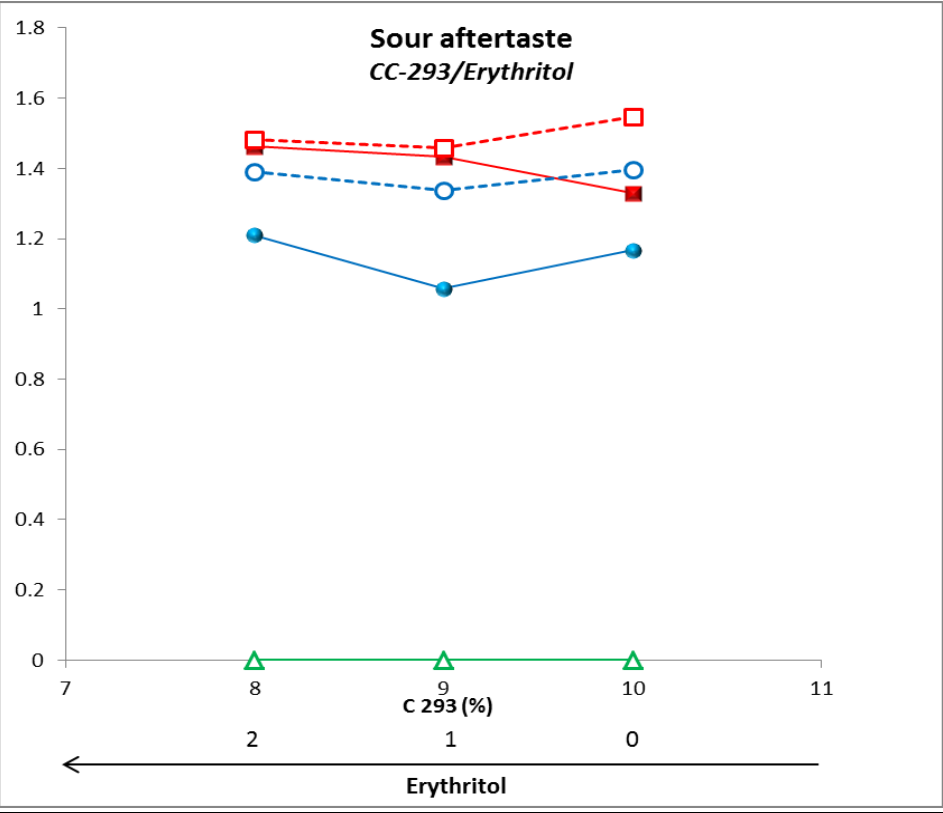
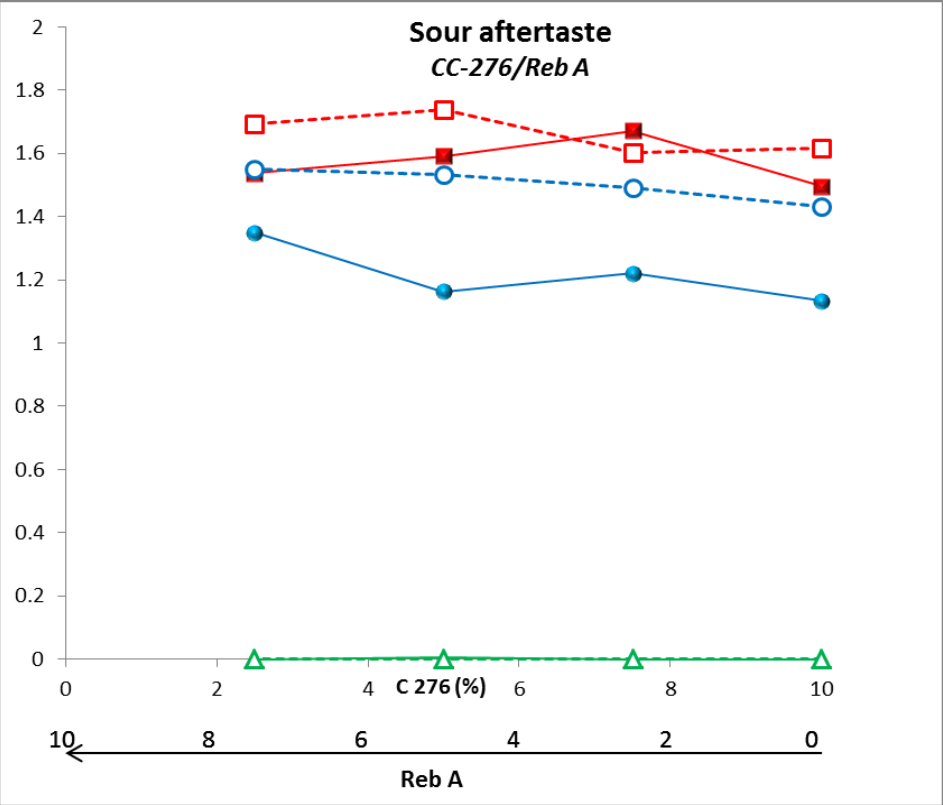


Figure 26: Mean intensities of sour taste across matrices for each blend examined.







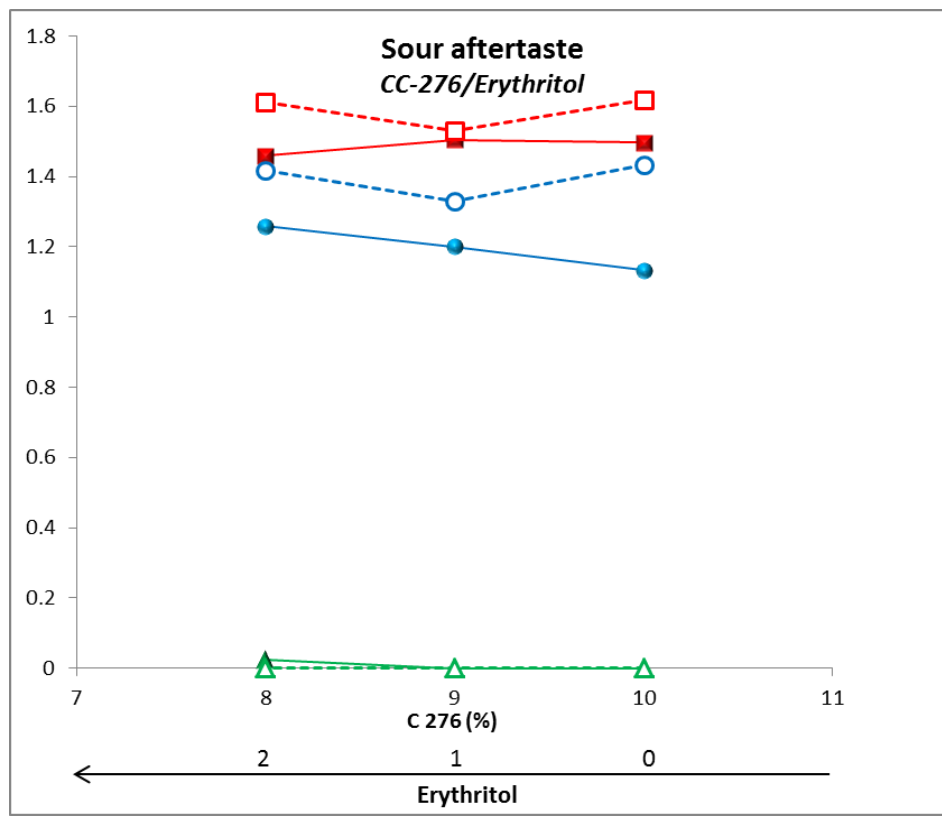
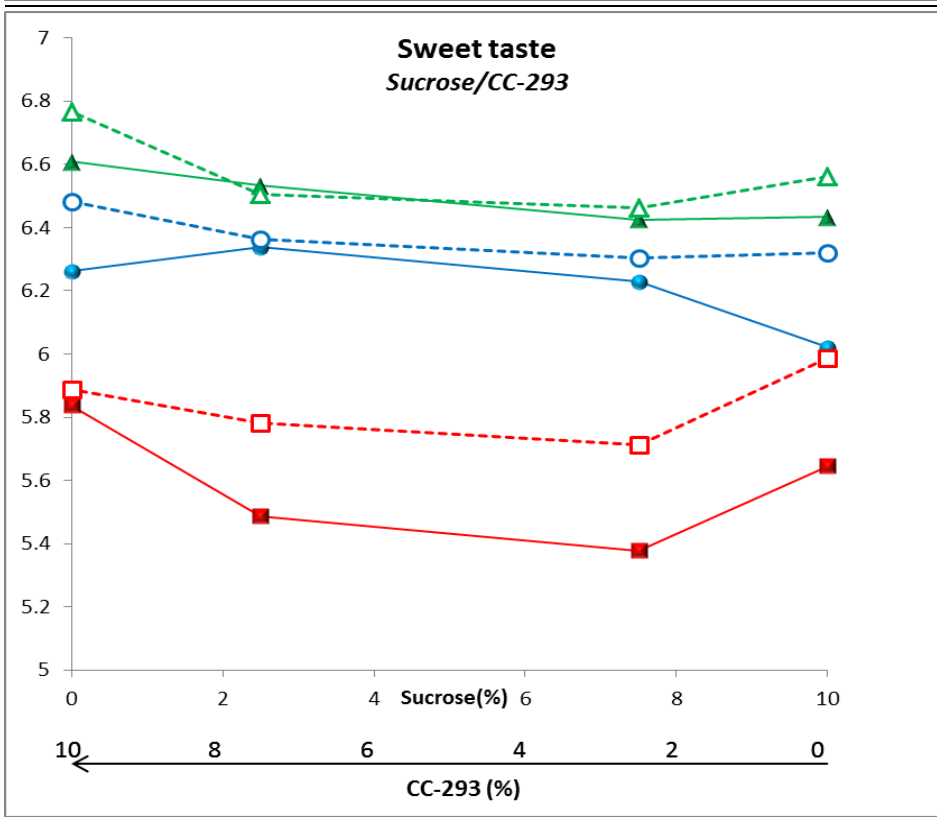
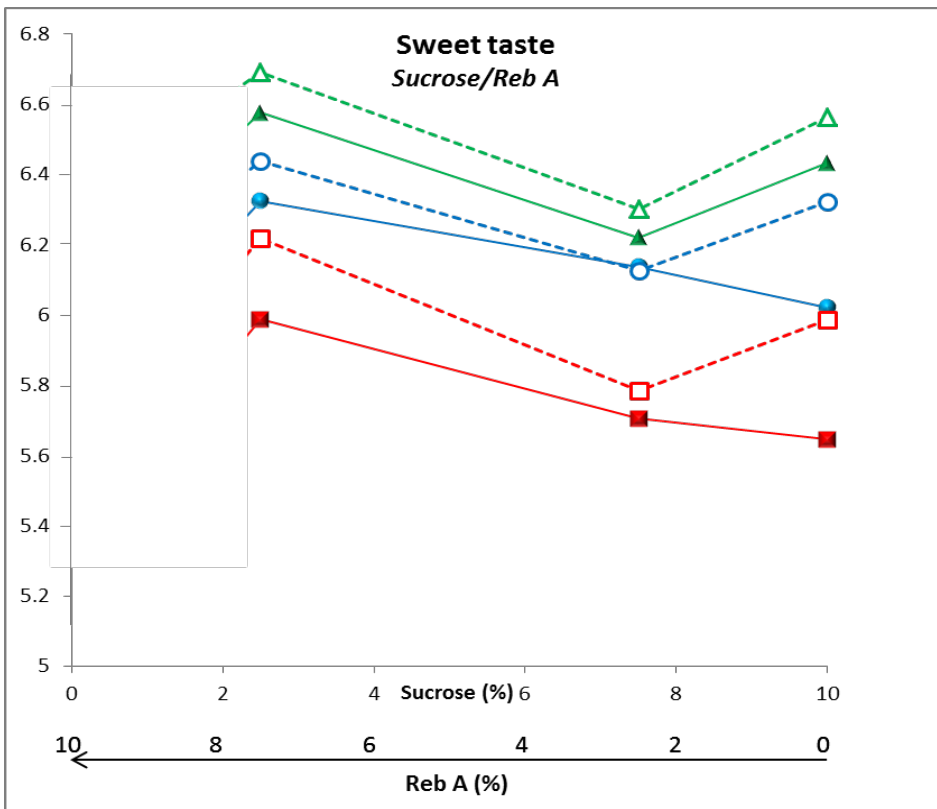
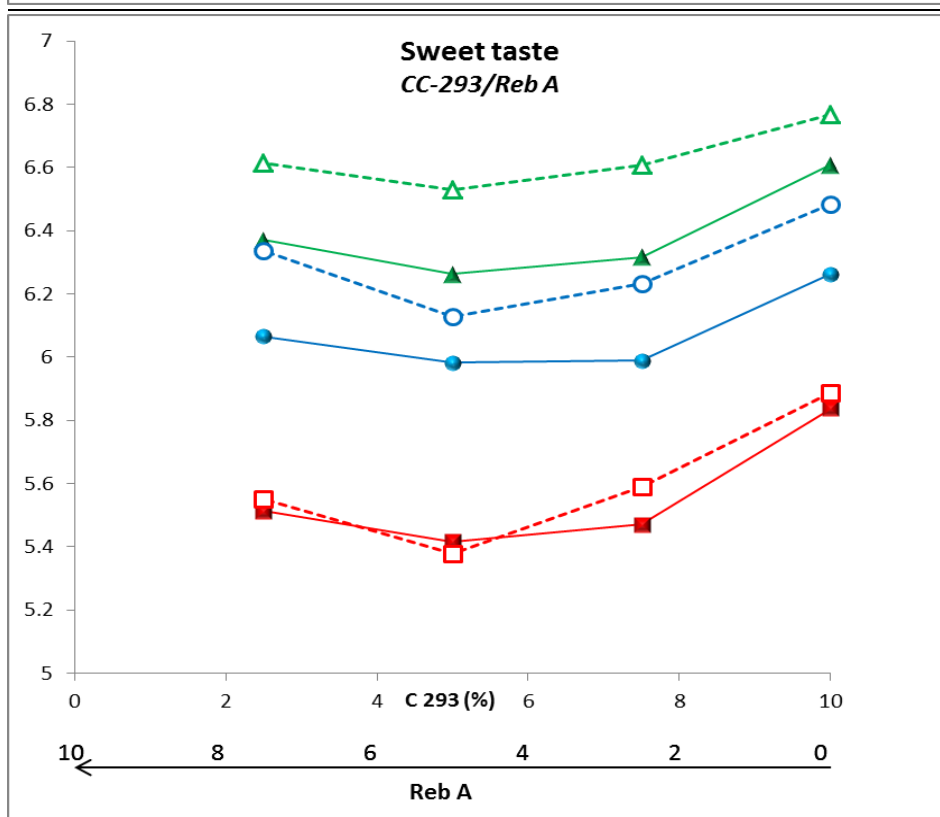
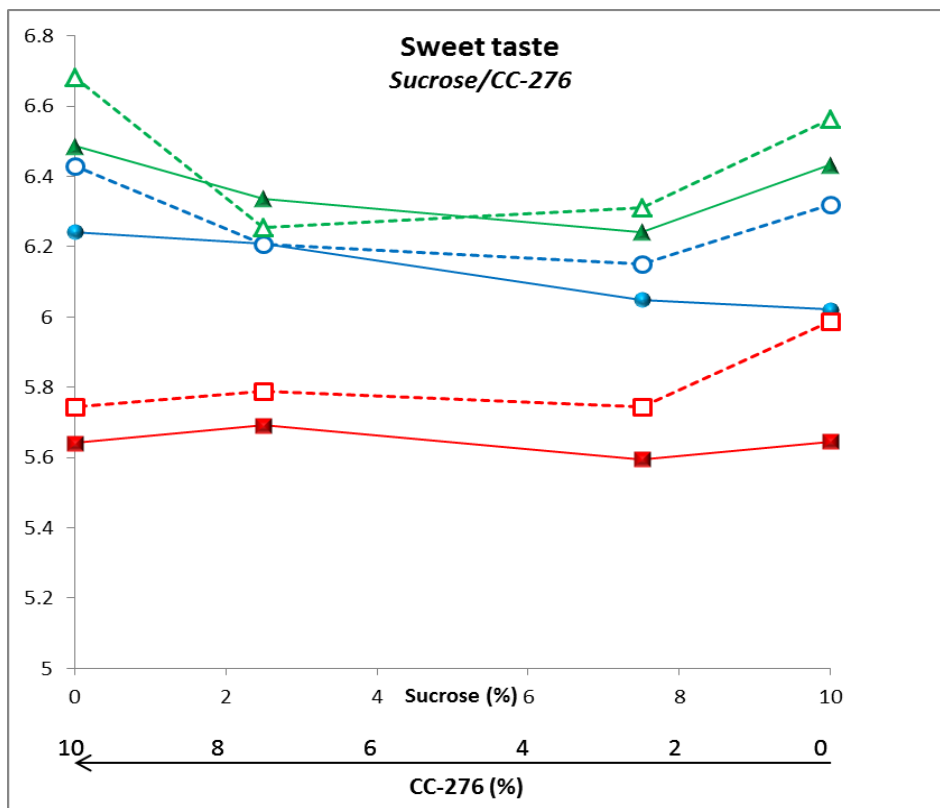
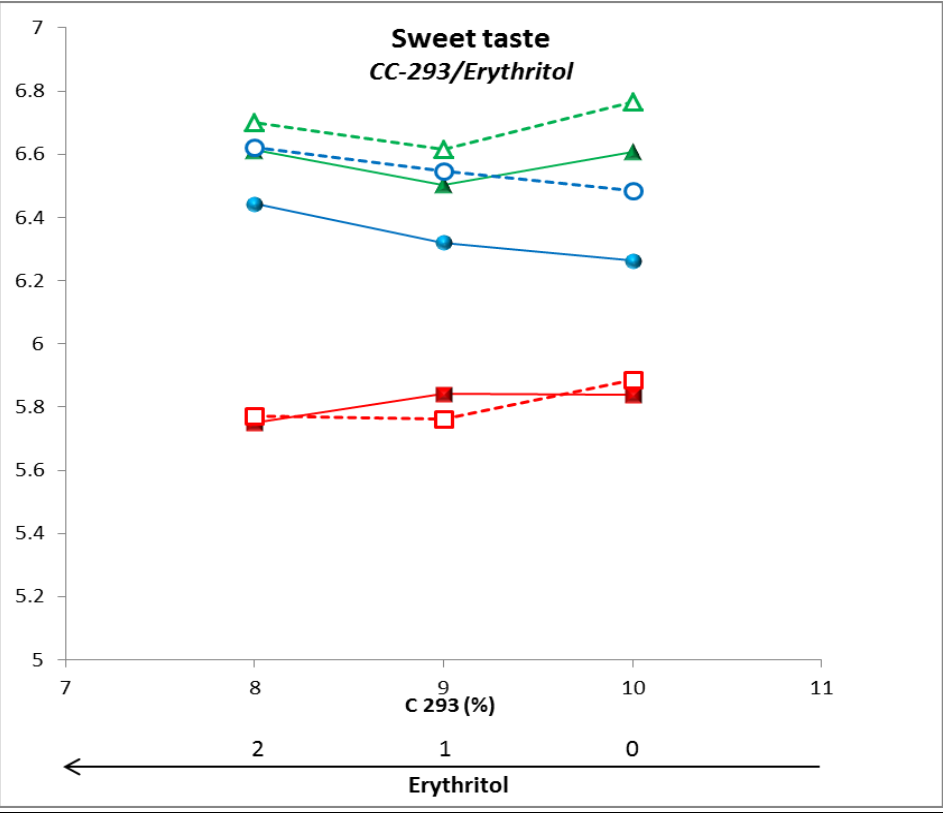
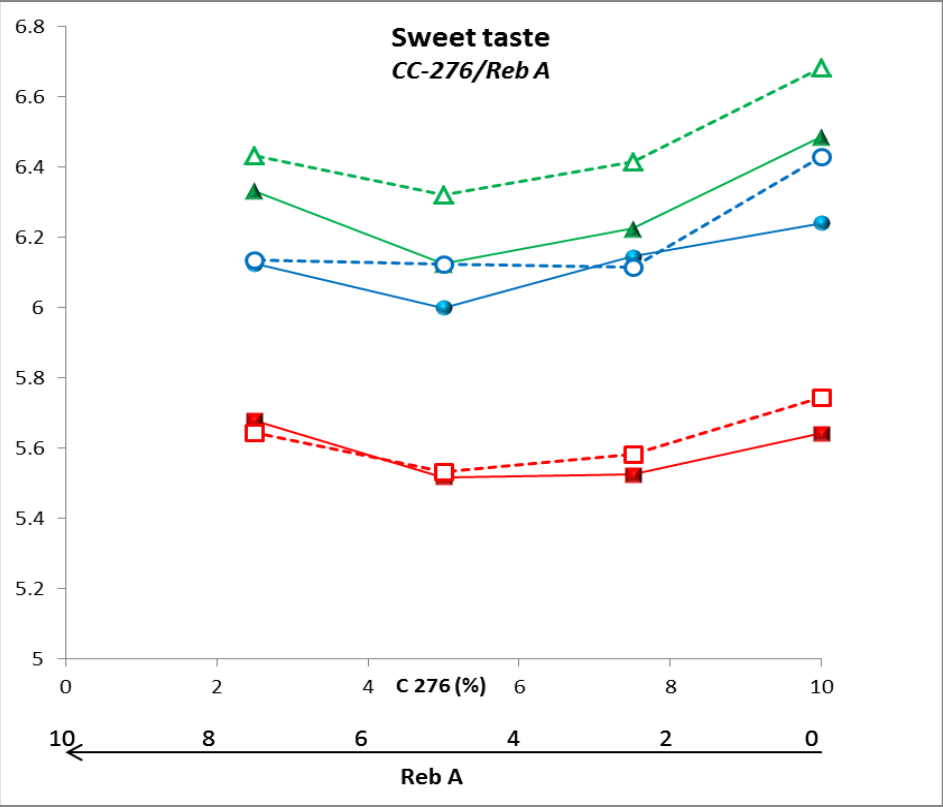


Figure 27: Mean intensities of sour aftertaste across matrices for each blend examined.







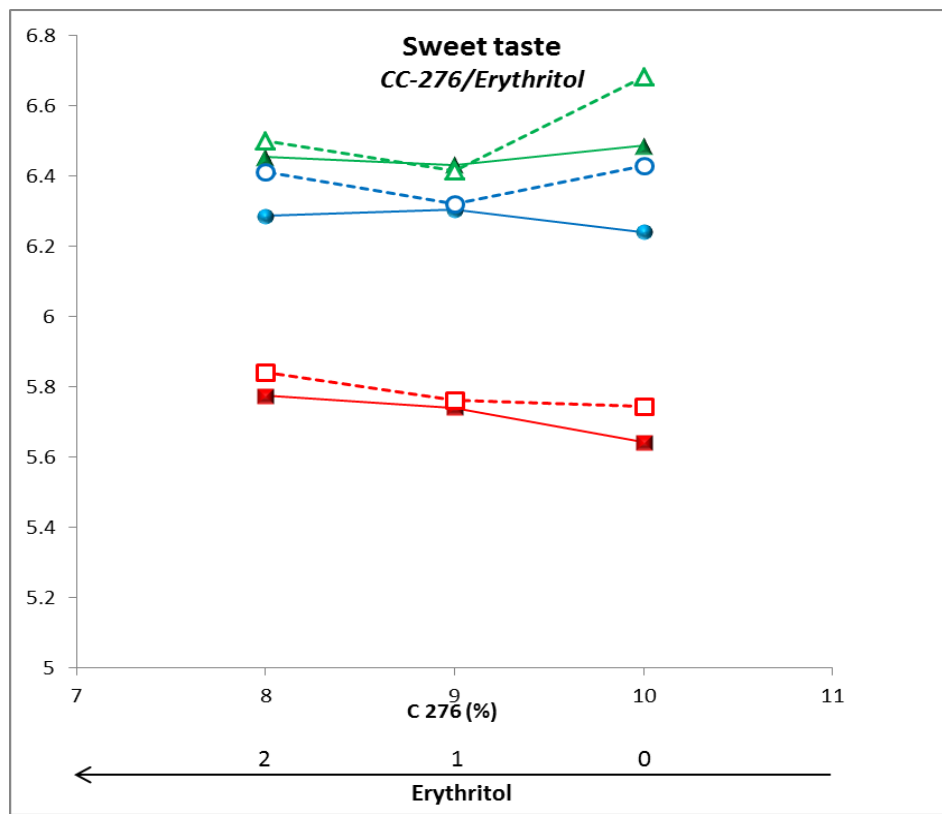
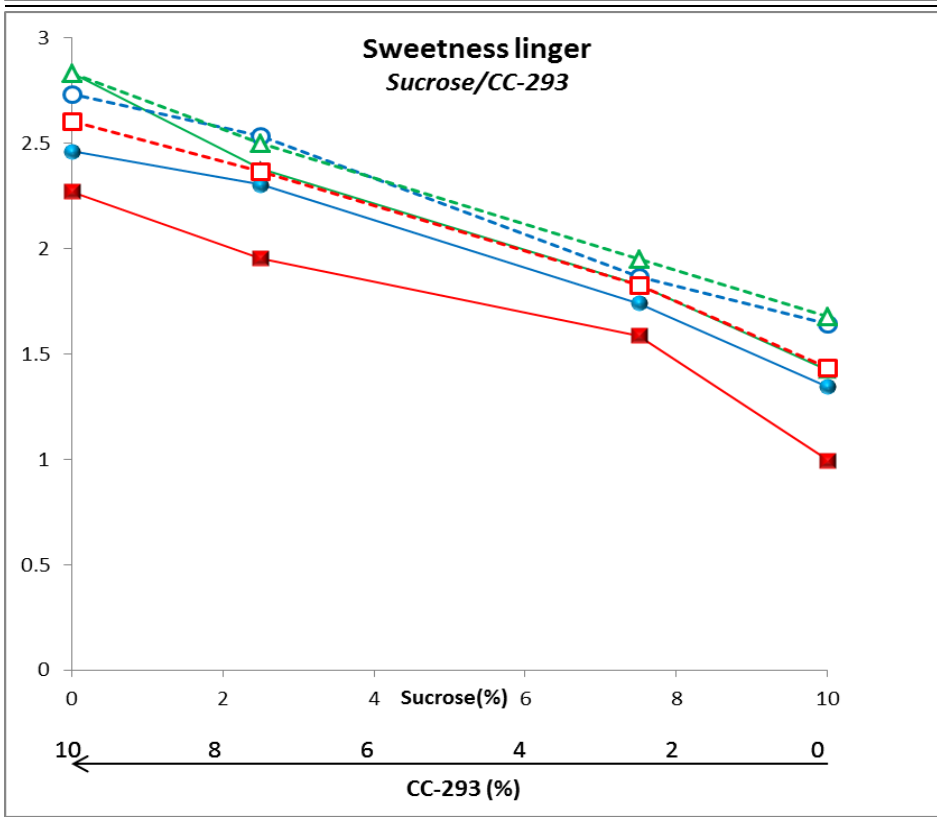
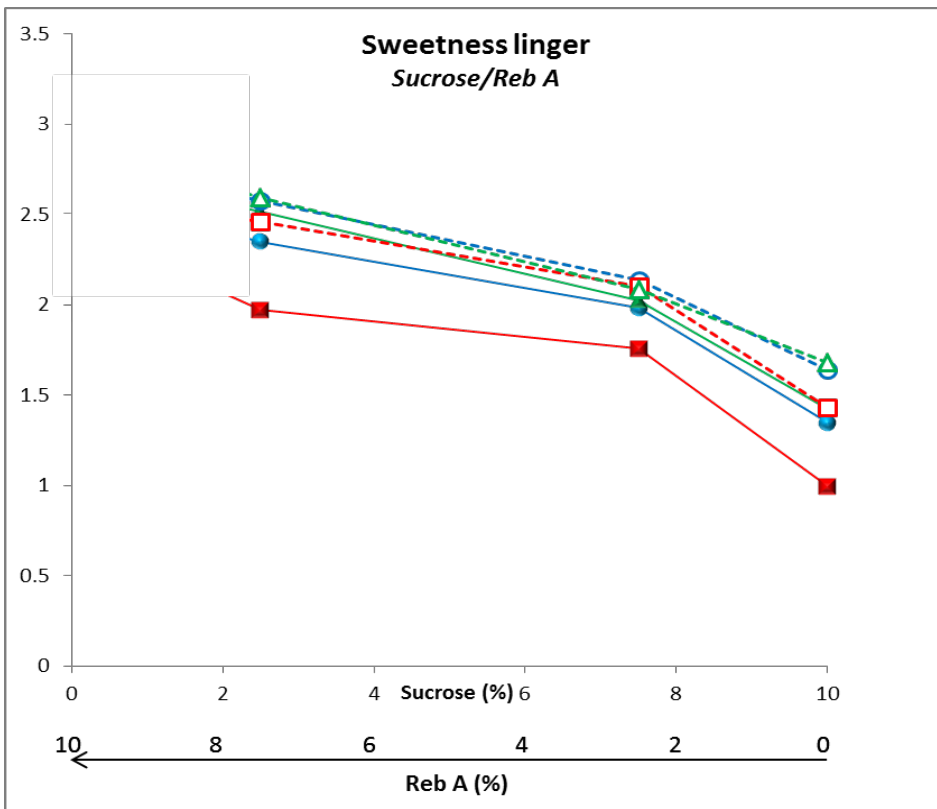
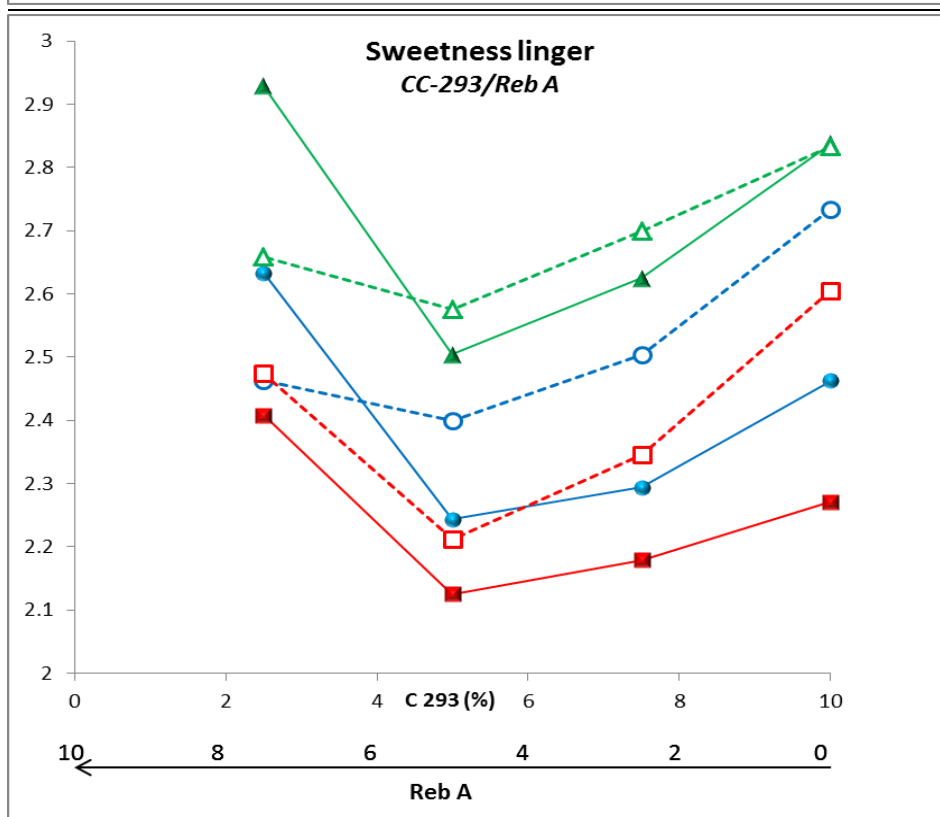
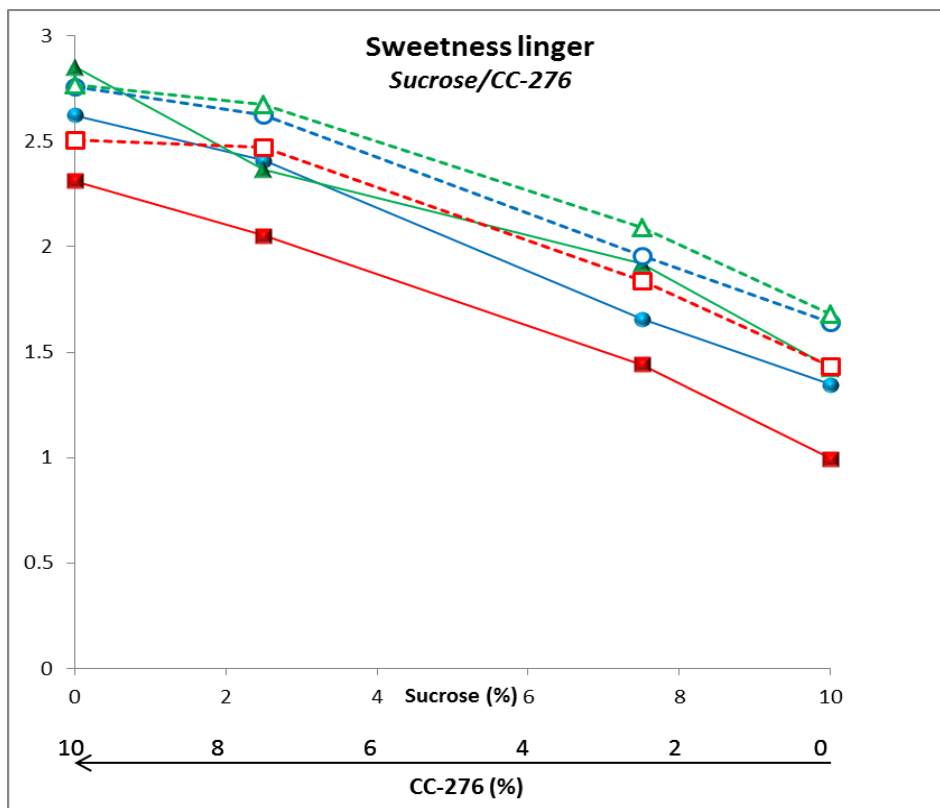
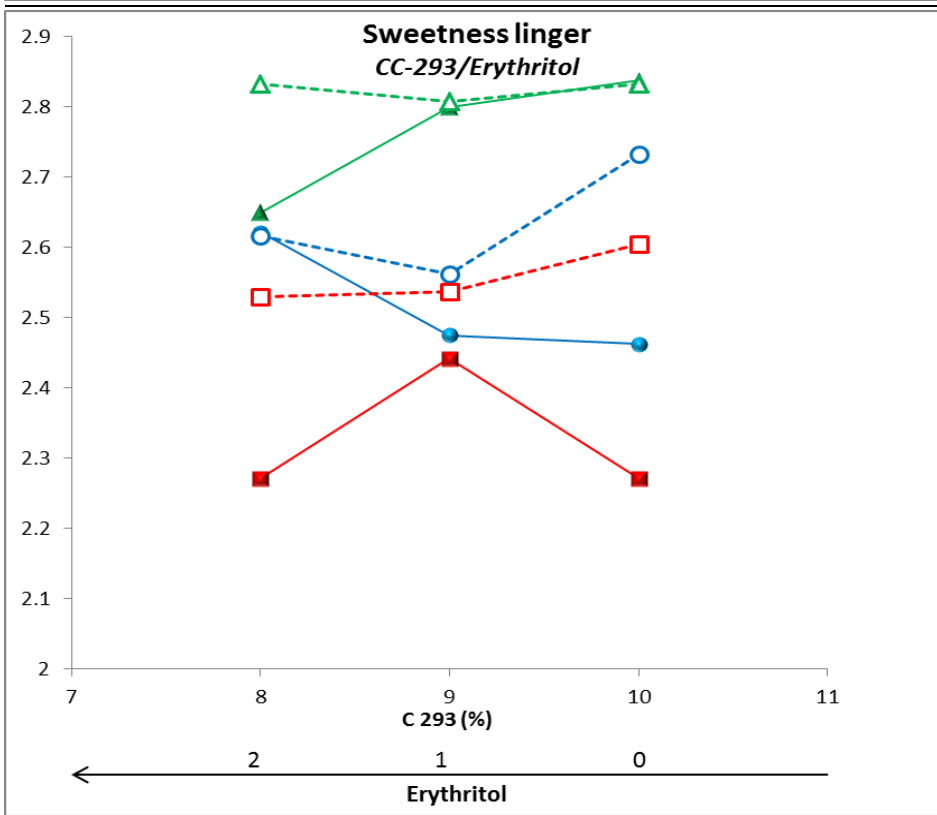
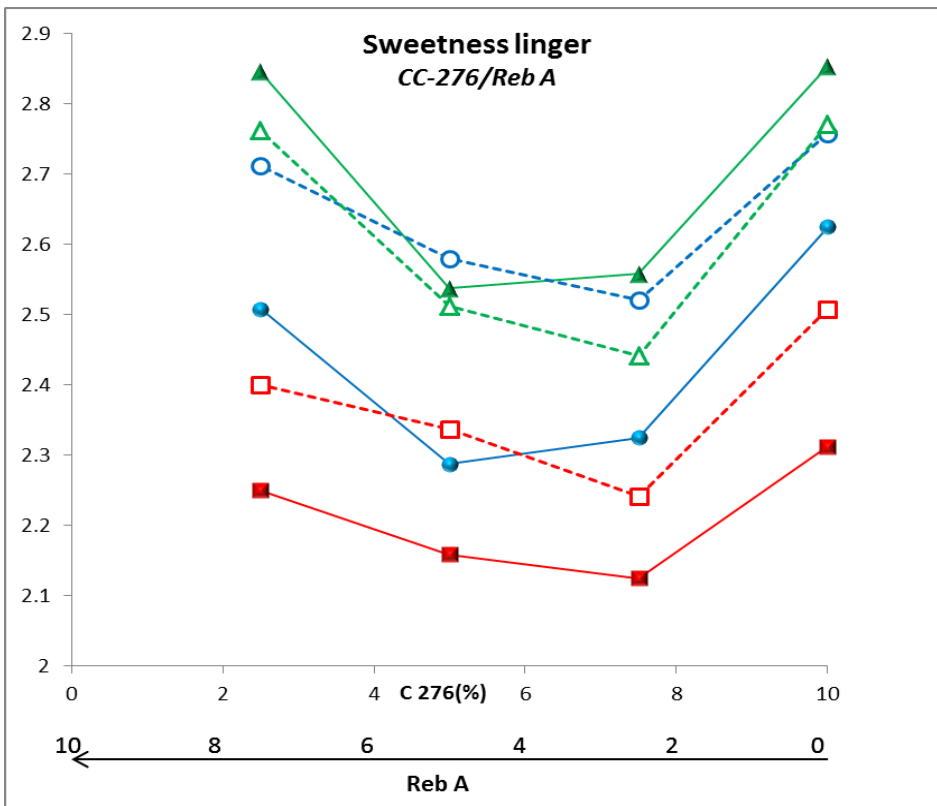


Figure 28: Mean intensities of sweet taste across matrices for each blend examined.







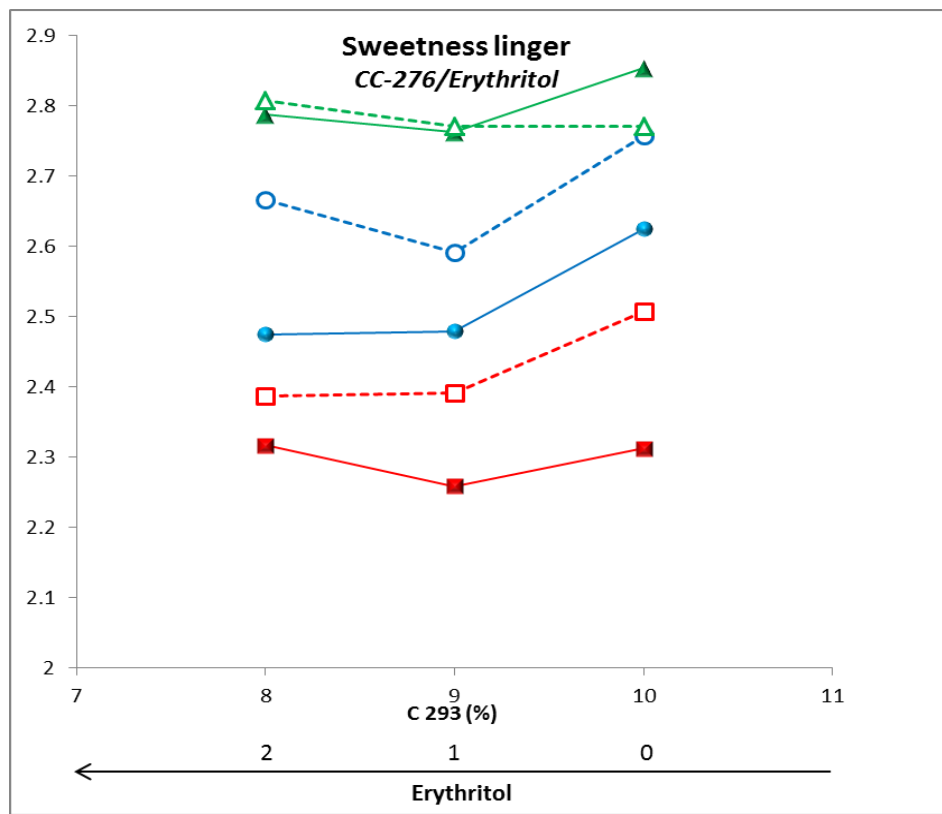
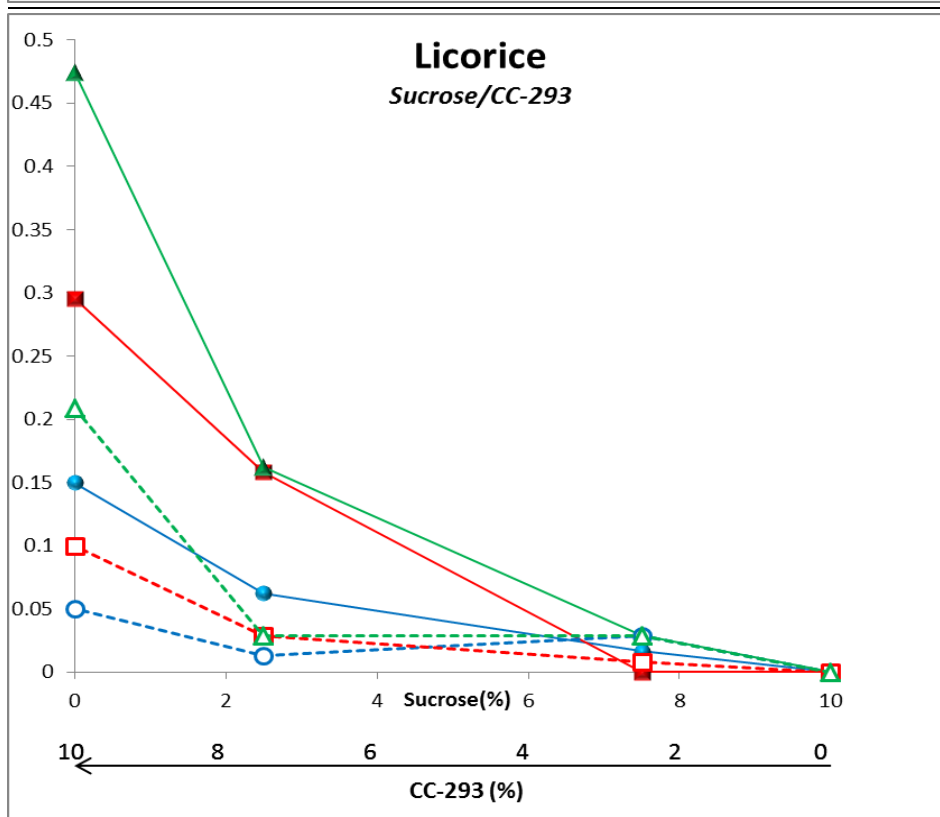
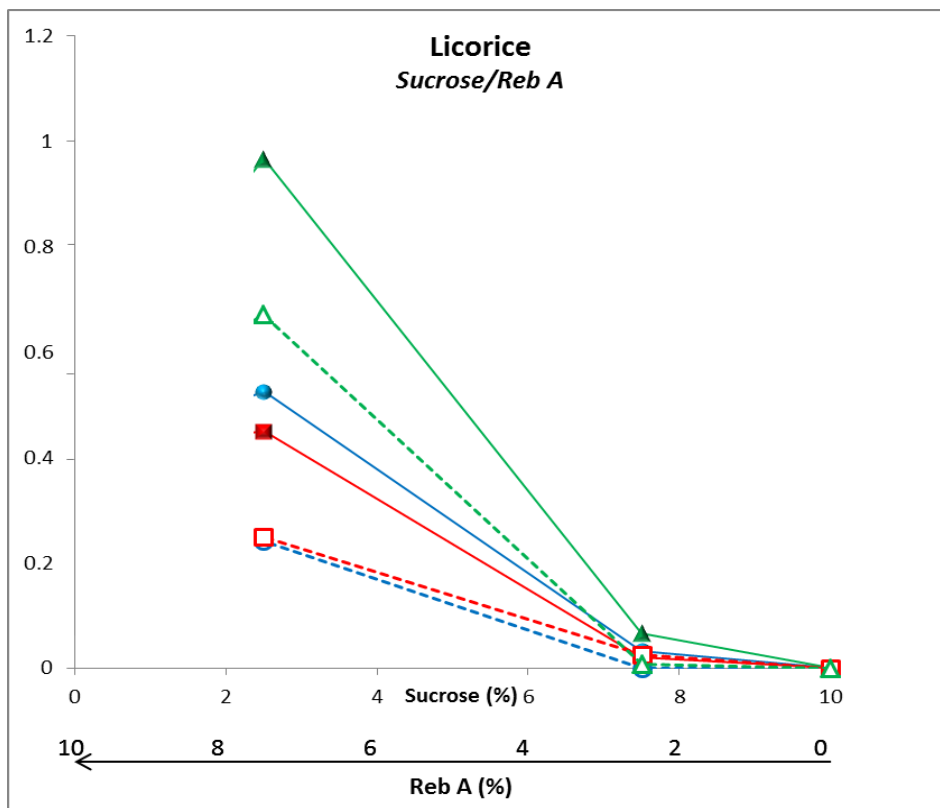
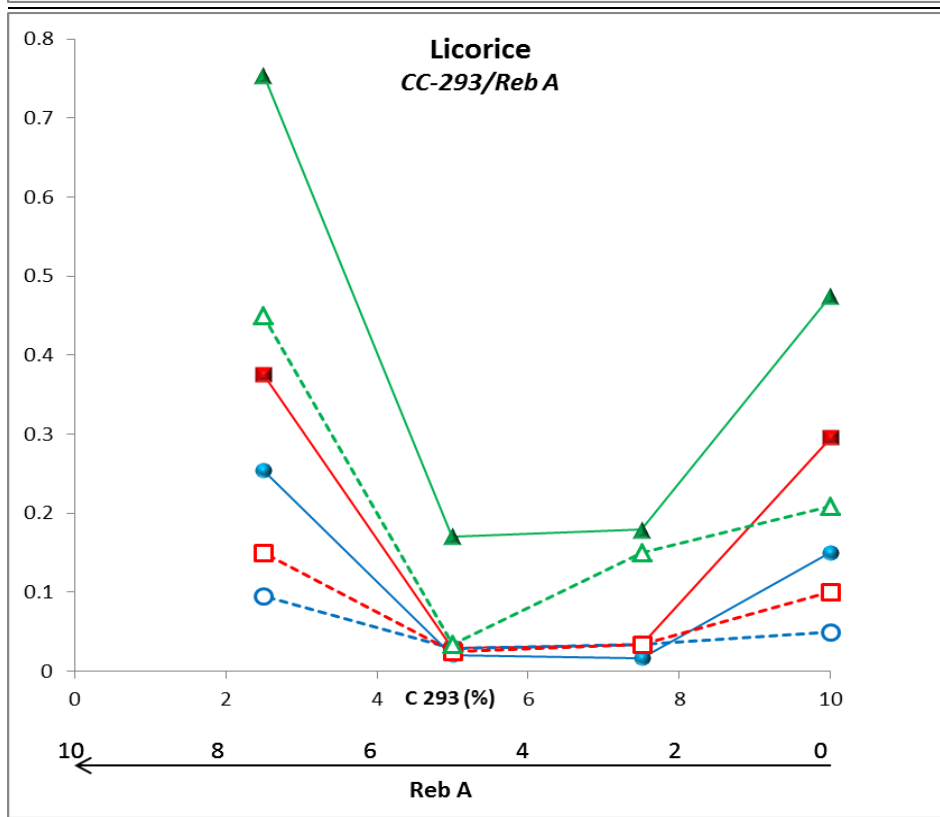
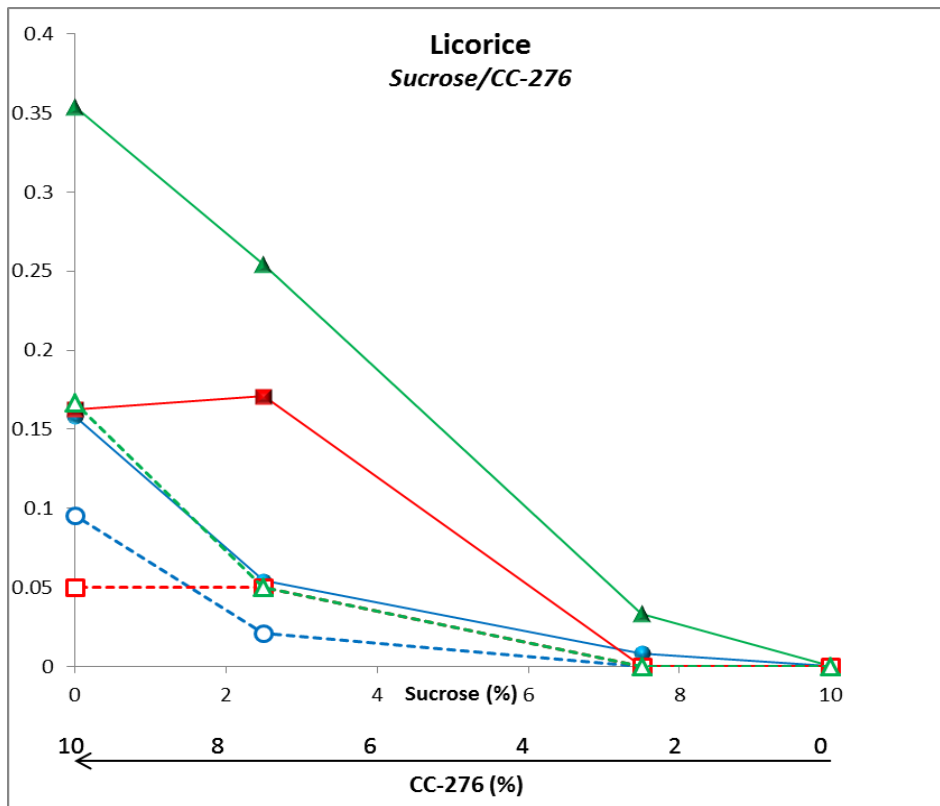
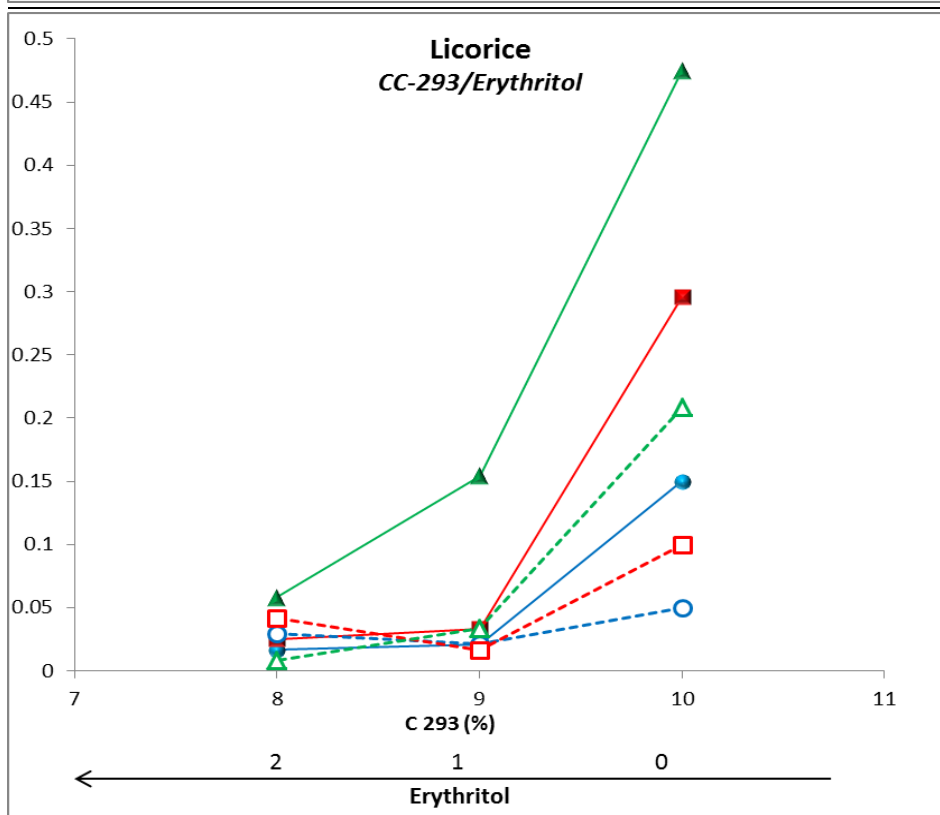
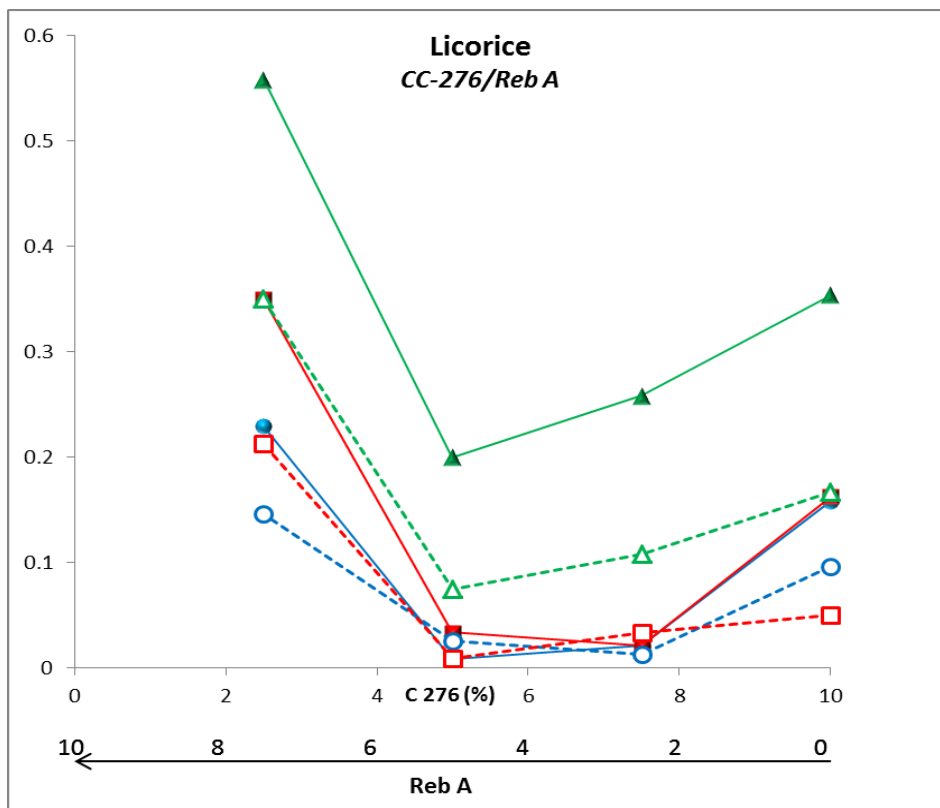


Figure 29: Mean intensities of sweetness linger across matrices for each blend examined.







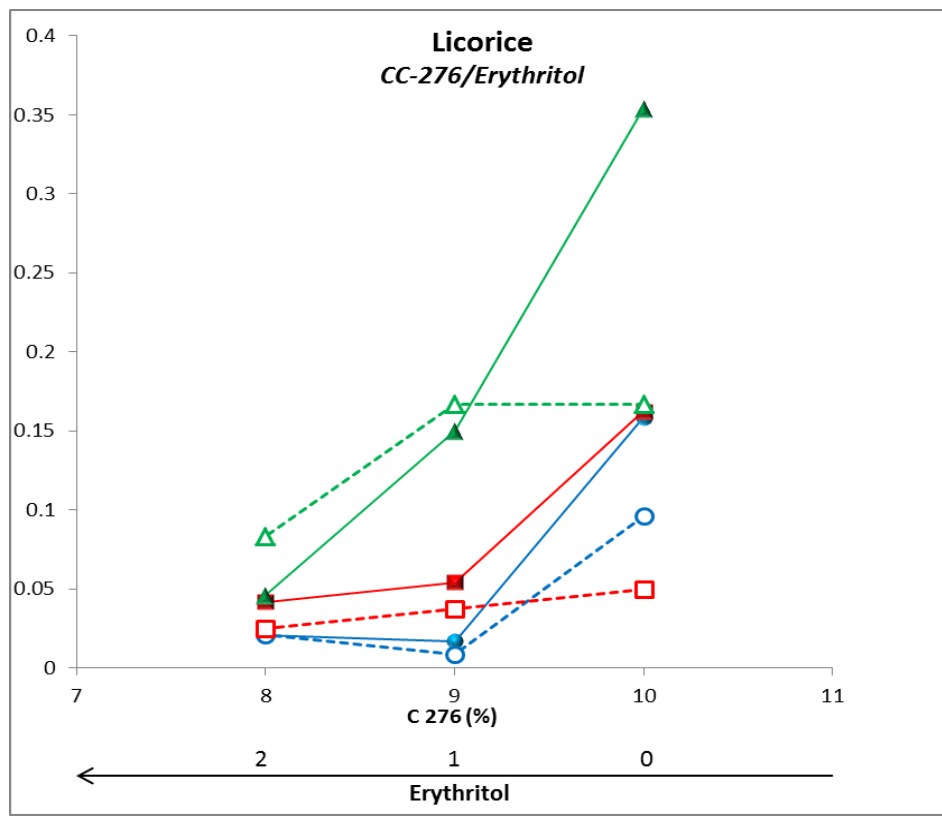
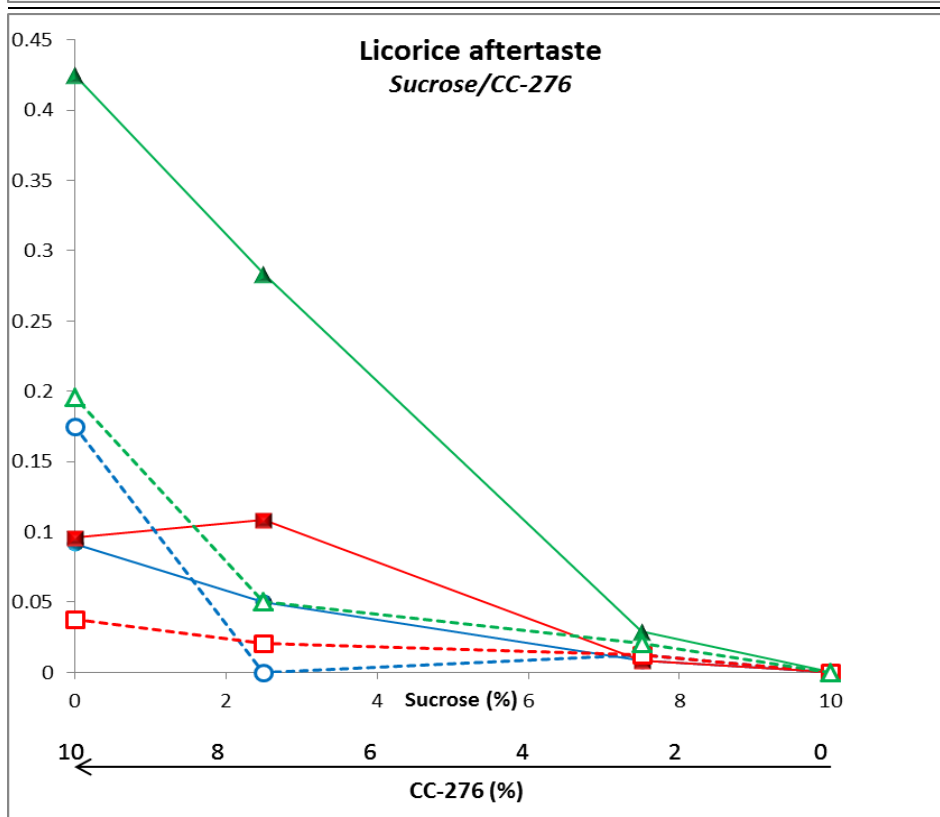
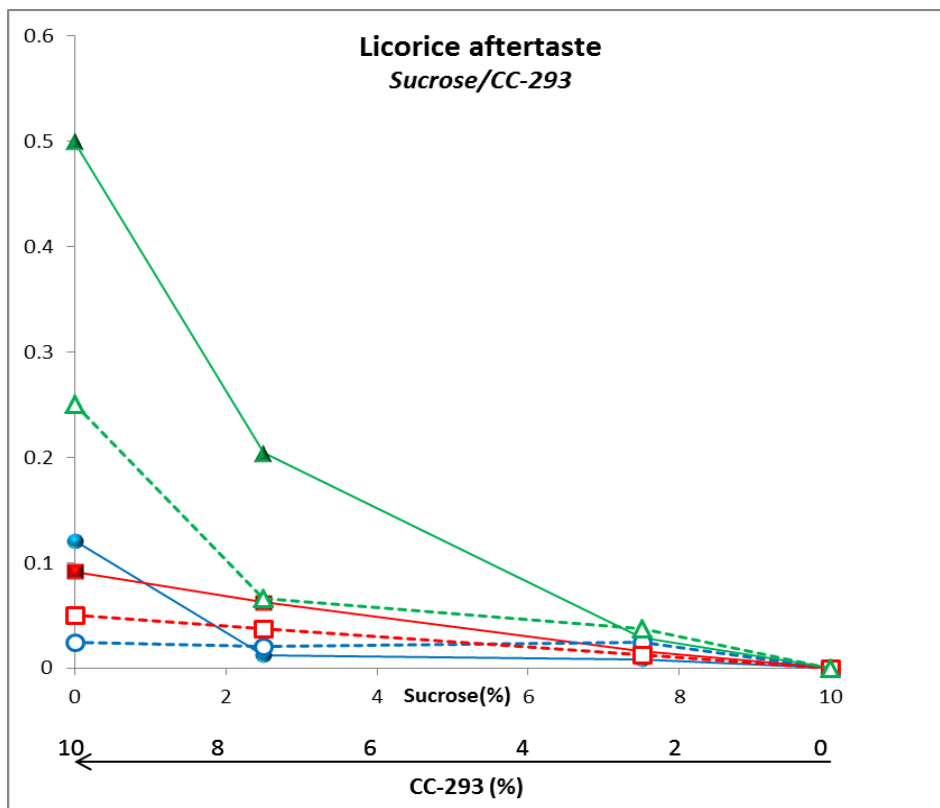
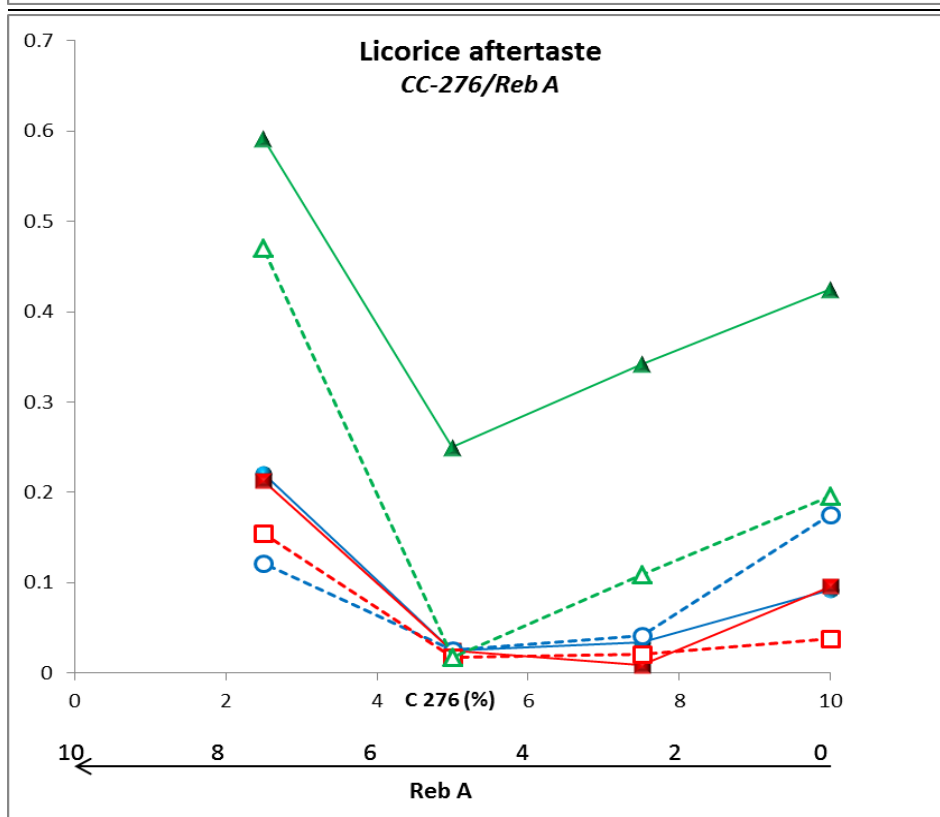
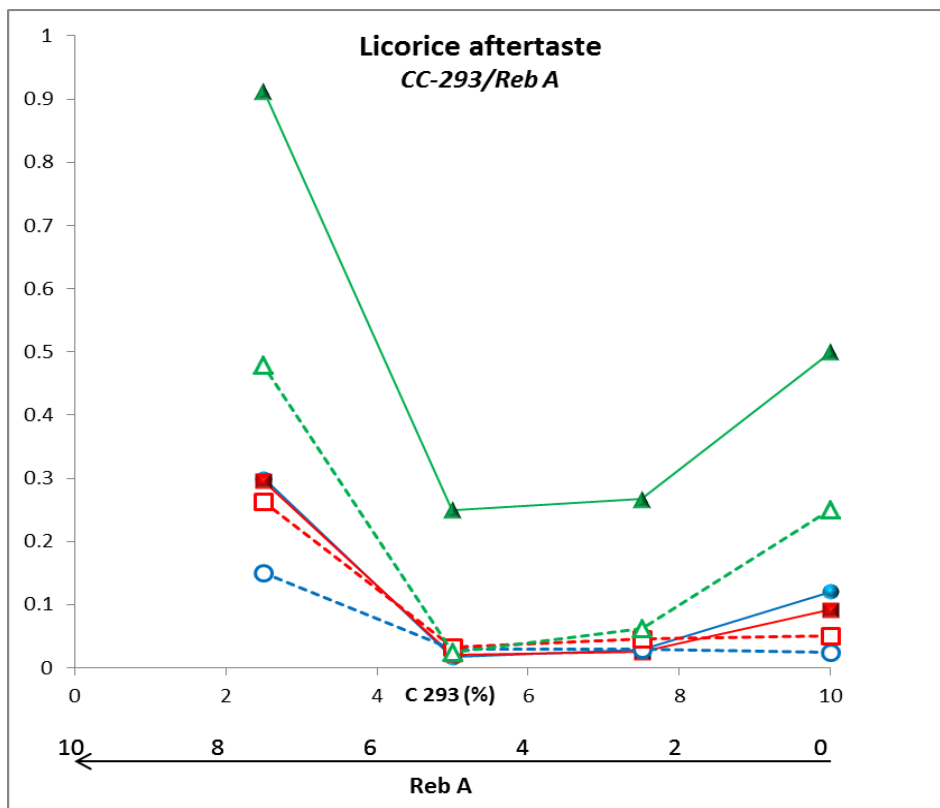


Figure 30: Mean intensities of licorice across matrices for each blend examined.





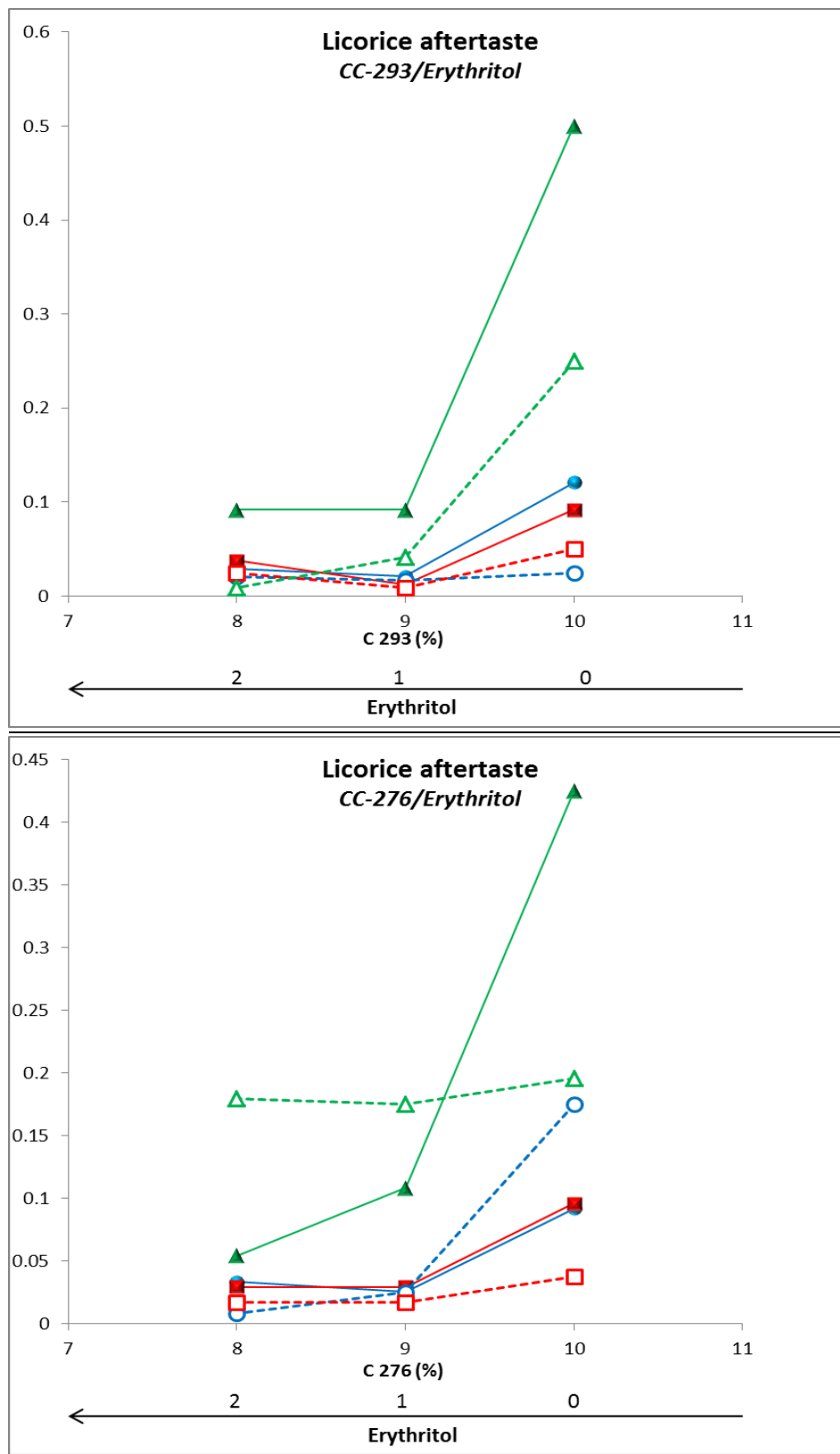


Figure 31: Mean intensities of licorice aftertaste across matrices for each blend examined.