

Comparative Sweetener Analysis



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Table of Contents

Overview Section	4	Environmental Impact	11
Summary of Agave Syrup Study	4	Water	11
Sensory Analysis	5	Waste	11
Summary Statement	5	Carbon	11
Appearance	5		
Aroma	5	Cost Comparison	13
Flavor	5	Key Takeaway	14
Aftertaste	5		
		Results Conclusions	15
Nutritional Paneling	8	Sensory	15
Summary Statement	8	Nutrient	15
		Fructan	15
Fructan Analysis	9	HFCS	15
Summary Statement	9	Environmental	16
		Cost	16
HFCS Company	10		
Composition	10	Glossary & Descriptive Lexicon	17
Glycemic Index (GI)	10		



Overview

Summary of Agave Syrup Study

This study has been organized and conducted to compare two of the leading commercially available agave syrup ingredient products on the market alongside the PhytoTeq™ agave syrup in order to provide qualitative as well as quantitative understanding of the differences between the ingredients.

Products: Samples were stored and evaluated at room temperature. Approximately 1 ounce was portioned out into 2-ounce soufflé cups with lids, labeled with 3-digit blinding codes.

- » Syrup 1 PhytoTeq™ Agave Syrup 78% Concentration
- » Syrup 2 Nectave Agave Syrup 79% Concentration
- » Syrup 3 ADM Agave Syrup 80% Concentration

Sensory Analysis

Objective: This analysis was conducted to define the appearance, aroma, flavor, texture, and aftertaste of of PhytoTeq™ Agave Syrup compared to two competitor samples to understand how they are similar and different.

Test Administered: Descriptive Analysis – Spectrum™ Methodology

- » **Panelists:** 8 panelists evaluated the samples in duplicate on 30 appearance, aroma, flavor, texture, and aftertaste attributes using Spectrum™ Methodology. See Table 2 for the attributes and definitions.
- » **Test Design:** Samples were randomized across the panelists and presented one at a time. RedJade® software was used for data collection. Data analyzed at 95% confidence level using Duncan’s post hoc analysis.

Summary Statement

Overall, the three samples were different in appearance, aroma, flavor, and aftertaste. Syrup 1 was the most opaque or cloudy in appearance. It had the most Honey flavor and aftertaste and was lower in the more unpleasant attributes, like Malt and Burnt Sugar. The Honey attribute is associated with 2-Acetylfuran and Burnt Sugar is associated with Furfural and Methyl Furan. Syrup 2 was the highest in Honey Aroma. It was also higher than Syrup 1 in Malt Aromatic and Burnt Sugar. Syrup 3 was also higher in Malt Aromatic and Burnt Sugar, but was not as high as Sample 2 in Honey Aroma.

Appearance

- » All three samples were Yellow in Color.
- » Syrup 1 was significantly higher in Opacity (more opaque) compared to Syrup 2 and Syrup 3.

Aroma

- » Syrup 2 was significantly higher than Syrup 3 in Total Aroma Intensity, Sweet Aromatic Complex Aroma, and Honey Aroma. Syrup 1 was at parity with both Syrup 2 and Syrup 3 in these attributes.
- » Syrup 1 had a statistically significant 2.6 Honey Aroma contrasted to 1.7 and 1.4 respectively for Syrup 2 and Syrup 3.
- » Conversely for Burnt Sugar, Syrup 1 demonstrated a significantly lower .8 results compared to 1.1 for both Syrup 2 and Syrup 3.
- » The Syrup 1 presented a 3.3 Positive Aroma Index contrasted to 1.5 and 1.3 for Syrup 2 and Syrup 3.

Flavor

In Malt Aromatic, Syrup 2 and Syrup 3 were significantly higher than Syrup 1. Syrup 1 was significantly higher than Syrup 2 and Syrup 3 in Honey and significantly lower than Syrup 2 and Syrup 3 in Burnt Sugar.

Aftertaste

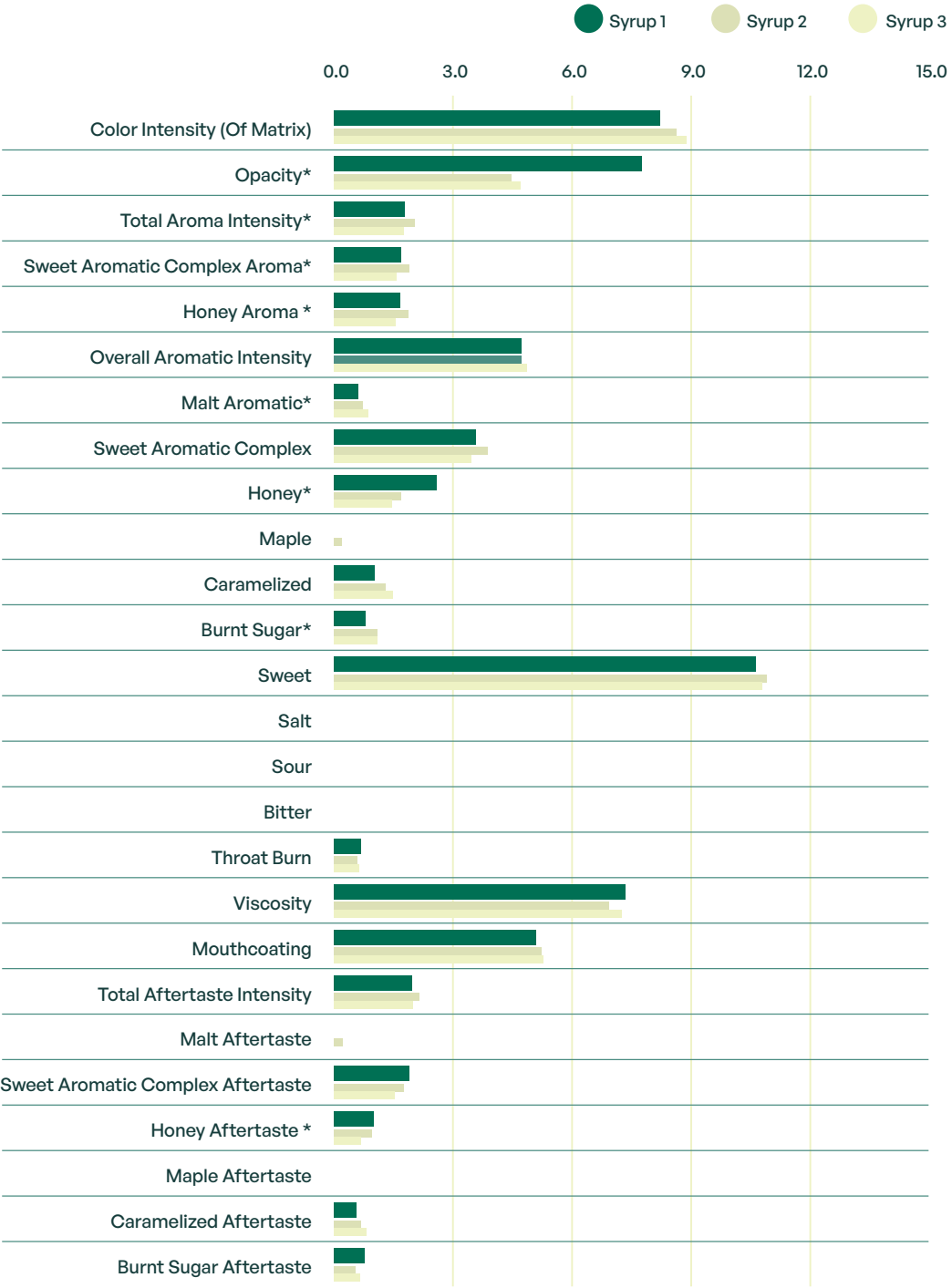
Syrup 1 and Syrup 2 were significantly higher than Syrup 3 in Honey Aftertaste.

TABLE 1: RESULTS MEAN SUMMARY

Agave Syrup						
N=8 Panelists, 2 Reps						
Appearance Attributes	Syrup 1		Syrup 2		Syrup 3	
Color (of Matrix)	Yellow		Yellow		Yellow	
Color Intensity (of Matrix)	8.3	a	8.7	a	8.9	a
Opacity	7.8	a	4.5	b	4.8	b
Aroma Attributes						
Total Aroma Intensity	1.8	ab	2.0	a	1.7	b
Sweet Aromatic Complex Aroma	1.7	ab	1.9	a	1.6	b
Honey Aroma	1.7	ab	1.9	a	1.6	b
Other Aromas	0.00		0.00		0.00	
Aromatic Attributes						
Overall Aromatic Intensity	4.8	a	4.8	a	4.9	a
Malt Aromatic	0.6	b	0.7	a	0.8	a
Sweet Aromatic Complex	3.6	a	3.9	a	3.5	a
Honey	2.6	a	1.7	b	1.4	b
Maple	0.0	a	0.0	a	0.0	a
Caramelized	1.0	a	1.3	a	1.5	a
Burnt Sugar	0.8	b	1.1	a	1.1	a
Other Aromatics	0.00		0.00		0.00	
Basic Taste & Feeling Factor Attributes						
Sweet	10.8	a	10.9	a	10.9	a
Salt	0.0	a	0.0	a	0.0	a
Sour	0.0	a	0.0	a	0.0	a
Bitter	0.0	a	0.0	a	0.0	a
Throat Burn	0.5	a	0.6	a	0.6	a
Texture & Residual Attributes						
Viscosity	7.4	a	7.0	a	7.3	s
Mouthcoating	5.2	a	5.3	a	5.3	a
Aftertaste Attributes						
Total Aftertaste Intensity	2.0	a	2.1	a	2.1	a
Malt Aftertaste	0.0	a	0.1	a	0.0	a
Sweet Aromatic Complex Aftertaste	1.9	a	1.8	a	1.7	a
Honey Aftertaste	1.0	a	1.0	a	0.7	b
Maple Aftertaste	0.0	a	0.0	a	0.0	a
Caramelized Aftertaste	0.6	a	0.7	a	0.6	a
Burnt Sugar Aftertaste	0.8	a	0.6	a	0.8	a
Other Aftertastes	0.0	a	0.0	a	0.0	a

*Attribute means that do not share a letter are significantly different. Attributes that are highlighted are significantly different (p<0.05).

GRAPH 1: AGAVE SYRUP - DESCRIPTIVE ATTRIBUTES GRAPH



*Indicates significantly different attribute

Nutritional *Paneling*

Objective: The three syrups under comparative review underwent nutritional panel analysis to provide a detailed breakdown of the nutrient composition of the ingredient products in order to define the similarities and/or variances between the two commercially available agave syrups and the proposed PhytoTeq™ syrup market entrant.

The **nutritional panel** in food ingredient labs serves as a comprehensive tool for compliance, product development, consumer information, and health marketing. It ensures transparency in food labeling, supports the formulation of healthier food products, and aids in maintaining quality control standards throughout the food manufacturing process.

Analysis Administered: All analysis was conducted by a single registered third-party mirco-biological and chemical laboratory utilizing accepted USDA Nutritional Analysis Methods in conformance with AOAC sections; 950.46, 920.144, 992.15, 996.06, 920.39, 922.06, 977.20, 982.14, and AACC Method AACC 32 07

Summary Statement

Overall, the three samples were statistically similar in nutritional profile, with exception of Syrup 2 having residual Iron as well as increased amounts of Sodium.

Syrup 1:
PhytoTeq

Nutrition Facts	
Serving size	(100g)
Amount per serving	
Calories	310
% Daily Value *	
Total Fat 0g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 0mg	0%
Total Carbohydrate 78g	28%
Dietary Fiber 0g	0%
Total Sugars 71g	
Includes 0g Added Sugars	0%
Protein 0g	
Vitamin D 0mcg	0%
Calcium 0mg	0%
Iron 0mg	0%
Potassium 0mg	0%
* The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.	

Syrup 2:
Nectave

Nutrition Facts	
Serving size	(100g)
Amount per serving	
Calories	320
% Daily Value *	
Total Fat 0g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 15mg	1%
Total Carbohydrate 79g	29%
Dietary Fiber 0g	0%
Total Sugars 79g	
Includes 0g Added Sugars	0%
Protein 0g	
Vitamin D 0mcg	0%
Calcium 2mg	0%
Iron 0mg	2%
Potassium 3mg	0%
* The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.	

Syrup 3:
ADM

Nutrition Facts	
Serving size	(100g)
Amount per serving	
Calories	320
% Daily Value *	
Total Fat 0g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 0mg	0%
Total Carbohydrate 80g	29%
Dietary Fiber 0g	0%
Total Sugars 79g	
Includes 0g Added Sugars	0%
Protein 0g	
Vitamin D 0mcg	0%
Calcium 1mg	0%
Iron 0mg	0%
Potassium 0mg	0%
* The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.	

Fructan *Analysis*

Objective: This analysis was conducted to confirm the Fructan conversion of the PhytoTeq™ Agave Sugars.

Test Administered: Fructans were quantified using an HPLC equipped with an RI detector. AOAC 997.08 is the method used for this assay.

Test Design: Samples were tested in triplicate for precision.

Summary Statement

Test Results confirmed that the PhytoTeq™ Sugars achieved a 98.4% Fructan conversion.



HFCS

Company

PhytoTeq™ Agave Syrup was found to be comparable or modestly superior in all notable characteristics of market(s) requirements.

Product Per 100 G	PHYTO	NECTAVE	ADM	HFCS 42	HFCS 55
Total Sugar G	71	79	79	70	70
Fructose G	60	73	73	42	55
Glucose G	11	6	6	28	15
Fructose %	84.5%	92.4%	92.4%	60.0%	78.6%
Calories	310	320	320	400	400
Glycemic Index	31	22	25	65	70

Composition

- » **Agave Syrup:** Contained a high percent-
age of fructose (60–73%), with some
glucose.
- » **HFCS:** Contains varying ratios of fruc-
tose and glucose, commonly 42% fruc-
tose (HFCS-42) or 55% fructose (HFCS-
55).

Glycemic Index (GI)

- » **Agave Syrup:** Contained a lower glyce-
mic index (between 22–31), meaning it
causes a slower rise in blood sugar. This is
due to its high fructose content.
- » **HFCS:** Medium to high glycemic index
(65–70), depending on the glucose-fruc-
tose ratio, causing a more significant
blood sugar spike.

Sweetener Equivalence: PhytoTeq™ Agave Syrup and Different Grades of HFCS

To calculate the dilutions needed to achieve similar relative sweetness between HFCS 42, HFCS 55, and PhytoTeq™ Agave Syrup we will be using the Sweetness Index Values shown in Table 1. We will also assume that all syrups have the same total sugar and moisture content. This will allow us to make a calculation of relative sweetness to be used for a theoretical dilution.

Table 1. Relative Sweetness of Sugar Syrups. Relative Sweetness is used to compare sweetness with sucrose as the baseline (Sucrose = 1). Agave syrup has the highest relative sweetness at 1.5. This is 50% higher than HFCS 42 (1) and 36.36% higher than HFCS 55 (1.1).

Sugar Syrup	Relative Sensory Sweetness
HFCS 42	1
HFCS 55	1.1
PhytoTeq™ Agave Syrup	1.5

This means to achieve a similar relative sensory sweetness to HFCS less agave syrup is required. The amount of PhytoTeq™ Agave Syrup required to match relative sensory sweetness of both HFCS 42 and HFCS 55 is summarized in Table 2.

Table 2. Relative Sweetness Comparison and Agave Syrup Requirement. This table provides the required amount of Agave Syrup to achieve the same as both HFCS 42 and HFCS 55. According to the values if a recipe called for 1L of HFCS 42, 667mL of agave syrup can be used to achieve the same sweetness as both. For 1L of HFCS 55, 733mL of agave syrup would be required.

HFCS Type	Relative Sweetness	Agave Syrup Sweetness	Agave Syrup Required
HFCS	1	1.5	66.67%
HFCS 55	1.1	1.5	73.33%

These relative sweetness predictions are most accurate when comparing syrup sweetness. If used in complex food matrices, adjustments may be necessary to account for additional sensory interactions.

Environmental Impact

The overall environmental footprint of the PhytoTeq™ product is extraordinary. All current sweetener products are environmentally unsustainable. HFCS and Tequila notably produce very high volumes of organic and chemical liquid waste that are pernicious and difficult to remediate. HFCS also consumes an extraordinary level of electric per Kg of product output.

CURRENT ENVIRONMENTAL EFFECT

	Carbon Capture (Kg)	Water Use (L)	Liquid Waste (L)	Solid Waste (Kg)	Electric (Kw)
Agave Syrup					
Current Output	1.68	13.40	0.02	3.30	1.44
High Fructose Corn Syrup (HFCS)					
Current Output	0.42	1.11	2.50	0.94	462.02
Tequila					
Current Output	1.32	13.5	12.4	5.5	1.80

Water

The PhytoTeq™ process uses milliliters of water vs gallons. A saving of >90% is a minimum versus comparable current production methodologies.

Waste

The PhytoTeq™ process produces no solid waste and only limited quantities of non-harmful, Ph neutral liquid waste, which contains no solids or additional chemicals.

Carbon

Internal carbon Intensity analysis calculates the PhytoTeq™ process with a revolutionary CI score below 20. The PhytoTeq™ process replicates Photosynthesis (sp) and consumes CO2, providing a net-positive ingredient manufacturing solution.

PHYTOTEQ™ ENVIRONMENTAL IMPACT

The below graphic illustrates the improvement variances by industry as a result of PhytoTeq™ implementation

	Carbon Footprint (Kg)	Water Use (L)	Liquid Waste (L)	Solid Waste (Kg)	Electric (Kw)
Agave Syrup					
Industry Use	1.68	13.4	6.7	3.3	1.44
Phyto Use	-1.17	0.26	0.26	0	1.17
Net	-2.85	-13.12	-6.44	-3.30	-0.27
Variance	-169.8%	-98.1%	-96.1%	-100.0%	-18.7%
High Fructose Corn Syrup (HFCS)					
Industry Use	0.42	1,110	2.5	0.943	462.2
Phyto Use	-1.17	0.26	0.26	0	1.17
Net	-1.59	-1109.75	-2.24	-0.94	-461.0
Variance	-279.3%	-100.0%	-89.6%	-100.0%	-99.7%
Tequila					
Industry Use	1.32	13.5	12.4	5.5	1.80
Phyto Use	-1.17	0.26	0.26	0	1.17
Net	-2.49	-13.25	-12.14	-5.50	-0.63
Variance	-88.9%	-98.1%	-97.9%	-100%	-34.8%

Cost Comparison

PhytoTeq™ Agave Syrups offer a savings of 37% compared to current High Fructose Corn Syrup, a 78% savings from current Agave Syrup; and 89% for ATWB Tequila.

COMPARING COSTS

	Economic
Agave Syrup	\$USD / Liter
Current Cost	\$3.25
Phyto Cost	\$0.73
Net	-\$2.52
Variance (savings)	-78%
High Fructose Corn Syrup (HFCS)	
Current Cost	\$1.37
Phyto Cost	\$0.73
Net	-\$0.64
Variance (savings)	-47%
Tequila	
Current Cost	\$3.11
Phyto Cost	\$0.34
Net	-\$2.77
Variance (savings)	-89%

Key Takeaway

Both sweeteners should be consumed in moderation. While Agave Syrup may have a lower glycemic index, its high fructose content poses similar risks to HFCS regarding liver and metabolic health. HFCS is more associated with processed foods and a higher glycemic response. Agave Syrup may be preferable for those seeking a lower glycemic sweetener, but it is not necessarily “healthier” if overused.



Results

Conclusions



Sensory

Overall, the three samples were different in appearance, aroma, flavor, and aftertaste.

- » **Syrup 1** was the most opaque or cloudy in appearance. It had the most Honey flavor and aftertaste and was lower in the more unpleasant attributes, like Malt and Burnt Sugar.
- » **Syrup 2** was the highest in Honey Aroma. It was also higher than Syrup 1 in Malt Aromatic and Burnt Sugar.
- » **Syrup 3** was also higher in Malt Aromatic and Burnt Sugar, but was not as high as Sample 2 in Honey Aroma.



Nutrient

Overall, the three samples were statistically similar in nutritional profile, with exception of Syrup #2 having residual Iron as well as increased amounts of Sodium.



Fructan

Test Results confirmed that the PhytoTeq™ Sugars achieved a 98.4% Fructan conversion.



HFCS

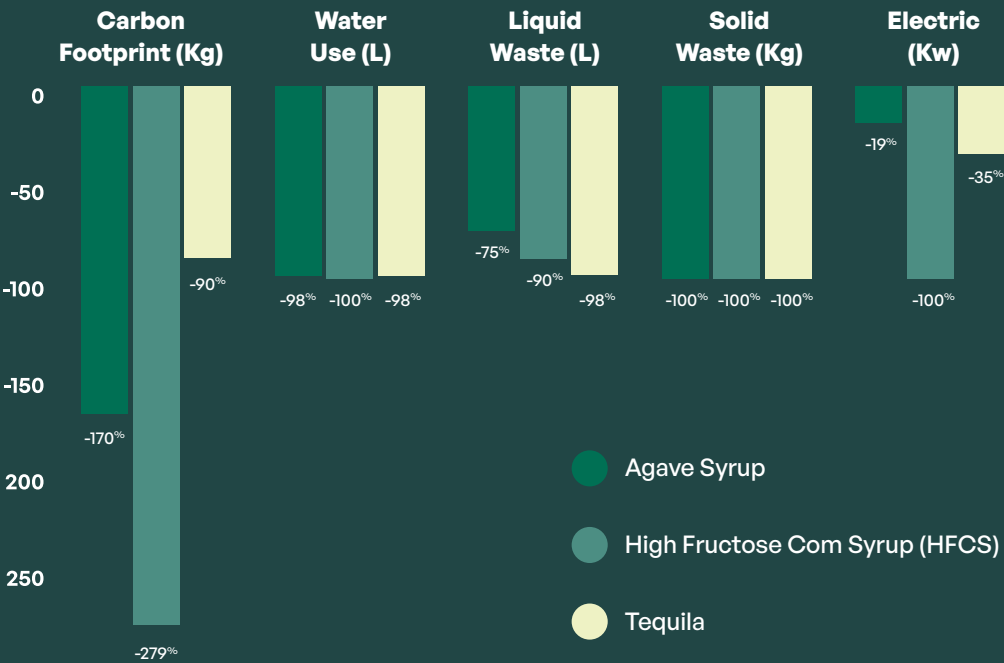
PhytoTeq™ Agave Syrup was found to be comparable or modestly superior in all notable characteristics of market(s) requirements.



Environmental

IMPROVED ENVIRONMENTAL IMPACT OF PHYTOTEQ™

Net savings and % improvement



Cost

PhytoTeq™ Agave Syrups offer a savings of 47% compared to current High Fructose Corn Syrup, a 78% savings from current Agave Syrup; and 89% for ATWB Tequila.

Glossary & *Descriptive Lexicon*

Appearance	Definitions
Color (Of Matrix)	The actual color name, such as red, blue, etc.
Color Intensity (of Matrix)	The intensity or strength of the color from light to dark.
Opacity	The degree to which light passes through the sample. Not Opaque Opaque
Aroma Attributes	Definitions
Total Aroma Intensity	The total portion of aroma that is perceived by the sense of smell from a substance by nose.
Sweet Aromatic Complex Aroma	The aromas associated with products which also taste sweet such as honey, caramelized sugar, maple syrup, brown sugar, and vanilla.
Honey Aroma	The sweet, caramelized floral and woody aroma associated with honey.
Aromatic Attributes	Definitions
Overall Aromatic Intensity	The total portion of flavor that is perceived by the sense of smell from a substance in the mouth.
Malt Aromatic	The sweet and nutty aromatic reminiscent of grains soaked in water.
Sweet Aromatic Complex	The aromatics associated with products which also smell sweet such as honey, caramelized sugar, maple syrup, brown sugar, and vanilla.
Honey	The sweet, caramelized floral and woody aromatic associated with honey.
Maple	A woody, sweet, caramelized, brown aromatic associated with maple syrup.
Caramelized	The aromatics associated with sugars and or carbohydrates which have been heated to the point of being browned or caramelized.
Burnt Sugar	Aromatic associated With blackened or burnt sugars.
Basic Taste Attributes	Definitions
Sweet	The taste on the tongue stimulated by sucrose and other sugars, such as fructose, glucose, etc., and by other sweet substances, such as saccharin, Aspartame and Acesulfame-K.
Salt	The taste on the tongue stimulated by sodium salts, such as sodium chloride and sodium glutamate, and in part by other salts, such as potassium chloride.
Sour	The taste on the tongue stimulated by acids, such as citric, malic, phosphoric, etc.
Bitter	The taste on the tongue stimulated by substances such as quinine, caffeine and hop bitters.
Feeling Factors	Definitions
Throat Burn	The burning of your throat.

Texture Attributes	Definitions & Techniques
Viscosity	The rate of flow per unit force: The force to draw between lips from spoon & the rate of flow across tongue. Not viscous Very viscous 1) place 1 tsp. of product close to lips; draw air in gently to induce flow of liquid; measure the force required. 2) Once product is in mouth, allow to flow across tongue by moving tongue slowly to roof of mouth; measure rate of flow (the force here is gravity).
Residual Atributes	Definitions & Techniques
Mouthcoating	The amount of film left on the mouth surfaces. None High Swallow or expectorate
Aftertaste Attributes	Definitions
Total Aftertaste Intensity	The total portion of flavor that is perceived by the sense of smell from a substance in the mouth. Score 30 seconds after swallowing/expectorating. Score 30 seconds after swallowing/expectorating.
Malt Aftertaste	The sweet and nutty aftertaste aromatic reminiscent of grains soaked in water. Score 30 seconds after swallowing/expectorating.
Sweet Aromatic Complex Aftertaste	The aftertaste associated With products which also smell sweet such as honey, caramelized sugar, maple syrup, brown sugar, and vanilla. Score 30 seconds after swallowing/expectorating.
Honey Aftertaste	The sweet, caramelized floral and woody aftertaste associated With honey. Score 30 seconds after swallowing/expectorating.
Maple Aftertaste	A woody, Sweet, caramelized, brown aromatic associated with maple syrup. Score 30 seconds after swallowing/expectorating.
Caramelized Aftertaste	The aftertaste associated With sugars and or carbohydrates which have been heated to the point of being browned or caramelized. Score 30 seconds after swallowing/expectorating. Score 30 seconds after swallowing/expectorating.
Burnt Sugar Aftertaste	Aftertaste associated with blackened or burnt sugars.

Flavor intensities are evaluated on a universal scale, in which panelists take consideration of all products and intensities they have experienced. References used for universal scale are listed in the table below:

Aromatics 2.0	Wesson Vegetable Oil
Cooked Apple 5.0	Motts Original Applesauce
Orange Complex 7.5	Minute Maid Frozen Orange Juice from Concentrate
Grape 10.0	Welch’s Concord Grape
Cinnamon 12.0	Big Red Cinnamon Gum



PhytoTeq

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delivers a *consistent*
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