



Agave Fermentation and Flavor

Ilya Soroka & Emily Del Bel

Hello!

I am Ilya Soroka



Ilya Soroka: Midwest region sales manager and BSG Distilling since 2015.

Reach me at: isoroka@bsgcraft.com

or (414)732-7382

Hello!

I am Emily Del Bel



Emily Del Bel: leads the sensory program at the Rahr Technical Center. She has both a B.S. and M.S. in food science and has worked in the sensory industry for 8 years. She designed and executed the sensory portion of this project, collecting, analyzing and reporting all data below.

Hello!

Project Leadership by:



Pattie Aron PhD: currently conducts research and development on brewing, wine, and distilling raw materials and manages the technical research and brewing laboratories in the Brewing Research and Innovation group at the Shakopee, MN headquarters.

Agave: The Project

Goals and Scope

- Goal: Explore the impact yeast choice and starting gravity on the fermentation, yield and sensory outcomes of agave ferments.
- Scope: Undertake agave ferments with four yeast strains at two starting gravities each. Evaluate yields and flavor produced.

Distillation

Fermentation

Sensory



Hello!

**Fermentation, Distillation,
Data collection and Reporting
were performed by:**



Ben Stanwood: Fermentation Scientist
at the Rahr Technical Center.

This project could not have been done
without him. Thank you, Ben!

Agave: Ingredients

Premium Agave Syrup

Blue Agave Nectar

<https://bsgdistilling.com/premium-agave-syrup-1380-kg>

<i>Parameter *</i>	<i>BG</i>	<i>Specification</i>	<i>Reference</i>
° BRIX	74° - 76°	74° MIN	NMX-FF-110-SCFI-2008 AGAVE SYRUP
MOISTURE	24 - 26%	-	-
pH	4 - 6	4 - 6	NMX-FF-110-SCFI-2008 AGAVE SYRUP
ASH	0.5% MAX	0.5% MAX	NMX-FF-110-SCFI-2008 AGAVE SYRUP
HYDROXYMETIL FURFURAL (HMF)	40 mg/kg MAX	40 mg/kg MAX	NMX-FF-110-SCFI-2008 AGAVE SYRUP
FRUCTOSE	84% MIN	80% MIN	NMX-FF-110-SCFI-2008 AGAVE SYRUP
DEXTROSE	13% MAX	15% MAX	NMX-FF-110-SCFI-2008 AGAVE SYRUP
SUCROSE	2% MAX	4% MAX	NMX-FF-110-SCFI-2008 AGAVE SYRUP
MANNITOL	0.5% MAX	0.5% MAX	NMX-FF-110-SCFI-2008 AGAVE SYRUP
INULIN	0.5 - 1.5%	0.5% MIN	NMX-FF-110-SCFI-2008 AGAVE SYRUP
OTHER CARBOHYDRATES	2% MAX	2% MAX	-
TOTAL CARBOHYDRATES	98% MIN	98% MIN	-
TOTAL BACTERIAL COUNT	100 UFC/g MAX		NOM 092-SSA1-1994 / NMX-FF-110-SCFI-2008
MOLD	10 UFC/g MAX		NOM-111 SSA1-1994 / NMX-FF-110-SCFI-2008
YEAST	10 UFC/g MAX		NOM-111-SSA1-1994 / NMX-FF-110-SCFI-2008
COLIFORMS	NEGATIVE		NOM 112-SSA1-1994 / NMX-FF-110-SCFI-2008
SALMONELLA	NEGATIVE in 25 g		NOM-114-SSA1-1994 / NMX-FF-110-SCFI-2008
E. COLI	NEGATIVE		NOM-113-SSA1 1994 / NMX-FF-110-SCFI-2008



Agave: Ingredients

Yeast

- ❖ Fermentis SafSpirit C70 (referred to as SS) <https://bsgdistilling.com/safspirit-c-70-500g>



- ❖ Fermentis SafTeq Blue Tequila (referred to as ST) <https://bsgdistilling.com/safteq-blue-500g>

- ❖ Pinnacle Robust (referred to as PR) <https://bsgwine.com/pinnacle-robust-500g>



- ❖ Pinnacle Fructo (referred to as PF) <https://bsgwine.com/pinnacle-fructo-500g>

Agave: Ingredients

Yeast Nutrient

- ❖ Startup <https://bsgdistilling.com/startup-20kg-sack>



- ❖ Superfood <https://bsgdistilling.com/superfood-20-kg>

- ❖ DAP <https://bsgdistilling.com/dap-25-kg>



Agave

Equipment

- ❖ Grainfather G30 Connect <https://bsghandcraft.com/grainfather-connect>
- ❖ Still Spirits Copper Dome with Alembic Condenser <https://bsghandcraft.com/pot-still-attachments>
- ❖ Grainfather Conical Fermenter Cooling Edition <https://bsghandcraft.com/grainfather-conical-fermenter-basic-cooling-edition>
- ❖ Anton Parr DMA35 Hand-held Densitometer (Starting point °Plato and temps)
- ❖ Anton Parr Alcoholyzzer (ABV, SG, ° Plato, pH, residual extract, RDF)
- ❖ Nexcelom Cellometer (Viability checks on yeast pre pitch)
- ❖ Agilent 1100 HPLC (carbohydrate information and will use for organic acids in future)
- ❖ Centrifuge (settling)
- ❖ Sonicating Water Bath (Degassing)
- ❖ Distilling Parrot
- ❖ Hydrometers - proof/tralle
- ❖ Thermometers
- ❖ Misc glassware, buckets, etc.

Agave Method/Data

Wash Preparation

- ❖ Sanitized fermenters #1-4 added 19 L of 90 C brewery water (measured by weight) and 8 Kg of agave syrup to make 22 brix wash.
- ❖ Sanitized fermenters #5-8 added 22 L of 90 C brewery water (measured by weight) and 4.2 Kg of agave syrup to make 12 brix wash.
- ❖ Adjusted final °Plato with sequential additions of approximately 2.75 L of sterile water to each fermenter. °Plato was measured with the DMA35.
- ❖ Cooled/heated each fermenter using the vessel's internal cooling band by pumping ice water through and internal heating element to get to close (within 2-3 F) to 90 °F for SS and ST yeasts. 80 °F for PR and PF yeasts.
- ❖ 90 mL samples were taken from each fermenter for analysis of the wash on the AlcoLyzer and carbohydrates by HPLC.

Fermenter	Initial °Plato	°P after 2 L add	°P after 0.5 L add	Final °P after 0.25 L add
1	23.9	22.5	22.2	21.9
2	24.0	22.6	22.1	22.1
3	24.0	22.6	22.3	22.0
4	24.1	22.4	22.2	22.0
5	13.4	12.5	12.3	12.2
6	13.2	12.4	12.3	12.1
7	13.2	12.5	12.3	12.1
8	13.3	12.6	12.4	12.1

Agave Method/Data

Yeast/Nutrient Preparation and Pitching

❖ Yeast and Nutrient Preparation

- ❖ Yeast pitch rate (per yeast spec) = 50 g / HL = 12.5 g / 25 L
- ❖ Superfood pitch rate (per current suggested dosing rate) = 400 ppm Superfood, 2/3 added at pitch, 1/3 added at 24 hours = 10 g / 25 L = 400 ppm
- ❖ Startup pitch rate (per Startup technical data sheet) = 12.5 g / 0.25 L
- ❖ 12.5 g yeast was rehydrated with 250 mL sterile RO water with 12.5 g Startup, and 6.66 g Superfood added in a 1L sterile baffled flask. Flask mixed on orbital shaker at 35 C for 15 minutes. Two sets of each of the four yeast types were prepared.

❖ Pitching

- ❖ Once yeast was prepared, contents of each flask were pitched and thoroughly stirred into their respective fermenters.
- ❖ The fermenter temperatures were set to warm to optimal fermentation temp according to manufactures recommendation.
- ❖ At 24 hours, the remaining 3.33 g of Superfood was pitched directly into the fermenters and mixed in. ST22 in #2 foamed over due to adding nutrient to fast.

Agave Method/Data

Fermentation

Fermenter	Yeast	Ferment Temp °F	Fermenter	Yeast	Ferment Temp °F
1	SS22	90	5	SS12	90
2	ST22	90	6	ST12	90
3	PR22	80	7	PR12	80
4	PF22	80	8	PF12	80

- ❖ Fermenters were checked daily to make sure they were holding temperature. #6 dropped to 84.3 overnight once but otherwise only slight variations occurred.
- ❖ Sampling - throughout the fermentation 45 mL samples were taken from each fermenter. Initially for the first 3 days, sampling was done morning and night. This was then changed to once per day (except weekends). Eventually, for the three slower 22 ferments (and due to holidays towards the end) sampling was done every 3-4 days.
- ❖ Samples were centrifuged (3000G for 10 min) to remove most yeast. Half of each sample was then degassed via sonication for 30 minutes and run on the Alcoholizer for data on: pH, plato, real degree of fermentation (RDF), residual extract (Er), specific gravity (SG) % alcohol by volume (ABV). From the second half of the sample, 1:7 to 1:1 dilutions with RO water were prepared, syringe filtered and run for carbohydrate analysis on the HPLC. The remaining sample was frozen.
- ❖ Re-pitching 22s, after 5 days it became clear that SS22, ST22, PF22 had stalled fermentations, and PR22 was slowing down. These four were repitched with 12.5 g yeast, 6.66 g Superfood, and 12.5 g Startup to each of the 22 fermenters at 141 hours. After repitching it took over 24 hours for the fermentations to pick up again. Around 28 days the four 22s were again slowing down without getting the expected attenuation. These were again repitched at 718 hours following the same amounts as the 1st repitch.

Agave Method/Data

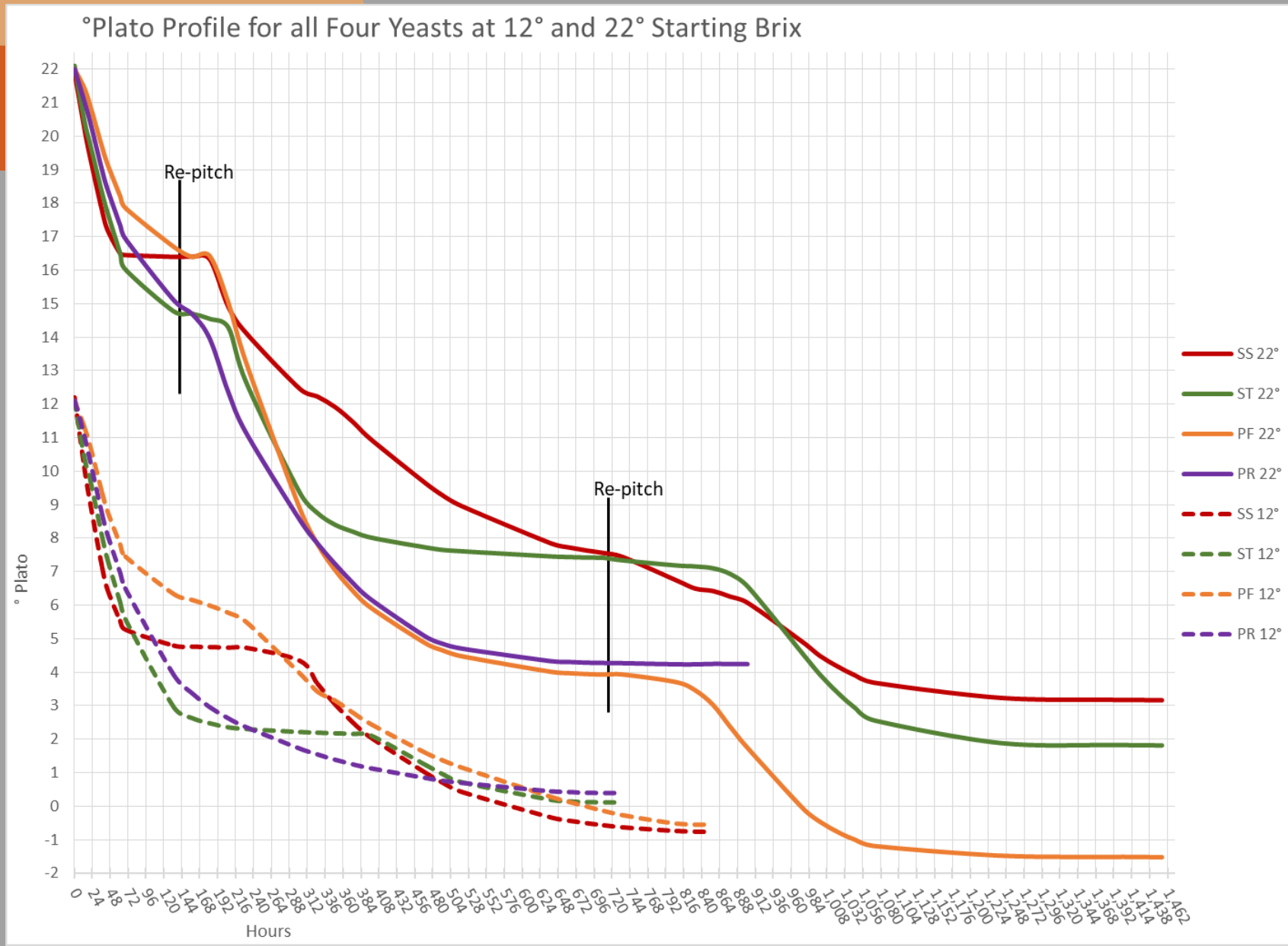
Fermentation



Agave Method/Data

Fermentation

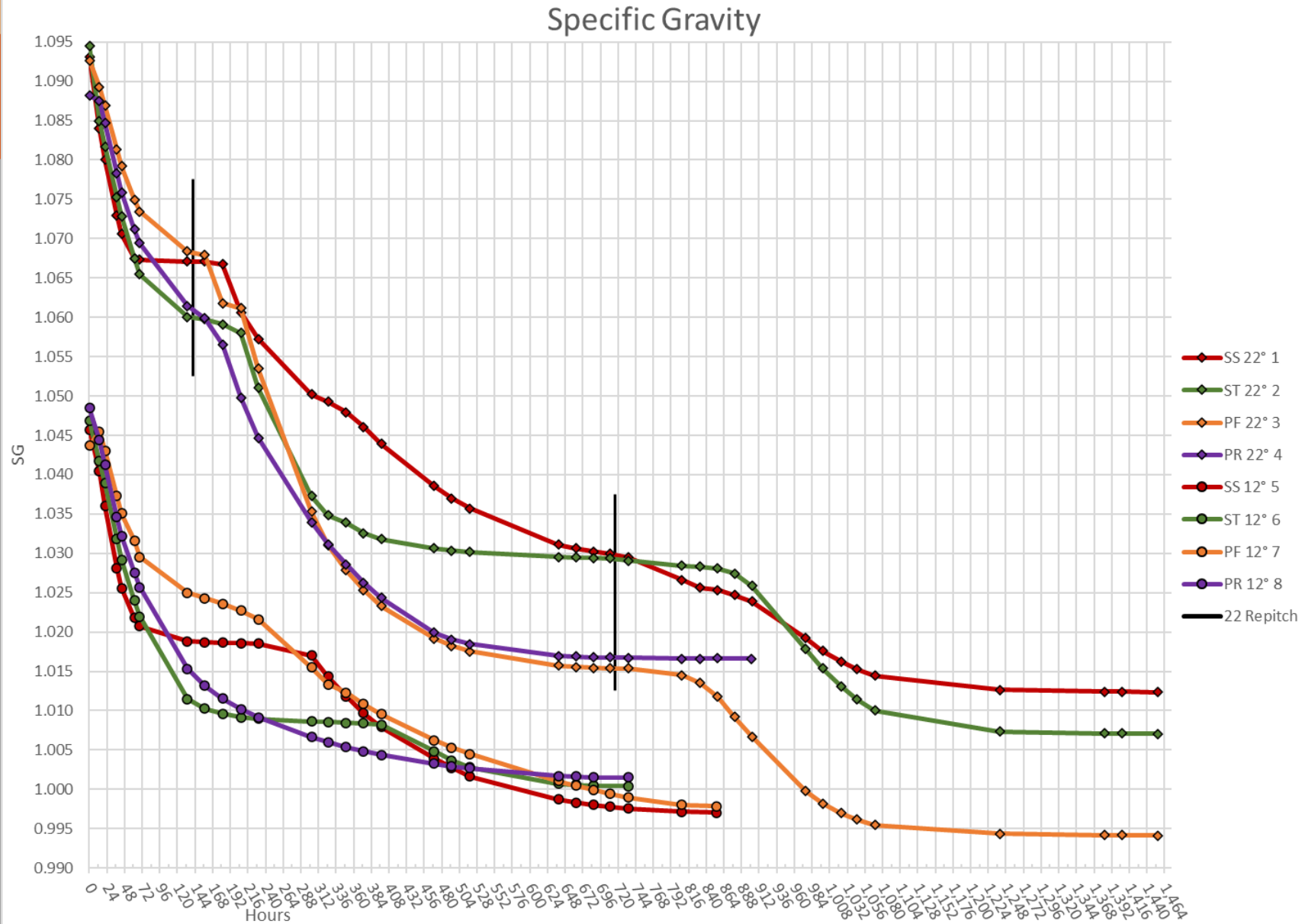
°Plato over time,
All ferments.



Agave Method/Data

Fermentation

SG over time,
All ferments.

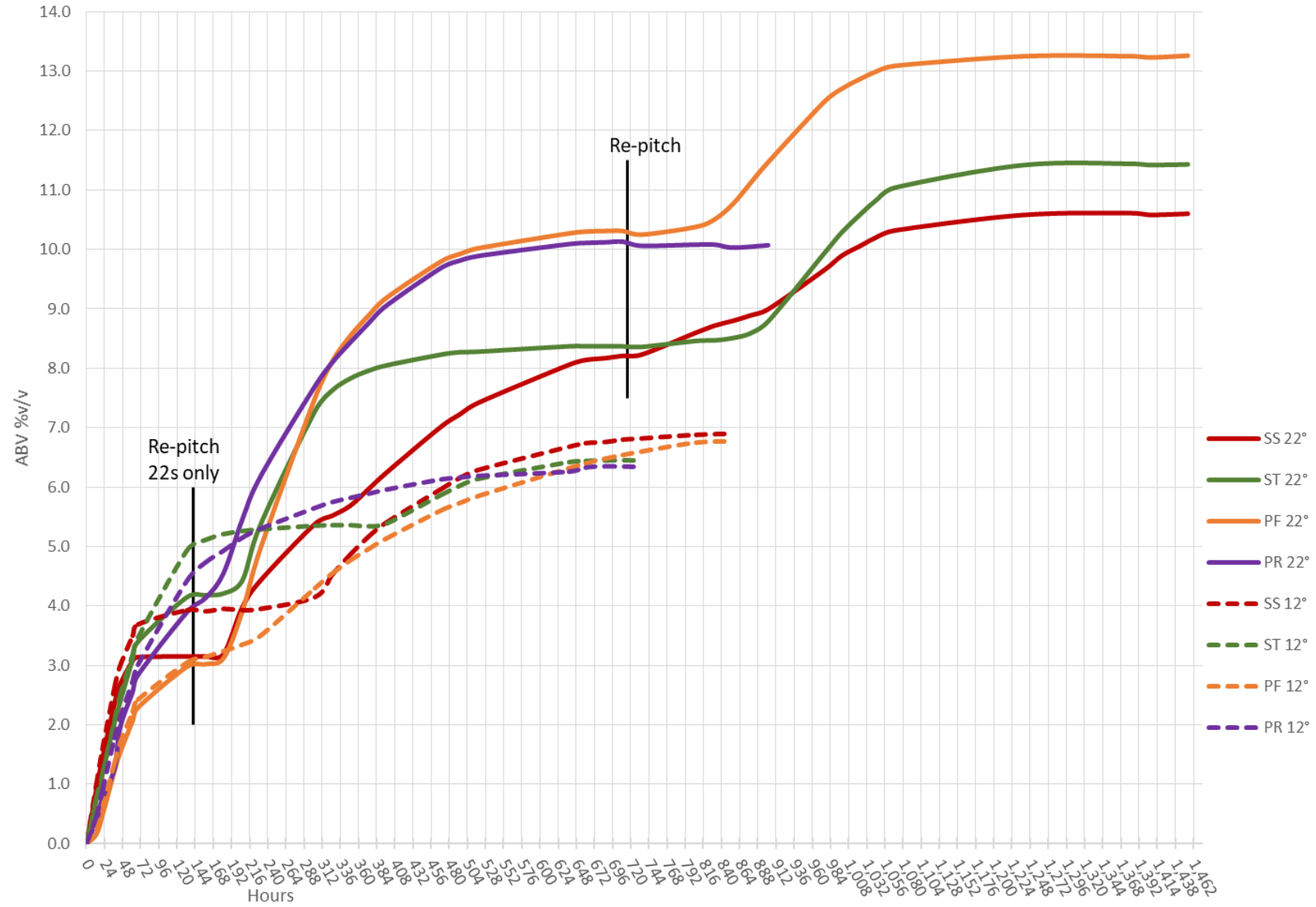


Agave Method/Data

Fermentation

Alcohol by Volume
over time, All
ferments.

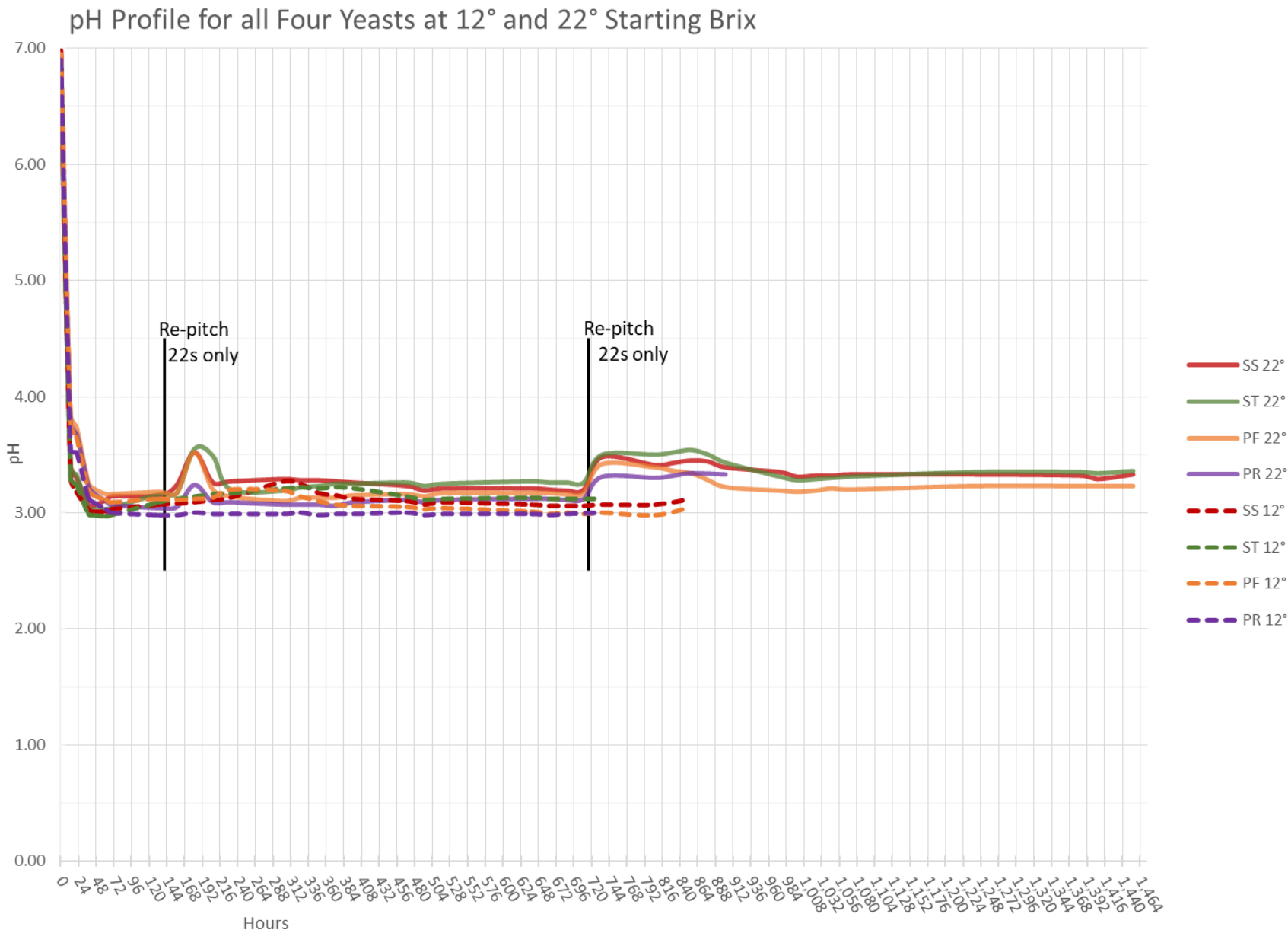
ABV Profile for all Four Yeasts at 12° and 22° Starting Brix



Agave Method/Data

Fermentation

pH over time, All ferments.



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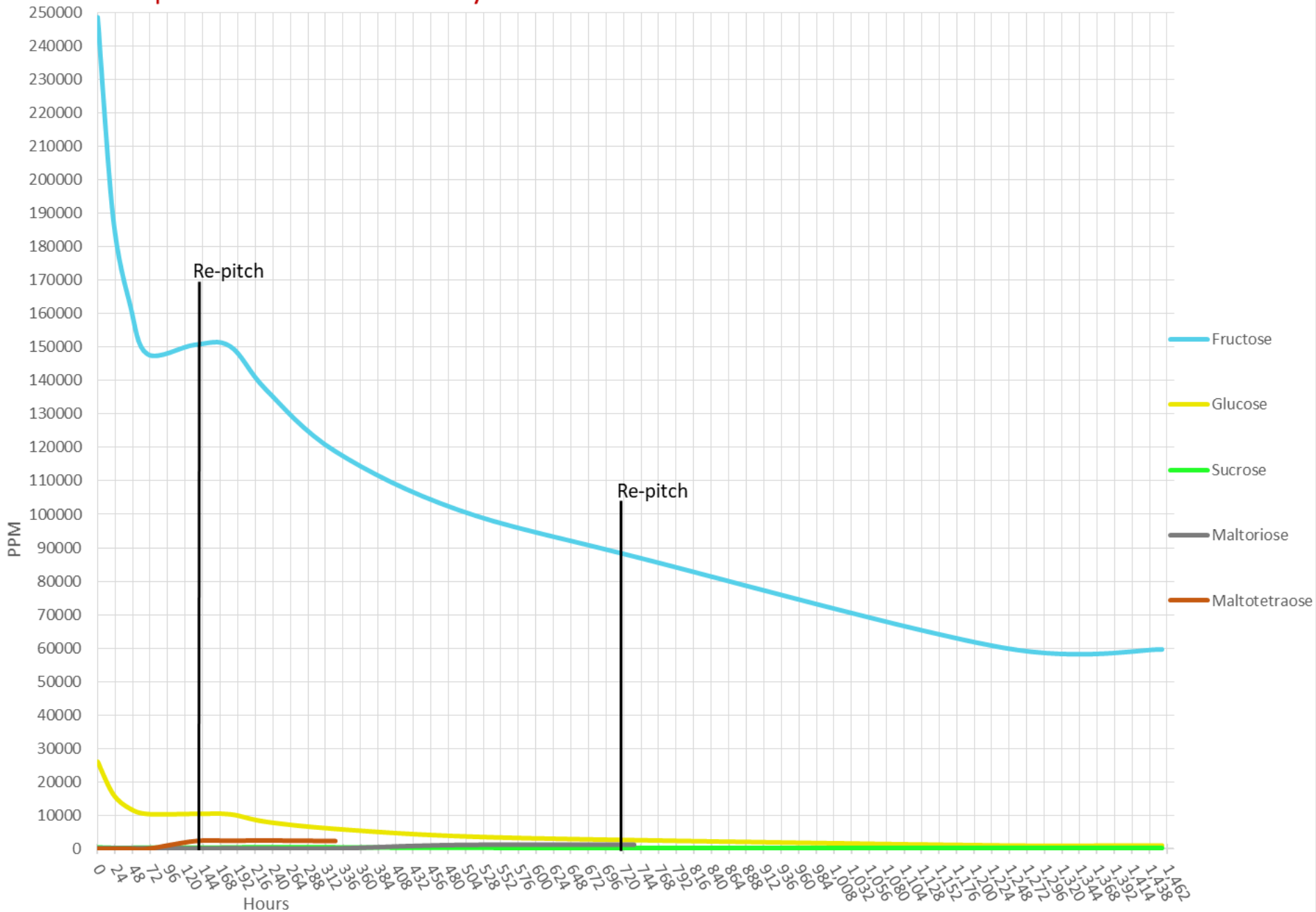
Conference and Vendor Expo



American Distilling Institute

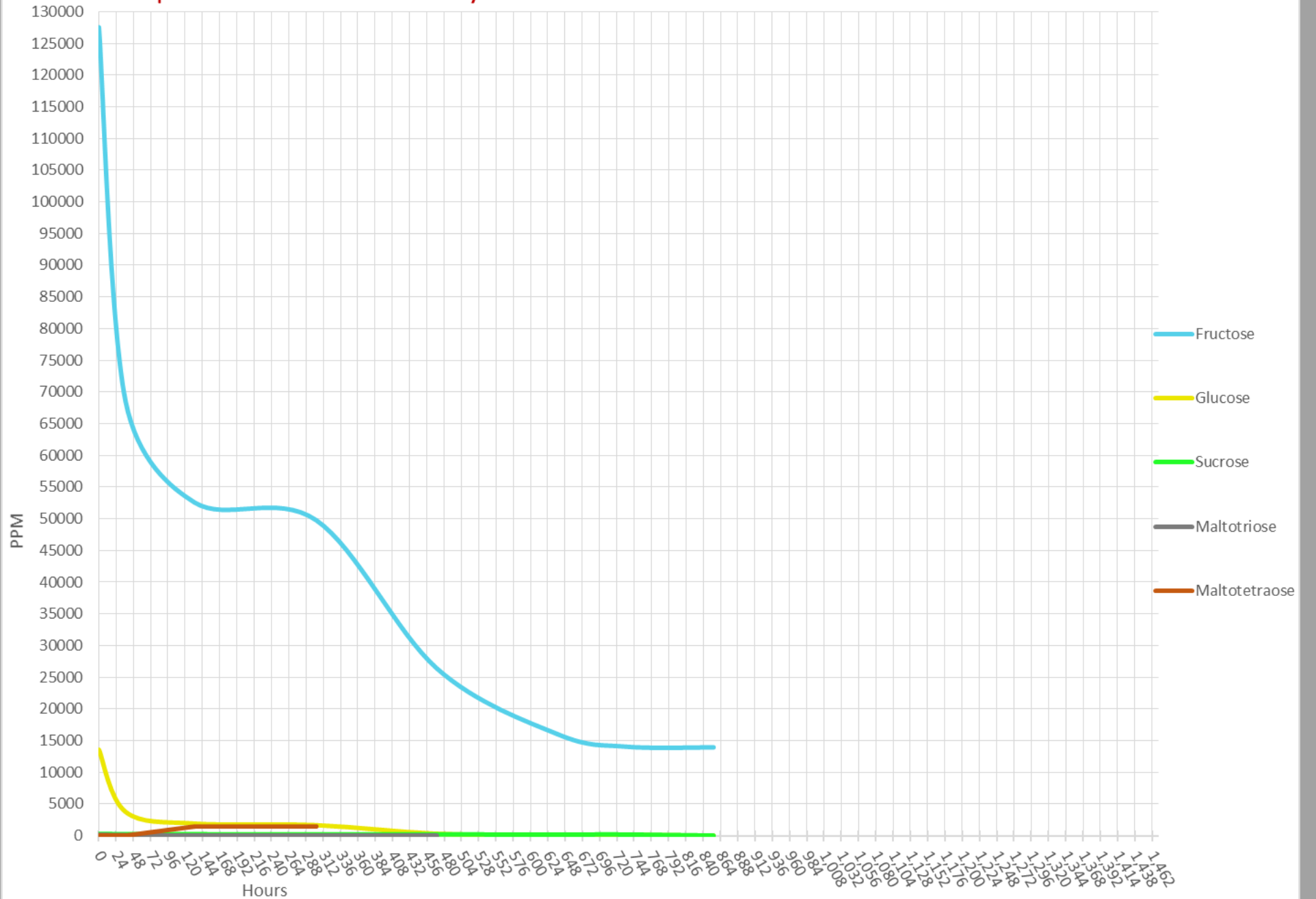


SafSpirit C-70 22 °Brix Carbohydrate Profile



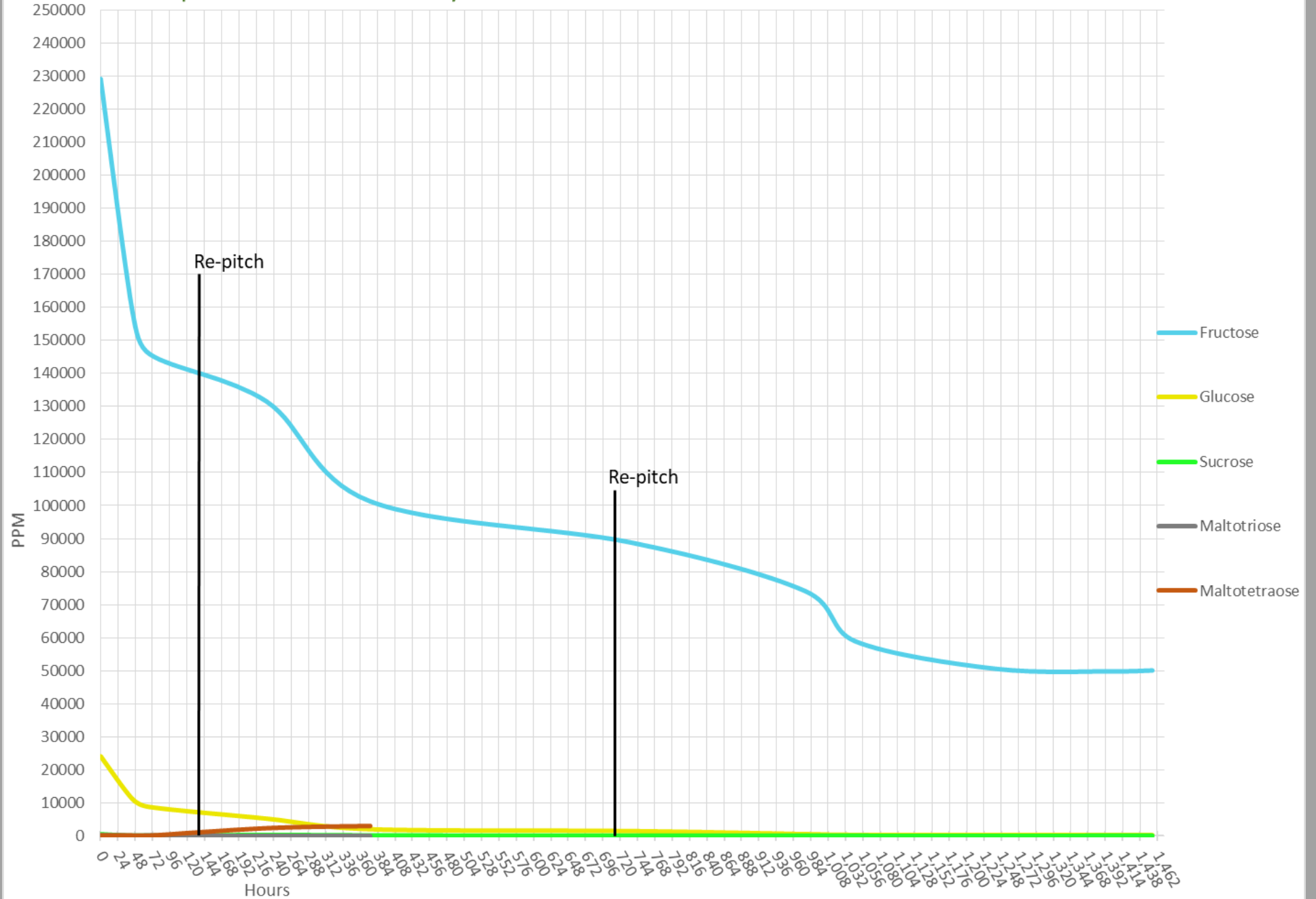


SafSpirit C-70 12 °Brix Carbohydrate Profile





SafTeq Blue 22 °Brix Carbohydrate Profile



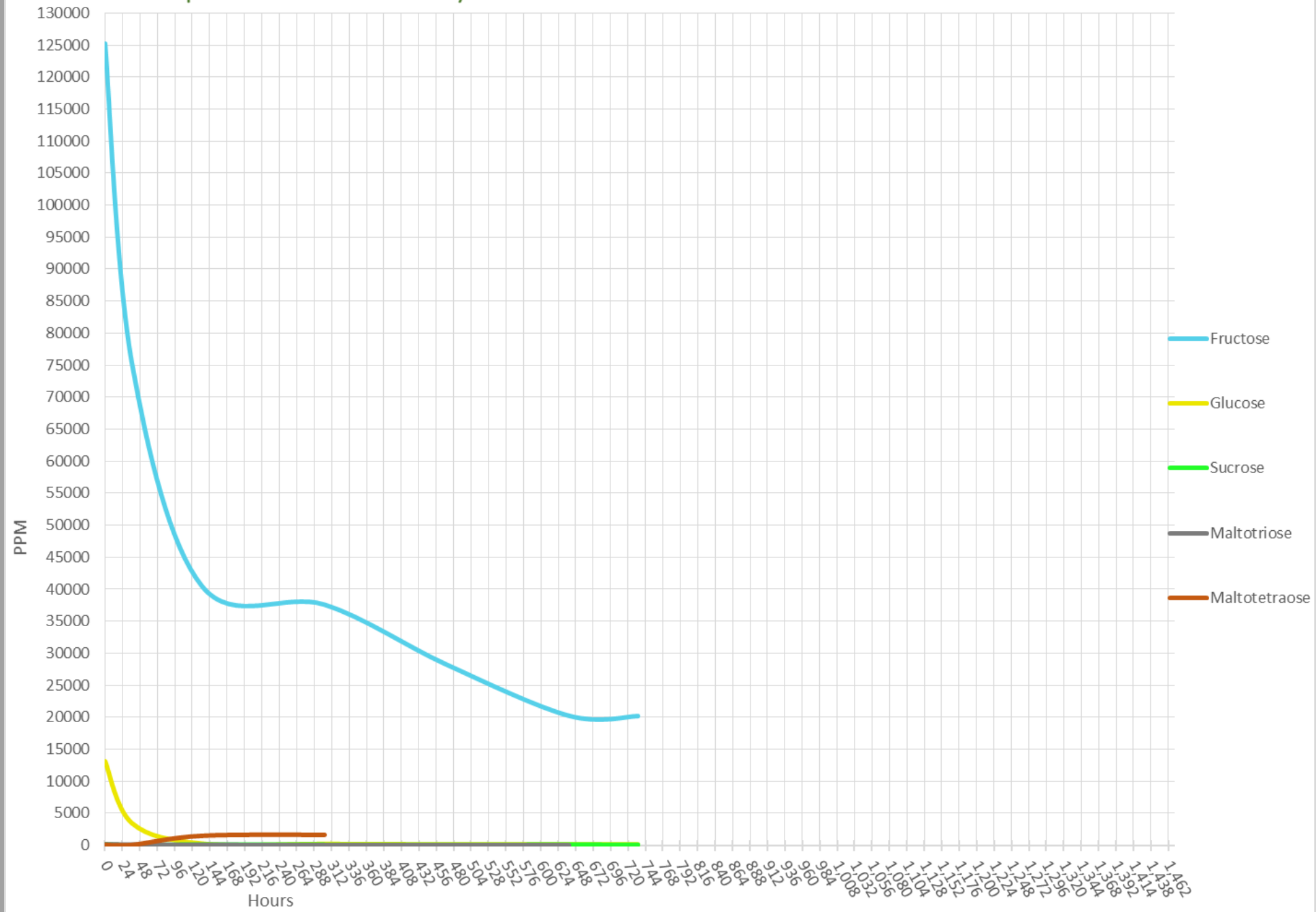
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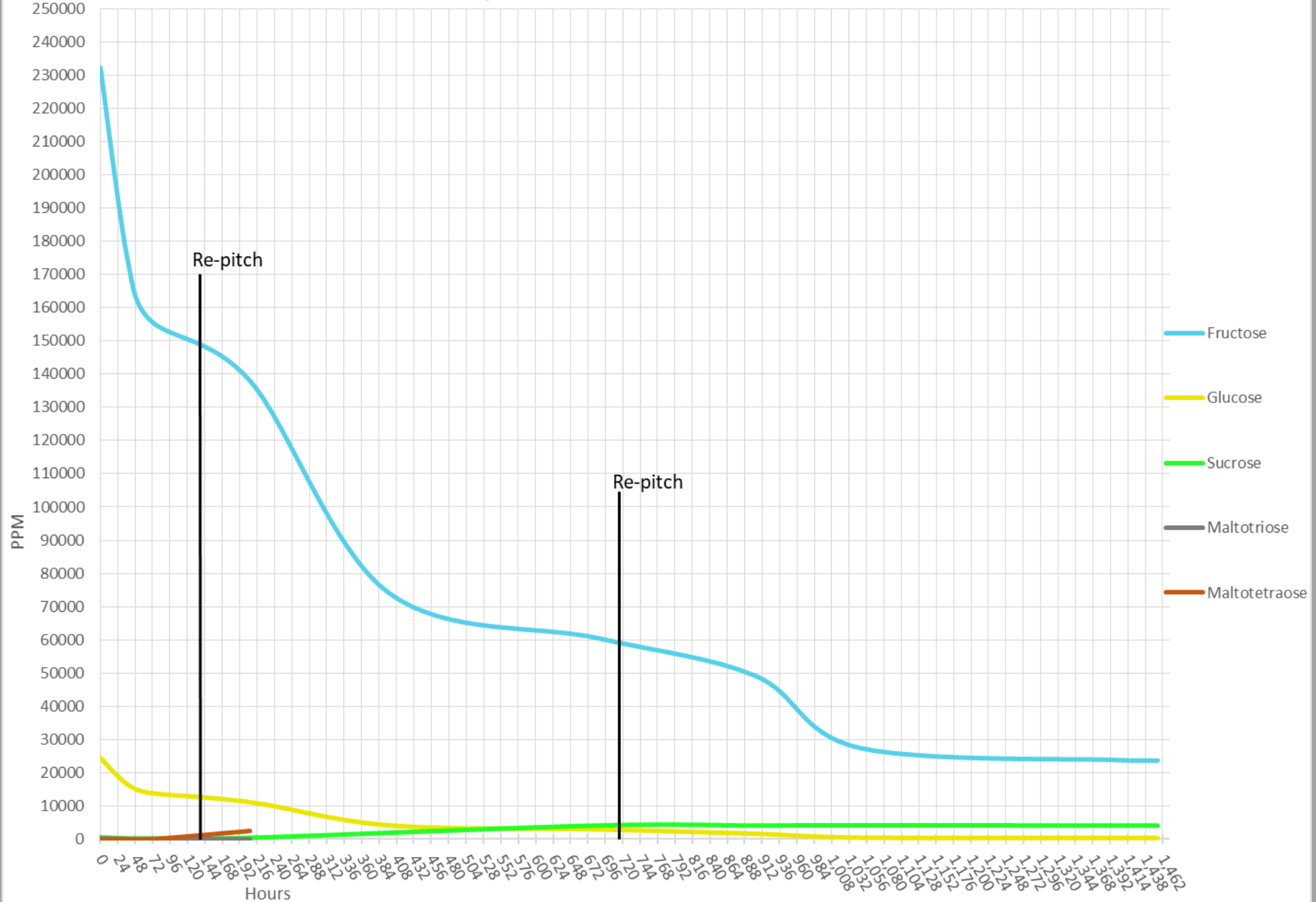


SafTeq Blue 12 °Brix Carbohydrate Profile





Pinnacle Fruct 22 °Brix Carbohydrate Profile



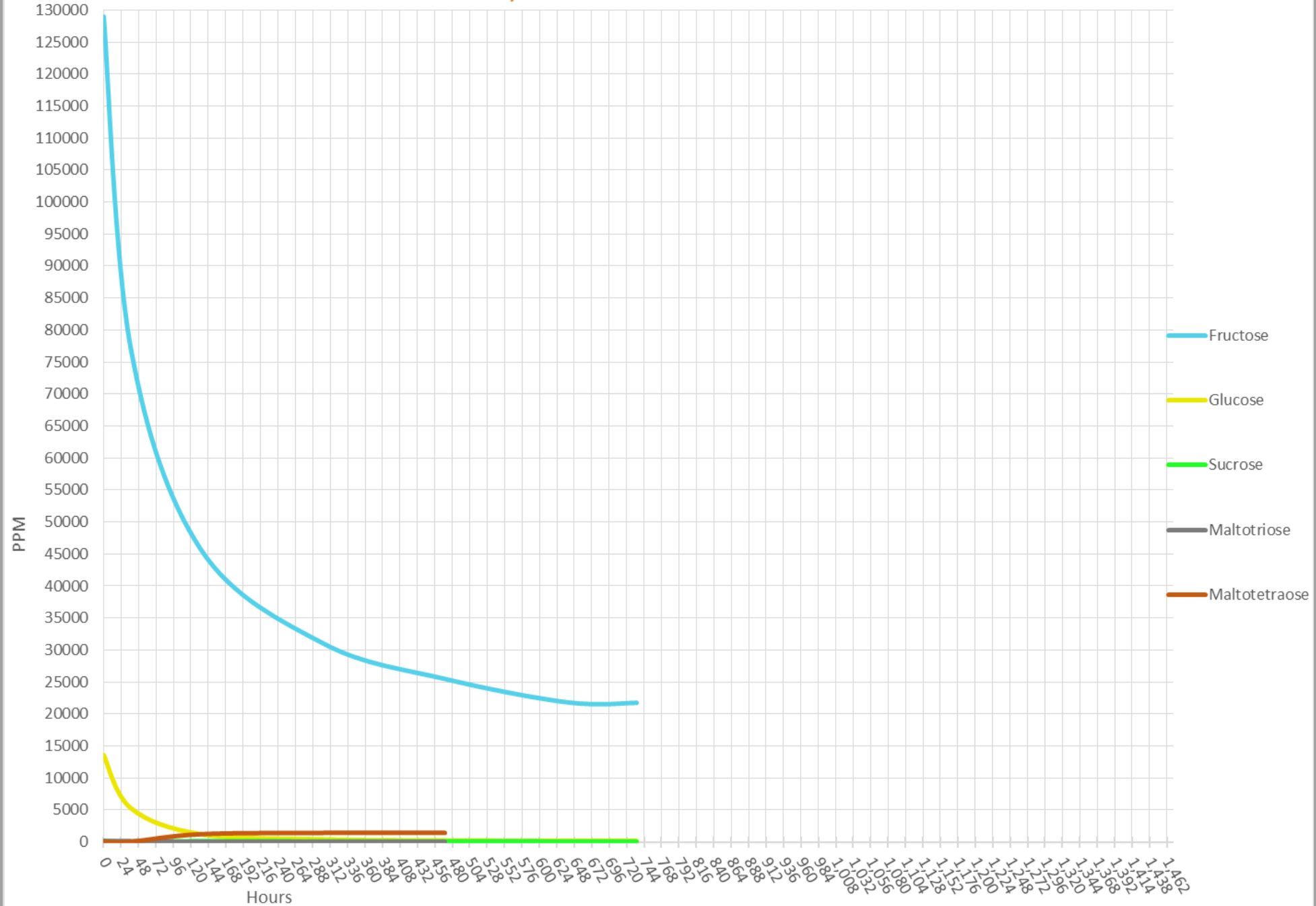
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Pinnacle Fructo 12 °Brix Carbohydrate Profile



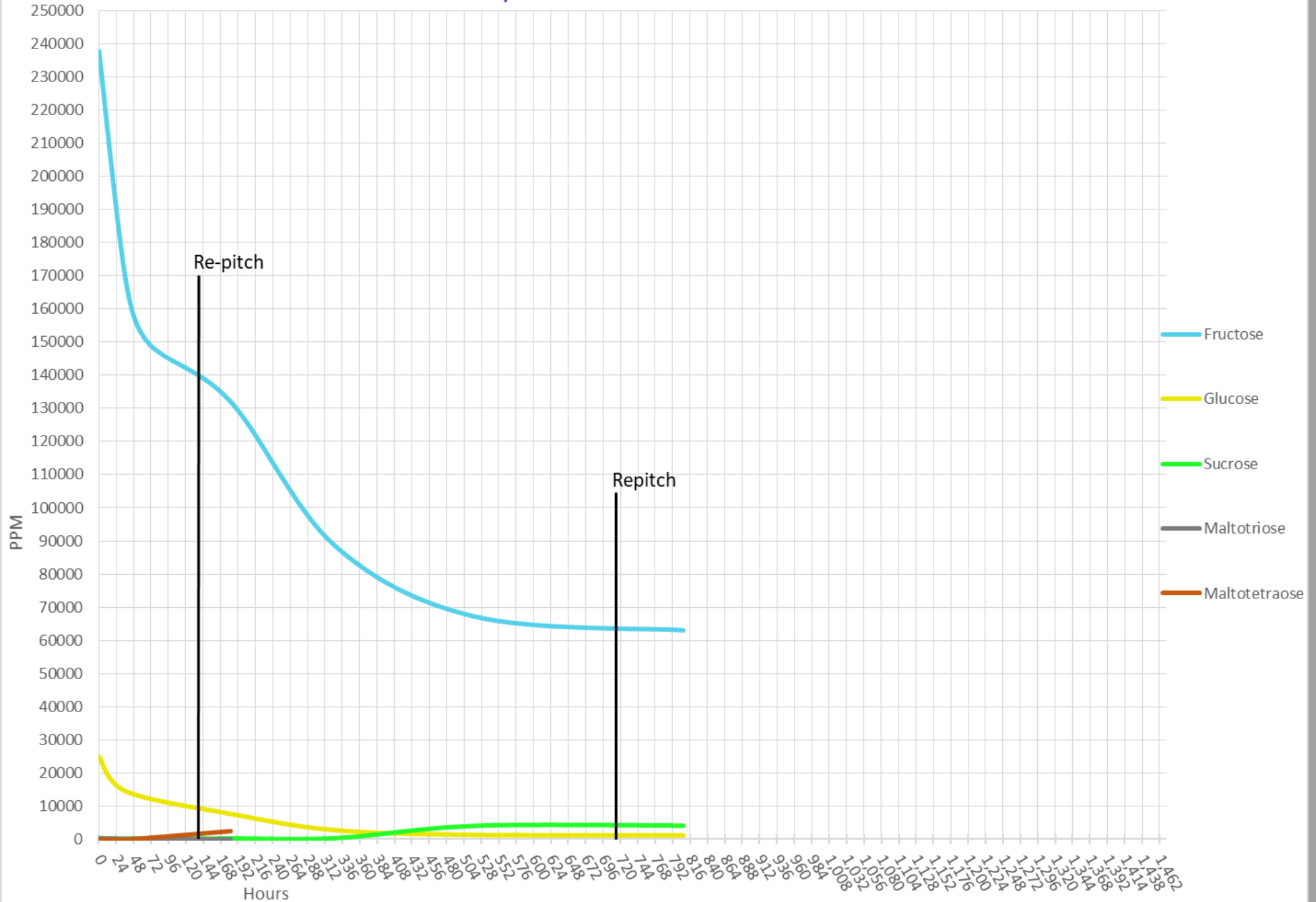
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Pinnacle Robust 22 °Brix Carbohydrate Profile



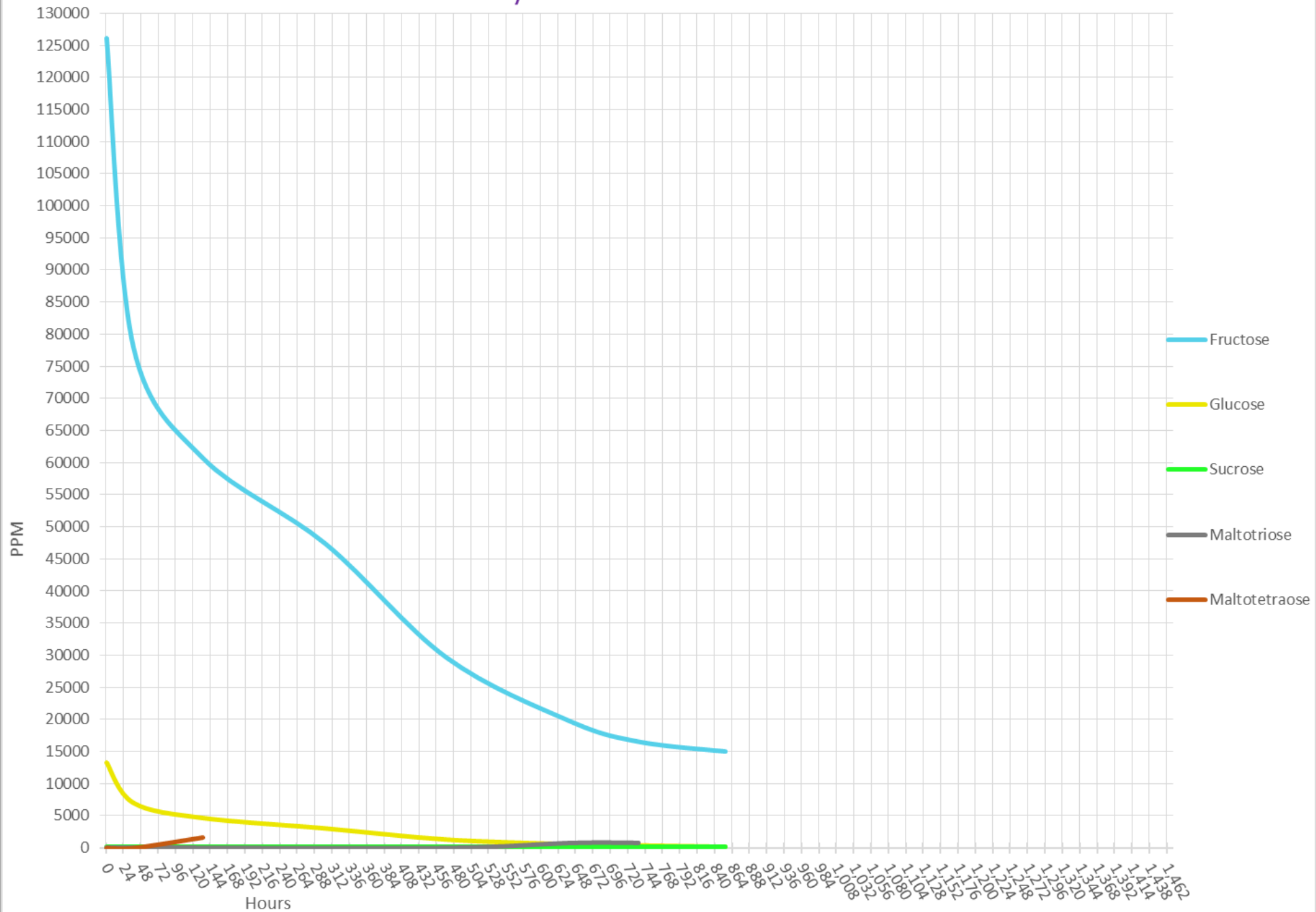
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Pinnacle Robust 12 °Brix Carbohydrate Profile



Agave Method/Data

Fermentation

- ❖ Once it was apparent from Alcholyzer ABV, RDF and other data that fermentations were done fermenters were cold crashed by placing into a 2C incubator for 48 hours.
 - ❖ PR 12 and ST12 were cold crashed at hour 688.
 - ❖ PF 12 and SS12 were cold crashed at hour 808.
 - ❖ PR 22 fermentation again stalled early (as far as attenuation). It was decided since the ABV was at 10.7% to cold crash it at hour 858.
 - ❖ ST22, SS22, PF22 all could have been cold crashed earlier but year-end holidays complicated the matter. These were all cold crashed at hour 1411.

Tequila	Initial °Plato	Final °Plato	Initial SG	Final SG	Initial RDF %	Final RDF %	Initial pH	Final pH	Initial ABV (%v/v)	Final ABV (%v/v)
SS22	21.9014	3.163	1.093151	1.012350	0	71.79	6.72	3.33	0	10.60
ST22	22.1013	1.814	1.094497	1.007049	0	76.64	6.68	3.36	0	11.43
PF22	22.0014	-1.523	1.092673	0.994152	0	88.12	6.70	3.23	0	13.26
PR22	22.0014	4.242	1.088196	1.016620	0	67.99	6.78	3.33	0	10.07
SS12	12.2022	-0.766	1.045713	0.997047	0	86.76	6.98	3.12	0	6.90
ST12	12.1022	0.111	1.046858	1.000443	0	81.18	6.88	3.12	0	6.45
PF12	12.1022	-0.549	1.043688	0.997881	0	85.40	6.95	3.05	0	6.77
PR12	12.1022	0.391	1.048461	1.001512	0	79.43	6.90	3.00	0	6.34

Agave Method/Data

Fermentation Optimization

- ❖ Fermentations yielded great results (flavor) but took too long.
- ❖ Where do we go from here:

Correct nutrition dosing and finetune pitching procedure:

- ❖ Yeast Hydration: in 10 x its weight in water at 90F with an addition of 50 g/l Startup® for 15 min and then doubling the hydration volume with the substrate fluid for another 15 min to acclimate the yeast to temp and osmotic pressure.
- ❖ Set desired level of YAN in the substrate to approximately 200 ppm and use this mark to revise nutrient additions:
- ❖ New nutrient dosing based or above set YAN goals for a 6-gallon agave ferment, Superfood total 13.6g (600 ppm) and DAP total 15g (650 ppm) providing a total of 195 ppm YAN. Sequential additions:
 - ❖ Into substrate before pitching yeast Superfood 5.44g and DAP 4.0g
 - ❖ Into the ferment at active fermentation (12 to 24 hrs.) Superfood 5.44g and DAP 5.5g
 - ❖ Mid ferment Superfood 2.72g and DAP 5.5g

Agave Method/Data

Distillation

❖ Stripping

- ❖ Following cold crashing, wash was siphoned into a G30 with alembic dome for distillation. The condenser was set up to drip into a parrot with a hydrometer and then collected in mason jars.
- ❖ The G30 power was set to 100%.
- ❖ Once the temperature at the base of the G30 got to 30 C, water was turned on to the condenser at 2.5L/minute flow rate (Still Spirits recommended flow).

❖ Spirit Runs

- ❖ Each samples' strip was put into a G30. Power was turned on 40% to gently heat. During each spirit run as the alcohol % dropped power was increased to 45-50%.
- ❖ Cuts
 - ❖ The first 200 mL of each run were collected in two 100 mL foreshots cuts.
 - ❖ Heads were collected in 50 mL cut.
 - ❖ Hearts were generally collected in 150 mL cuts and assigned a single cut # (35.1, 35.2, 35.3 etc. for each part of the heart). The last heart cut may have been smaller than 150 mL depending on ABV and temperature.
 - ❖ Tails were collected in 50 mL cuts.

Agave Method/Data

Distillation



Agave Method/Data

Distillation

❖ Cuts cont.

- ❖ While cutting tasting was being done to look for off flavors. Finding the hearts on PR22 and PR12 were more difficult due to strong bitter off flavors. This resulted in smaller heart cuts on these two.
- ❖ Blending - cuts were sampled by RTC staff and Ilya and the best cuts were kept for blending to make the final product.

Ferment	Cut # *	Vol (mL)	Temp (C)	ABV (%)	Cuts #s Blended	Ferment	Cut # *	Vol (mL)	Temp (C)	ABV (%)	Cuts #s Blended
SS12	Heads 1-15	800	82.1-86.5	80-71	14-15	SS22	Heads 1-31	1575	80.8-86.2	83.5-72.0	31
	Hearts 16	425	86.5-92.5	71-58	16		Hearts 32	390	86.2-92.0	72.0-68.5	32 **
	Tails 17-21	250	92.5-96	58-40			Tails 33-36	210	92.0-98.4	68.5-40.0	
ST12	Heads 1-13	755	83.1-88.2	77-67.5	12-13	ST22	Heads 1-34	1810	81.2-86.0	82.0-72.5	
	Hearts 14	440	88.2-92	67.5-59.5	14		Hearts 35	450	86.0-91.7	72.5-59.0	35
	Tails 15-20	210	92-97.3	59.5-30			Tails 36-40	255	91.7-96.2	59.0-39.0	
PF12	Heads 1-15	750	82.3-88.2	80-68	14-15	PF22	Heads 1-43	2250	81.1-86.2	83.5-73.0	
	Hearts 16	405	88.2-92.0	68-58.5	16		Hearts 44	450	86.2-92.0	73.0-59.0	44
	Tails 17-22	250	92.0-97.0	58.5-34			Tails 45-49	310	92.0-96.5	59.0-40.0	
PR12	Heads 1-16	905	81.9-89.8	79.5-61.5	12-16	PR22	Heads 1-33	1805	81.6-88.7	81.0-66.5	29-33
	Hearts 17	250	89.8-91.4	61.5-58.0	17		Hearts 34	235	88.7-92.9	66.5-55.0	34
	Tails 18-23	300	91.0-96.0	58.0-34.0			Tails 35-38	205	92.9-96.5	55.0-38.5	
* Cuts 1-2 are foreshots						** SS22 had cut 34 from ST22 added by mistake					

Agave Method/Data

Distillation

❖ Final Dilution and Proofing

- ❖ Each tequila was slowly mixed with room temperature RO water to reach a final target proof of 80. 80 proof is the most common proof of commercially sold tequilas.
- ❖ SS22 developed a slight haziness on mixing with water, indicating some fusel alcohols common in the tails were probably still in the blend.



Tequila	Cut points of blend	Blend Initial ABV	Blend Volume	Final ABV	Final volume
SS22**	73% - 58%	69.9	490 ml	40%	856 ml
ST22	72.5% - 59%	69.9	450 ml	40%	786 ml
PR22	72% - 55%	70.7	445 ml	40%	787 ml
PF22	73% - 59%	70.5	450 ml	40%	793 ml
SS12	73% - 58%	70.6	525 ml	40%	927 ml
ST12	72% - 59.5%	70.4	540 ml	40%	950 ml
PR12	72.5% - 58%	70.8	500 ml	40%	885 ml
PF12	73% - 58.5%	69.2	505 ml	40%	874 ml

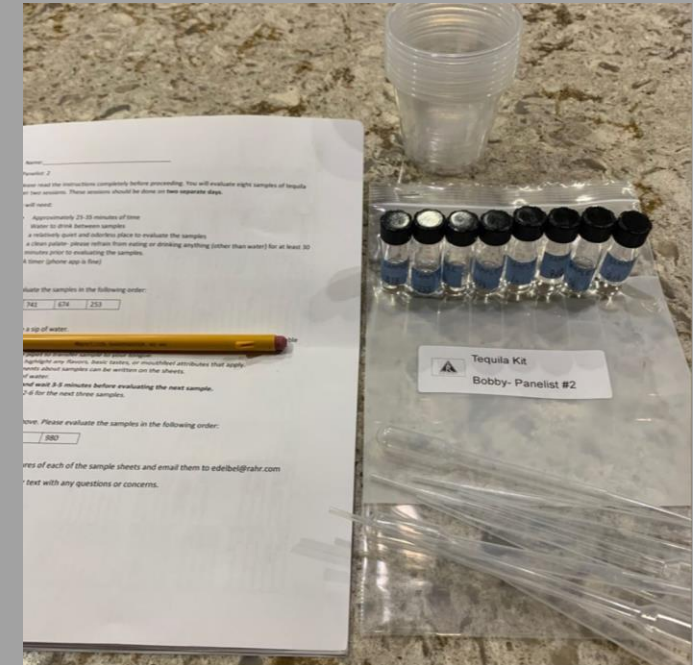
** SS22 had cut 34 from ST22 added by mistake

- ❖ Sensory - once blending and dilution was complete the final products were given to Emily Del Bel for sensory analysis.

Agave Spirit Sensory

Methodology

- Eight samples of agave spirit were produced at the RTC and sent home with panelists for a socially-distant sensory evaluation.
- Panelists were instructed to pour the 1 mL sample of tequila into a 5.5 ounce sample cup and evaluate the aroma before using a disposable pipette to transfer it to the tongue for taste and flavor evaluation.
- They evaluated 4 samples per day in a balanced Latin square design.



Agave Spirit Sensory

Sensory Panel

- ❖ Rahr's sensory panel consists of employees who have undergone sensory training on malt (hot steep), beer, and hops. Most have been on the panel for at least 2 years.



Agave Spirit Sensory

Yeast Strains Used:

- ❖ Fermentis SafSpirit C70 <https://bsgdistilling.com/safspirit-c-70-500g>



- ❖ Fermentis SafTeq Blue Tequila <https://bsgdistilling.com/safteq-blue-500g>

- ❖ Pinnacle Robust <https://bsgwine.com/pinnacle-robust-500g>



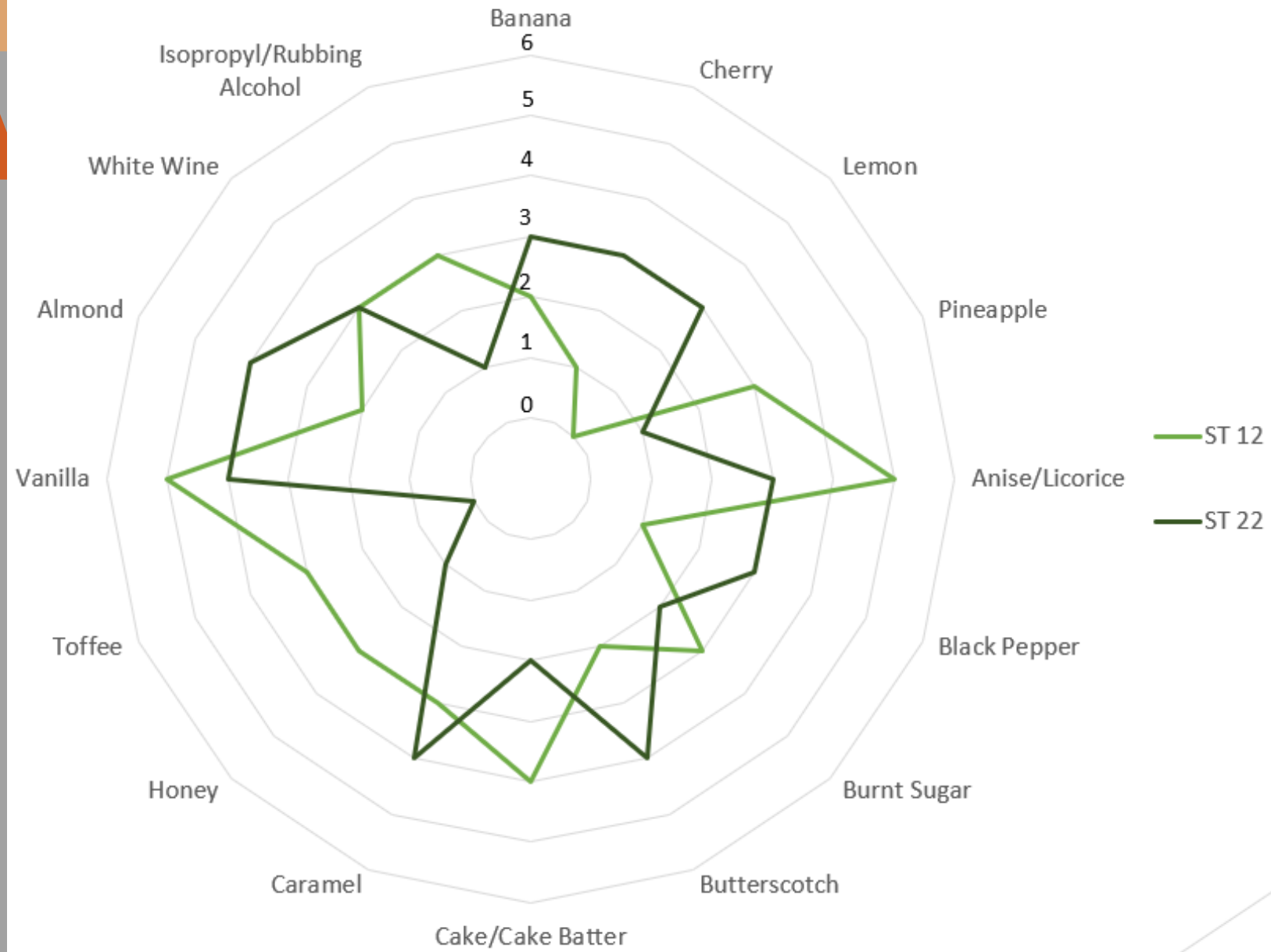
- ❖ Pinnacle Fructo <https://bsgwine.com/pinnacle-fructo-500g>

Agave Spirit Sensory

SafTeq Blue Yeast Results

The sample fermented with SafTeq Blue Tequila yeast and distilled from a 12° wash had a higher reporting of anise/licorice, burnt sugar, cake/cake batter, honey, toffee, vanilla, and isopropyl/rubbing alcohol than the sample distilled from a 22° wash. That sample had a higher reporting of banana, cherry, lemon, black pepper, butterscotch, caramel, and almond. Both samples had an equal reporting of white wine character.

SafTeq Blue Tequila Attributes
Frequency out of 12 Panelists

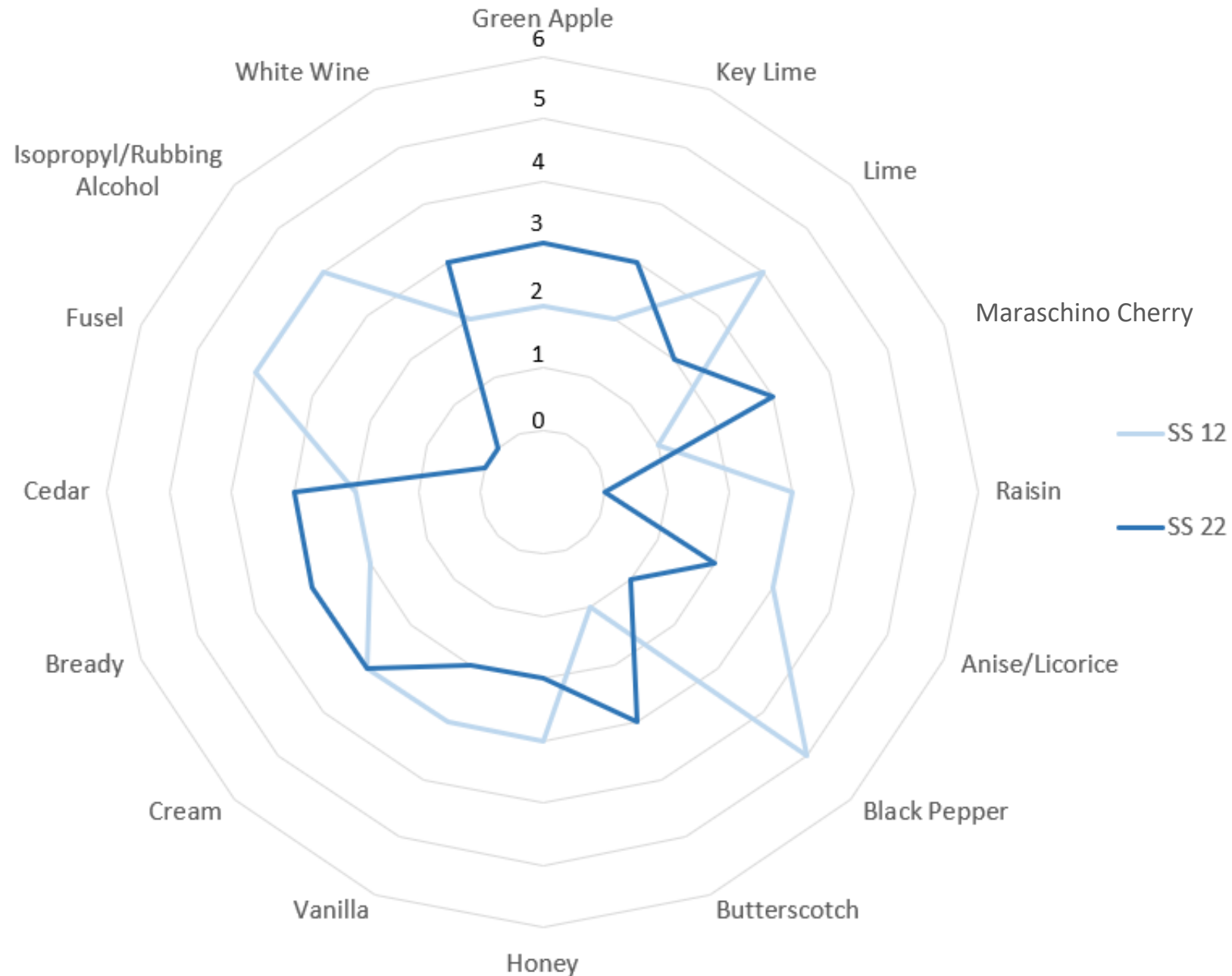


Agave Spirit Sensory

SafSpirit C-70 Yeast Results

The sample fermented with SafSpirit C-70 yeast and distilled from a 12° wash had a higher reporting of lime, raisin, anise/licorice, black pepper, honey, vanilla, fusel, and isopropyl/rubbing alcohol than the sample distilled from a 22° wash. That sample had a higher reporting of green apple, key lime, maraschino cherry, butterscotch, bready, cedar, and white wine. Both samples had an equal reporting of cream character.

SafSpirit C-70 Attributes
Frequency out of 12 Panelists

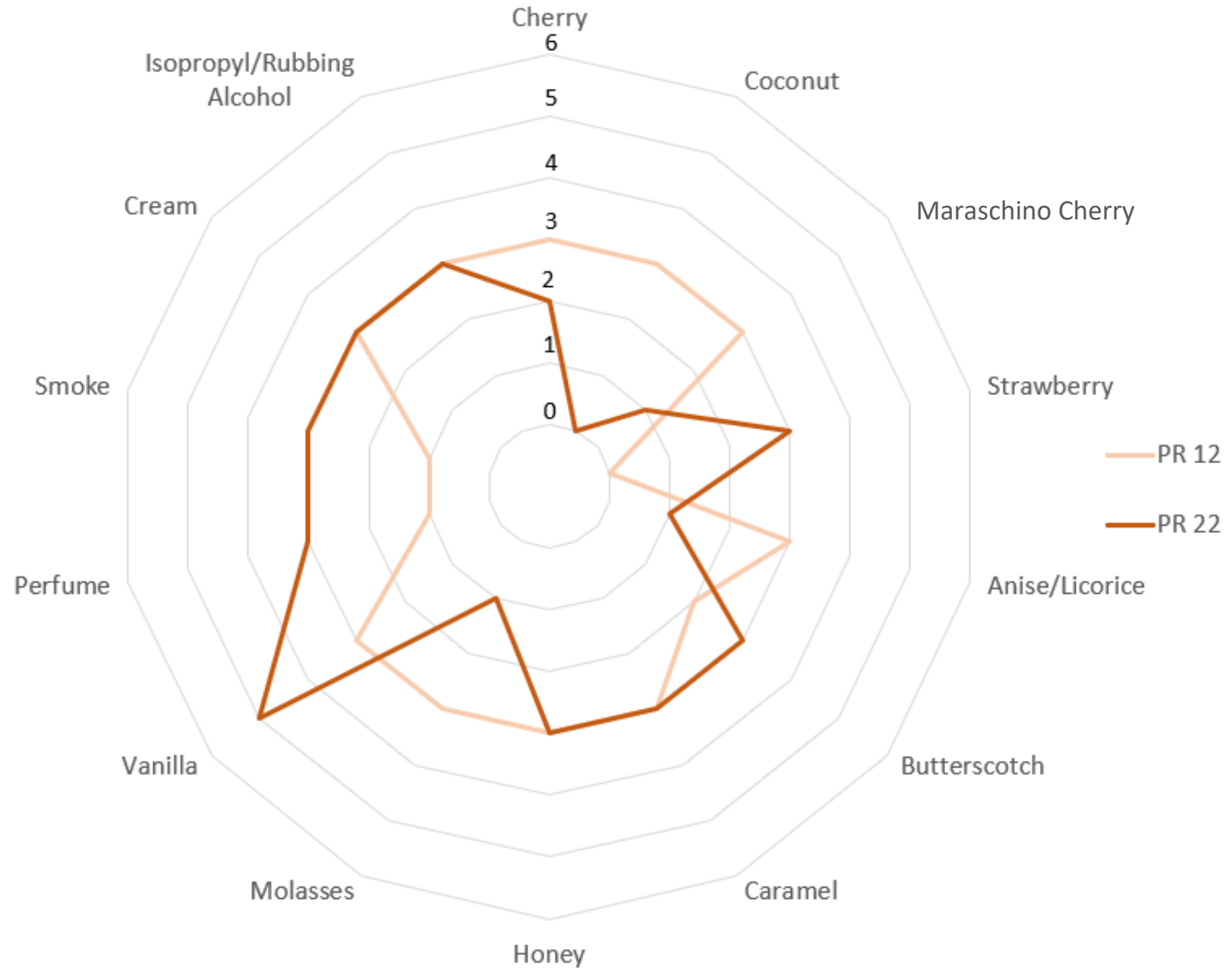


Agave Spirit Sensory

Pinnacle Robust Yeast Results

The sample fermented with Pinnacle Robust yeast and distilled from a 12° wash had a higher reporting of cherry, coconut, maraschino cherry, anise/licorice, and molasses than the sample distilled from a 22° wash. That sample had a higher reporting of strawberry, butterscotch, vanilla, perfume, and smoke. Both samples had an equal reporting of caramel, honey, cream, and isopropyl/rubbing alcohol.

Pinnacle Robust Attributes
Frequency out of 12 Panelists

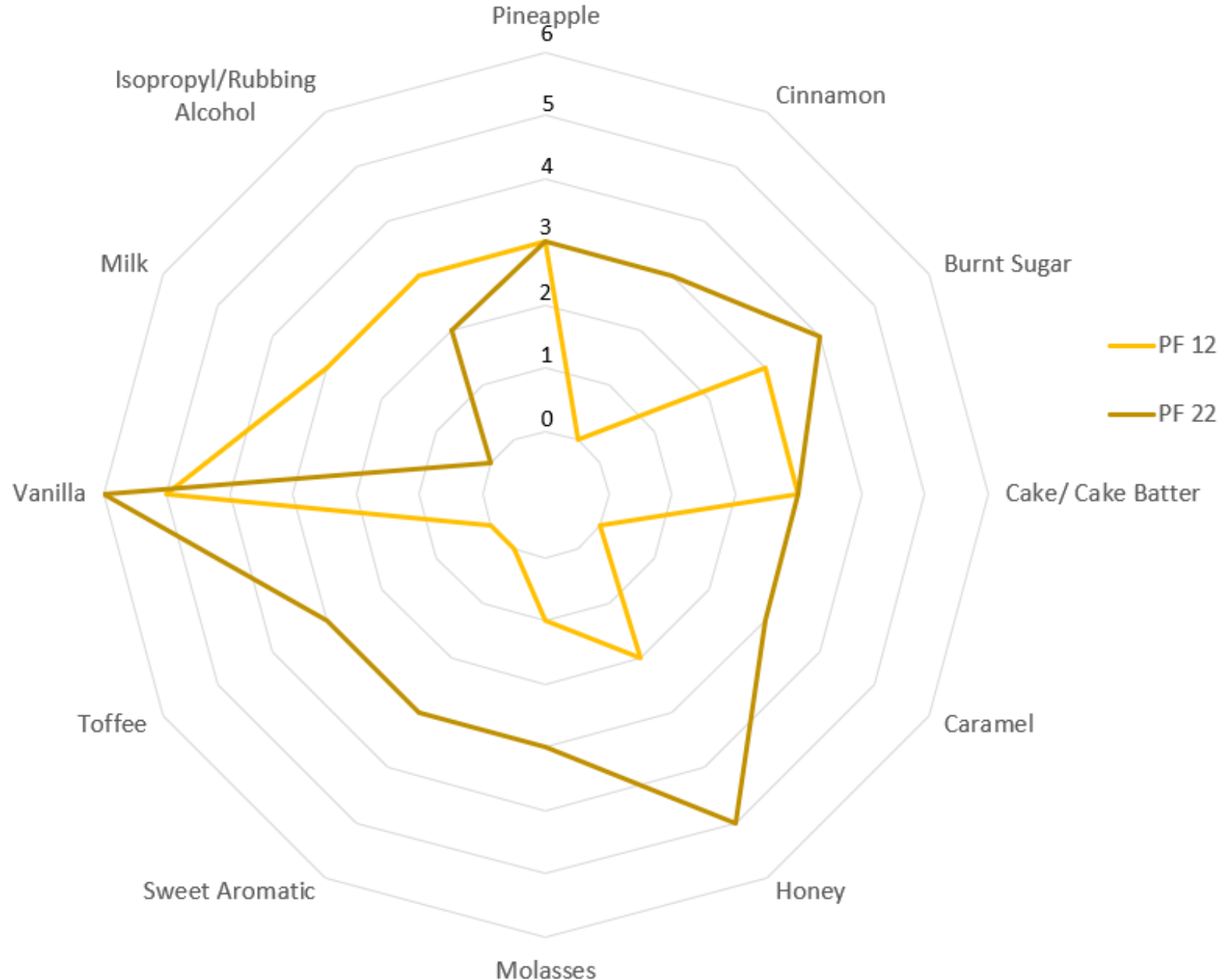


Agave Spirit Sensory

Pinnacle Fructo Yeast Results

The sample fermented with Pinnacle Fructo yeast and distilled from a 12° wash had a higher reporting of milk and isopropyl/rubbing alcohol than the sample distilled from a 22° wash. That sample had a higher reporting of cinnamon, burnt sugar, caramel, honey, molasses, sweet aromatic, toffee, and vanilla. Both samples had an equal reporting of pineapple and cake/cake batter.

Pinnacle Fructo Attributes
Frequency out of 12 Panelists



Agave Spirit Sensory

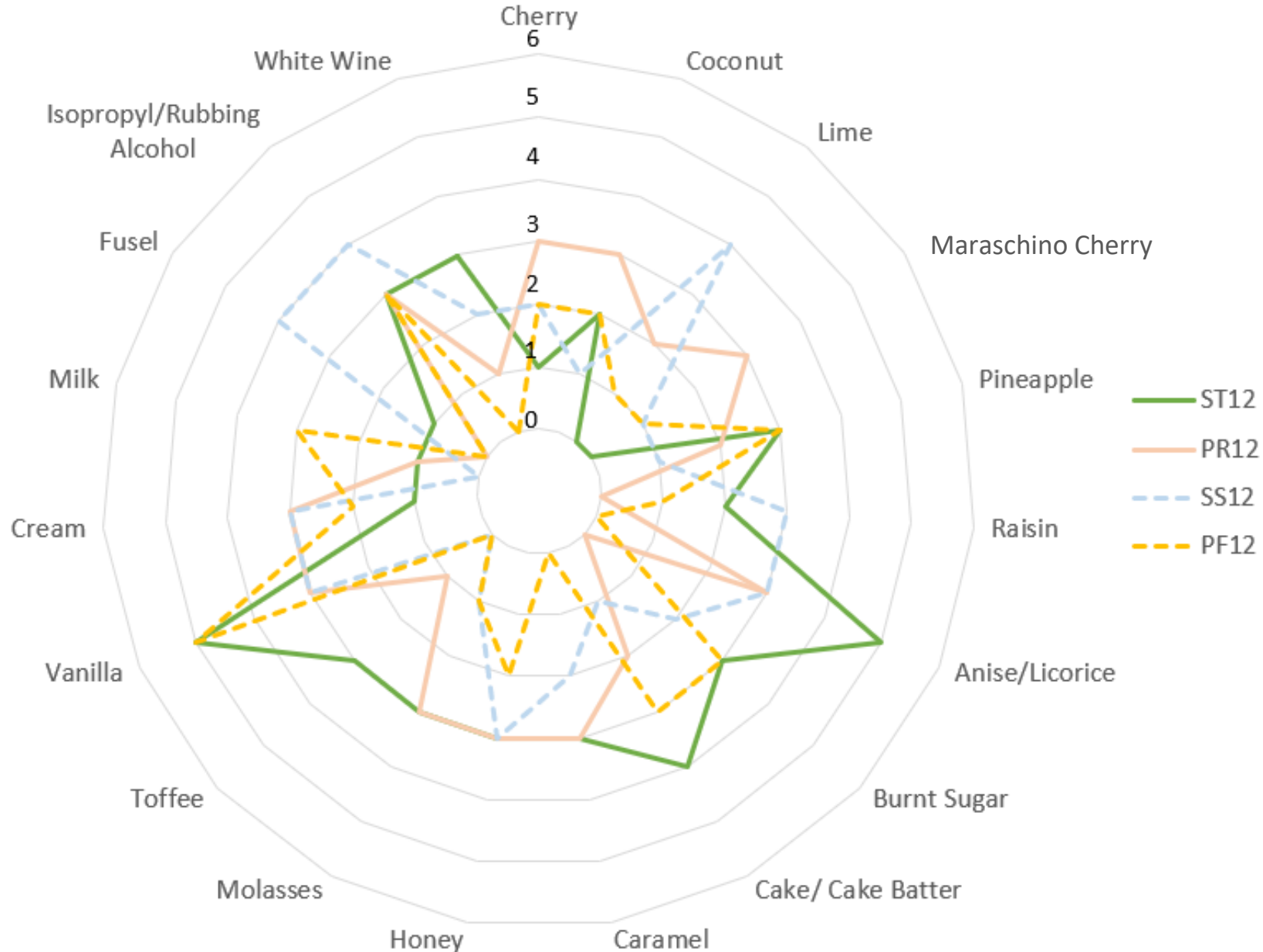
All 12° Plato Wash Results

Looking at the low and high brix washes separately is a bit more messy as there are more significant attributes (defined as attributes where at least one sample had a minimum of three panelists select it).

The PR12 sample had a higher fruity character than most samples with the exception of SS12 and lime aroma. SS 12 also had a relatively strong fusel and isopropyl/rubbing alcohol character.

ST12 had a prominent anise/licorice and sweet aromatic character. PR12 12 had some sweet aromatic attributes such as caramel, honey, and molasses jump to the top.

12° Wash Attributes
Frequency out of 12 Panelists

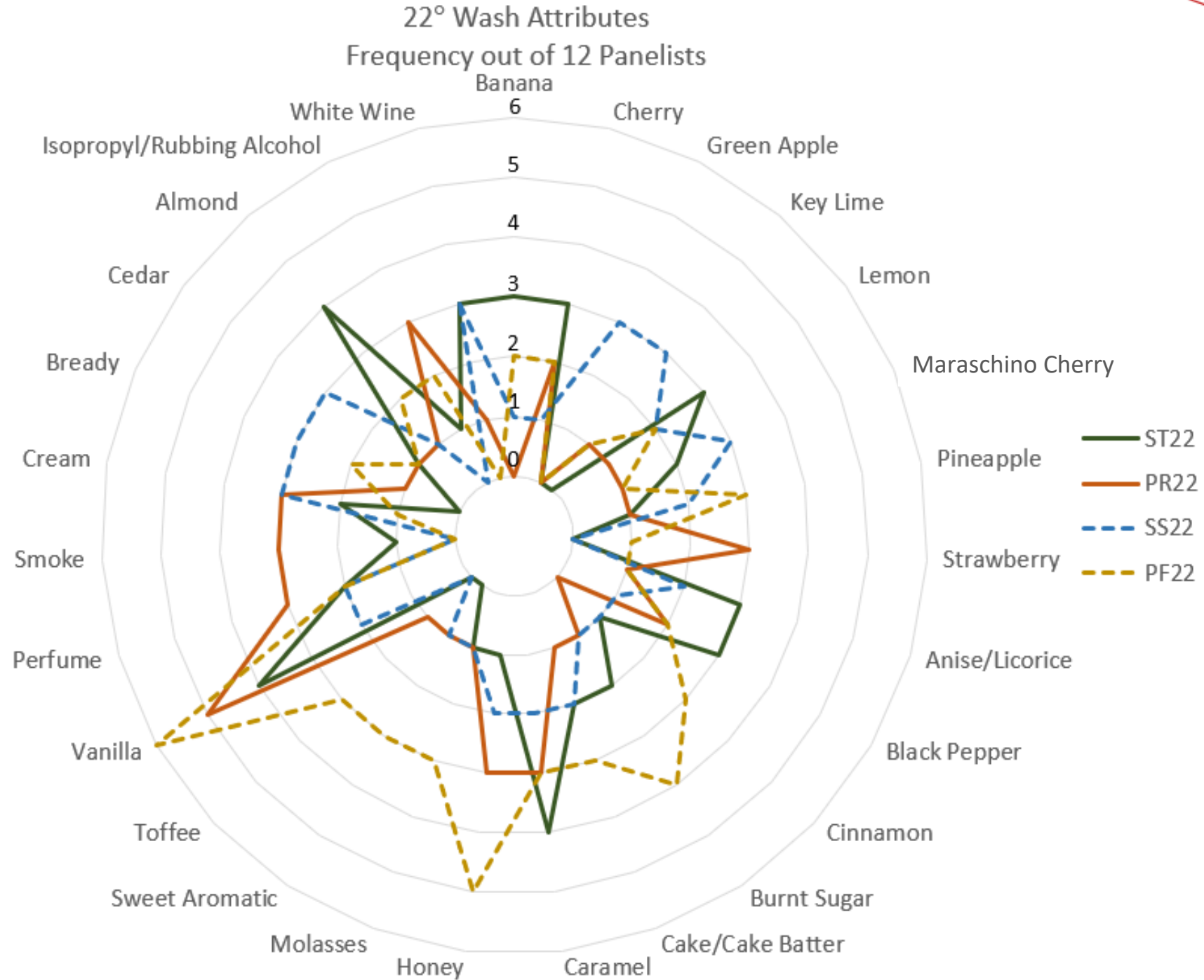


Agave Spirit Sensory

All 22° Plato Wash Results

PF22 had a very high rating of vanilla, honey, and other sweet aromatic characters, though both PR22 and ST22 had high vanilla ratings.

The distribution of fruity attributes is more varied in the 22 degree samples than in the 12 degree samples.



Agave Spirit Sensory

Dominant attributes by yeast

As can be seen in these modified bar charts, in general, each of the yeasts developed a different set of characteristics, though with many overlapping flavors.

Most notably, the Pinnacle Fructo yeast produced little fruity character, with the exception of pineapple, and was dominantly sweet aromatic with very strong vanilla character.

SafTeq Blue Tequila yeast produced a wide variety of sweet aromatic attributes, along with bright fruit and nutty spice.

SafSpirit C-70 yeast produced a more green fruit character, along with a few attributes not seen in high values in other yeasts, such as cedar, bready, and fusel.

Pinnacle Robust produced some smoke and perfume aromas not seen in the other samples at high levels.

All samples produced some spicy characteristic, and most produced some dairy characteristics, with the exception of SafTeq Blue Tequila yeast.

The SafTeq samples also produced white wine aromatics not seen in the other samples at high levels.

SafTeq Blue Tequila	ST 12	ST 22	SafSpirit C-70	SS 12	SS 22
Banana	2	3	Green Apple	2	3
Cherry	1	3	Key Lime	2	3
Lemon	0	3	Lime	4	2
Pineapple	3	1	Maraschino Cherry	1	3
Anise/Licorice	5	3	Raisin	3	0
Black Pepper	1	3	Anise/Licorice	3	2
Burnt Sugar	3	2	Black Pepper	5	1
Butterscotch	2	4	Butterscotch	1	3
Cake/Cake Batter	4	2	Honey	3	2
Caramel	3	4	Vanilla	3	2
Honey	3	1	Cream	3	3
Toffee	3	0	Bready	2	3
Vanilla	5	4	Cedar	2	3
Almond	2	4	Fusel	4	0
White Wine	3	3	Isopropyl/Rubbing Alcohol	4	0
Isopropyl/Rubbing Alcohol	3	1	White Wine	2	3

Pinnacle Robust	PR 12	PR 22	Pinnacle Fructo	PF 12	PF 22
Cherry	3	2	Pineapple	3	3
Coconut	3	0	Cinnamon	0	3
Maraschino Cherry	3	1	Burnt Sugar	3	4
Strawberry	0	3	Cake/ Cake Batter	3	3
Anise/Licorice	3	1	Caramel	0	3
Butterscotch	2	3	Honey	2	5
Caramel	3	3	Molasses	1	3
Honey	3	3	Sweet Aromatic	0	3
Molasses	3	1	Toffee	0	3
Vanilla	3	5	Vanilla	5	6
Perfume	1	3	Milk	3	0
Smoke	1	3	Isopropyl/Rubbing Alcohol	3	2
Cream	3	3			
Isopropyl/Rubbing Alcohol	3	3			

Note: only attributes that were present at a frequency of 3 or greater for at least one of the sample pairs were included

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Dominant attributes by brix

Attribute	ST12	PR12	SS12	PF12
Cherry	1	3	2	2
Coconut	2	3	1	2
Lime	0	2	4	1
Maraschino Cherry	0	3	1	1
Pineapple	3	2	1	3
Raisin	2	0	3	1
Anise/Licorice	5	3	3	0
Burnt Sugar	3	0	2	3
Cake/ Cake Batter	4	2	1	3
Caramel	3	3	2	0
Honey	3	3	3	2
Molasses	3	3	1	1
Toffee	3	1	0	0
Vanilla	5	3	3	5
Cream	1	3	3	2
Milk	1	1	0	3
Fusel	1	0	4	0
Isopropyl/Rubbing Alcohol	3	3	4	3
White Wine	3	1	2	0

Note: only attributes that were present at a frequency of 3 or greater for at least one of the sample pairs were included

Attribute	ST22	PR22	SS22	PF22
Banana	3	0	1	2
Cherry	3	2	1	2
Green Apple	0	0	3	0
Key Lime	0	1	3	1
Lemon	3	1	2	2
Maraschino Cherry	2	1	3	1
Pineapple	1	1	2	3
Strawberry	0	3	0	1
Anise/Licorice	3	1	2	1
Black Pepper	3	2	1	2
Cinnamon	1	0	1	3
Burnt Sugar	2	1	1	4
Cake/Cake Batter	2	1	2	3
Caramel	4	3	2	3
Honey	1	3	2	5
Molasses	1	1	1	3
Sweet Aromatic	0	1	1	3
Toffee	0	1	0	3
Vanilla	4	5	2	6
Perfume	2	3	2	2
Smoke	1	3	0	0
Cream	2	3	3	1
Bready	0	1	3	2
Cedar	1	1	3	1
Almond	4	1	1	2
Isopropyl/Rubbing Alcohol	1	3	0	2
White Wine	3	1	3	0

In general, more diverse flavors appeared in the 22 degree samples such as perfume, smoke, bready, cedar, and almond. This may have been due to a secondary fermentation by a lactobacillus species or other bacteria or wild yeast.

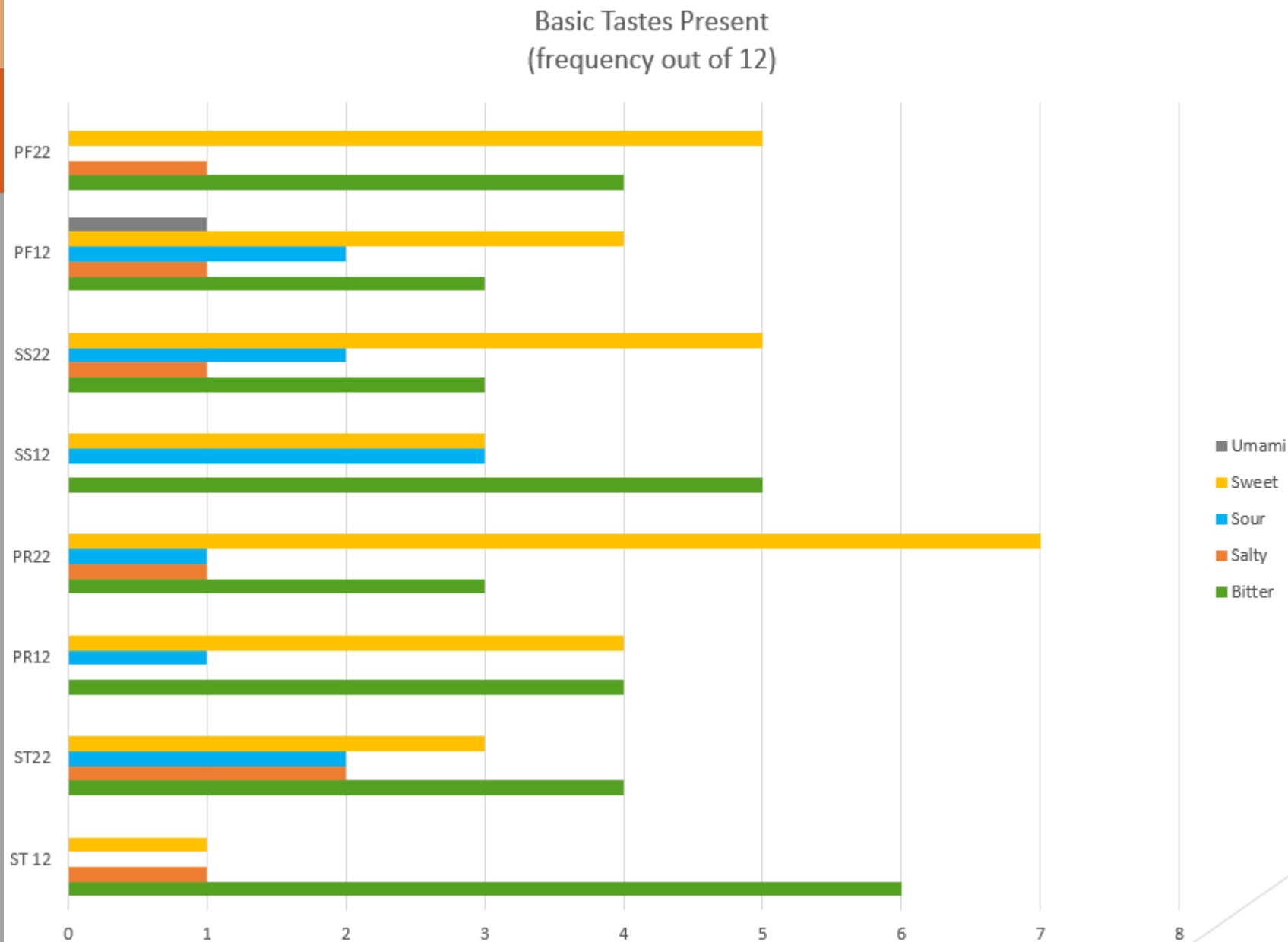
Agave Spirit Sensory

Basic Tastes

Panelists reported basic tastes activated by these samples in a check-all-that-apply fashion. Sweet and bitter were the most highly reported, though none more than 7 out of 12 (58%).

PR22 had the highest reporting of sweet, followed by PF12 and PF22, and PR12.

In contrast, ST12 had the highest reporting of bitter, followed by SS12. These two samples had relatively reporting of sweet taste.



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Basic Tastes

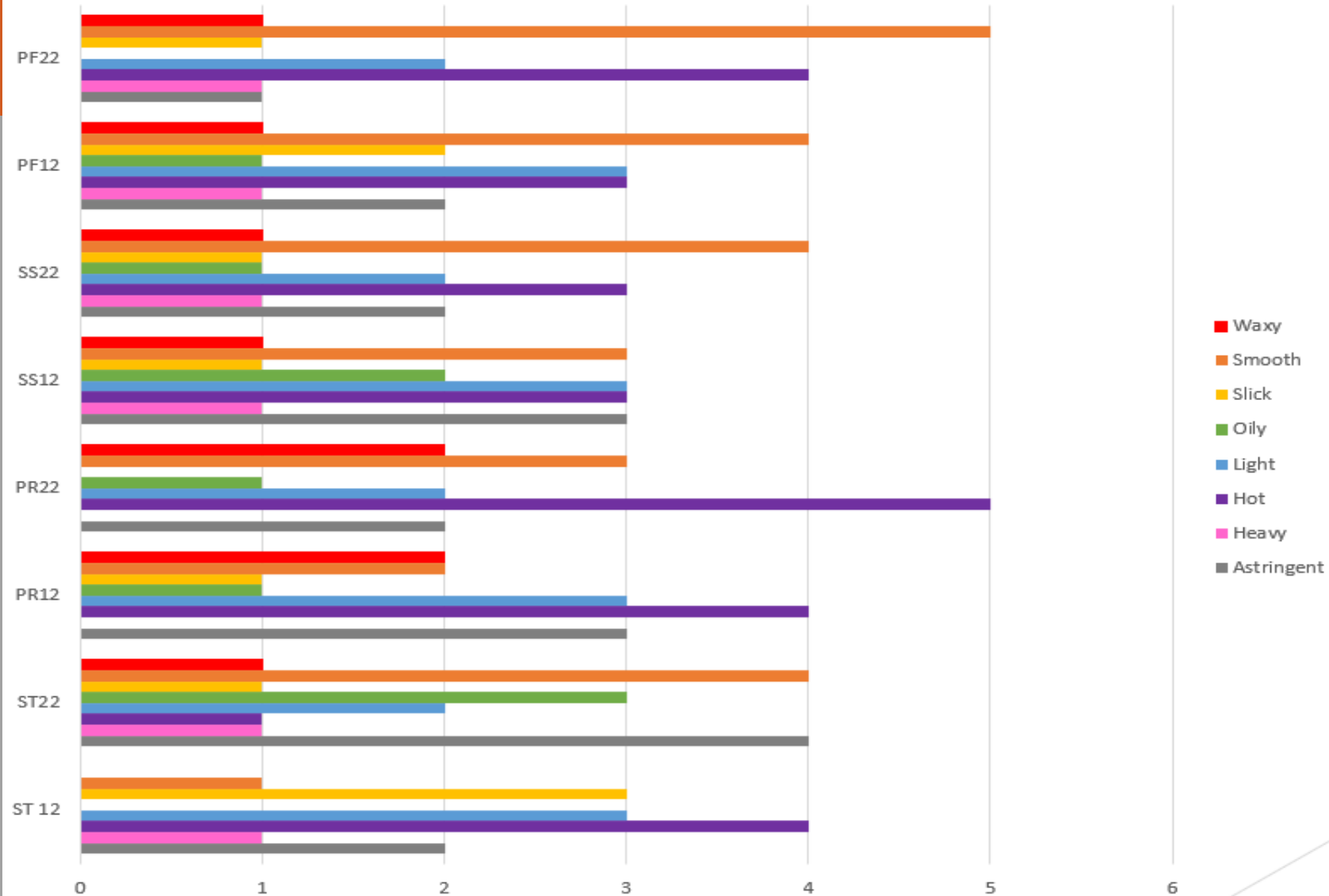
Panelists reported mouthfeel attributes for each of the samples, but no training nor additional descriptors were given for the following: waxy, smooth, slick, oily, light, hot, heavy, and astringent.

Smooth and hot were the two descriptors most widely used, followed by astringent, slick, and light.

PR22 had the highest reporting of hot, followed by PF22, PR12, and ST12.

PF22 had the highest reporting of smooth, followed by PF12, SS22, and ST22.

Mouthfeel Attributes
(frequency out of 12)



Agave Spirit Sensory

Summary I

- ❖ In general, each of the yeasts developed a different set of characteristics, though with many overlapping flavors:
 - ❖ Most notably, the Pinnacle Fructo yeast produced little fruity character apart from pineapple and was dominantly sweet aromatic with very strong vanilla character.
 - ❖ SafTeq Blue Tequila yeast produced a wide variety of sweet aromatic attributes, along with bright fruit and nutty spice.
 - ❖ SafSpirit C-70 yeast produced a more of a green fruit character, along with a few attributes not seen in high values in other yeasts, such as cedar, bready, and fusel.
 - ❖ Pinnacle Robust produced some smoke and perfume aromas not seen in the other samples at high levels.
 - ❖ All samples produced some spicy characteristic, and most produced some dairy characteristics.

Agave Spirit

Summary II

- ❖ Unless looking for a specific set of flavors particular to a more difficult high gravity ferment, it is not justified by an increased yield, ingredient cost and production time.



Tequila	Cut points of blend	Blend Initial ABV	Blend Volume	Final ABV	Final volume
SS22**	73% - 58%	69.9	490 ml	40%	856 ml
ST22	72.5% - 59%	69.9	450 ml	40%	786 ml
PR22	72% - 55%	70.7	445 ml	40%	787 ml
PF22	73% - 59%	70.5	450 ml	40%	793 ml
SS12	73% - 58%	70.6	525 ml	40%	927 ml
ST12	72% - 59.5%	70.4	540 ml	40%	950 ml
PR12	72.5% - 58%	70.8	500 ml	40%	885 ml
PF12	73% - 58.5%	69.2	505 ml	40%	874 ml

** SS22 had cut 34 from ST22 added by mistake

- ❖ Fermentation optimization trials are ongoing and further research is planned for agave fermentations and flavor.

Rahr/BSG Agave Spirit Project



Contributors and Contact Information

Pattie Aron paron@rahr.com

Emily Del Bel edelbel@rahr.com

Ben Stanwood bstanwood@rahr.com

Ilya Soroka isoroka@bsgcraft.com





Thanks

Any questions?