

Research Round-Up: Survivables

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Presentation Overview

- Analytical Journey
 - *What are survivables?*
 - *Past and present analytical instrumentation*
 - *Data availability*
- Survivables Chart
 - *CY25 Chart*
 - *Utilization*
- 5-year anniversary of CryoPop®

What are the survivables?

- The 'survivables' are beer soluble compounds derived from hops that survive the brewing process.
- The current target compounds include:

Linalool

Geraniol

Isobutyl isobutyrate

Isoamyl isobutyrate

2-nonanone

Methyl geranate

3-mercaptohexanol (3MH)

Survivables Compounds



Geraniol

- Monoterpene alcohol
- Can survive late boil and whirlpool additions
- Rose-like and citrus aromas



2-nonanone

- Ketone
- Can be sweet and fruity
- Can be cheesy, buttery or waxy



Linalool

- Monoterpene alcohol
- Commonly survives the brewing process
- Strong fruity and floral aromas



Methyl geranate

- Hop derived ester
- Fruit and floral aroma



Survivables Compounds



Isobutyl isobutyrate

- Hop derived ester
- Fruity aroma specifically pineapple



Isoamyl isobutyrate

- Hop derived ester
- Fruity aromas specifically tropical



2-methylbutyl isobutyrate

- Hop derived ester
- Fruity aroma specifically apricot



3-mercaptohexanol

- Sulfur-containing compound
- Tropical, grapefruit and passionfruit aromas

Where It All Began

- The original survivables data was collected on this instrument.
- Agilent 6890N GC and a 5975B MS
- Analyzed 1100 hop samples during harvest 2018
- Analyzed ~640 between harvest 2019 and 2020
- Analyzed 600+ beer samples since 2018



Research Ramp-Up

- Survivables analysis was transferred onto the newest instrument in 2019.
- Agilent 7890B GC, 7200 MS with a quadrupole time-of-flight (Q-ToF) and a sulfur chemiluminescence detector.
- Data from this instrument helped develop the Cryo Pop® blend.



Established Analytical Method

- New GCMS with SCD system installed in late 2021 to develop a more efficient method of analysis.
- Agilent 7890B GC, 5977B MS and SCD.
- This system utilizes the total oil samples already produced by the QC lab.
- This method has been in use for reporting survivables since 2022.



Data Availability



2023 Citra® Brand • HBC 394 • Type 90 Hop Pellets

Best Use Before: September 2026 Farm(s): Coleman Greenleaf, LLC

Add to Compare

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ALPHA ACID vs Typical Variety Range

13.7
UV Alpha (%)



BREWING VALUES

Percentage (%)

UV ALPHA	13.7%
UV BETA	4.4%
HPLC ALPHA	12.2%
HPLC BETA	4%
LCV ALPHA 7.5	13.6%

SURVIVABLE COMPOUNDS

Parts per Million (ppm)

ISOBUTYL ISOBUTYRATE	12.8
ISOAMYL ISOBUTYRATE	27
2-METHYLBUTYL ISOBUTYRATE	77.9
LINALOOL	131.6
GERANIOL	159.1
2-NONANONE	10.4
METHYL GERANATE	312.5
3-MERCAPTOHEXANOL	0.6

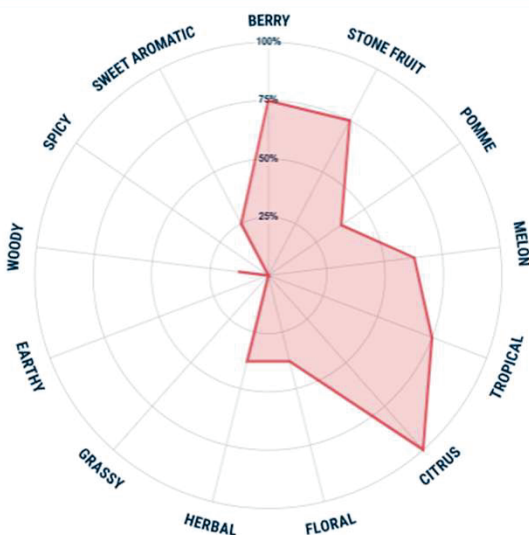
TERPENES

Parts per Million (ppm)

MYRCENE	
BETA PINENE	
LIMONENE	
TRANS CARYOPHYLLENE	
HUMULENE	

AROMA PROFILE

Percentage Detected (%)



TOP 5 AROMAS



CITRUS



BERRY



STONE FRUIT



TROPICAL



MELON

TOTAL OIL

vs Typical Variety Range

2
mL/100g



OIL COMPONENTS

Percentage (%)

β-PINENE	0.8%
MYRCENE	61.3%
LINALOOL	0.9%
CARYOPHYLLENE	6.9%
FARNESENE	0.2%
HUMULENE	11.9%
GERANIOL	0.8%
OTHER	17.2%

OTHER

HSI	0.246
HPLC COHUMULONE	21.9%
HPLC COLUPULONE	51.6%
MOISTURE	9.3%
SPRAY RECORD NOTES	

CY 2025 Survivables Chart

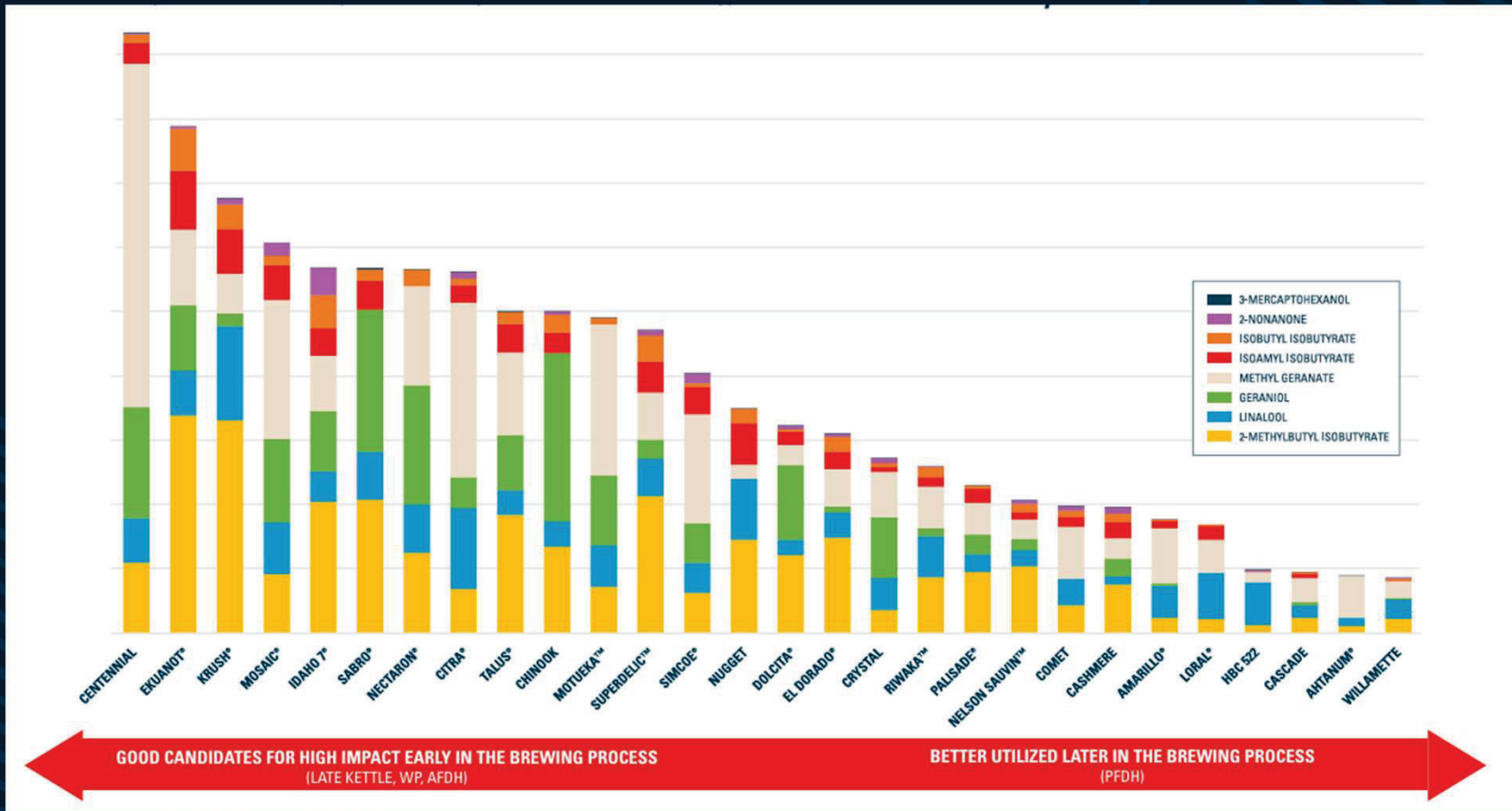


Chart Utilization: Addition Timing

Use high survivables
hops early (or late)

- Hops with higher concentrations of survivable compounds are likely to be more successful when used earlier in the brewing process (late kettle, WP or AFDH)
- Krush® would be a better choice than Loral®

Use low survivable hops late

- Hops with lower concentrations of survivable compounds will likely be more successful when used later in the brewing process (PFDH).
- Cashmere or Palisade® would have a better impact when used later.

CY 2025 Survivables Chart

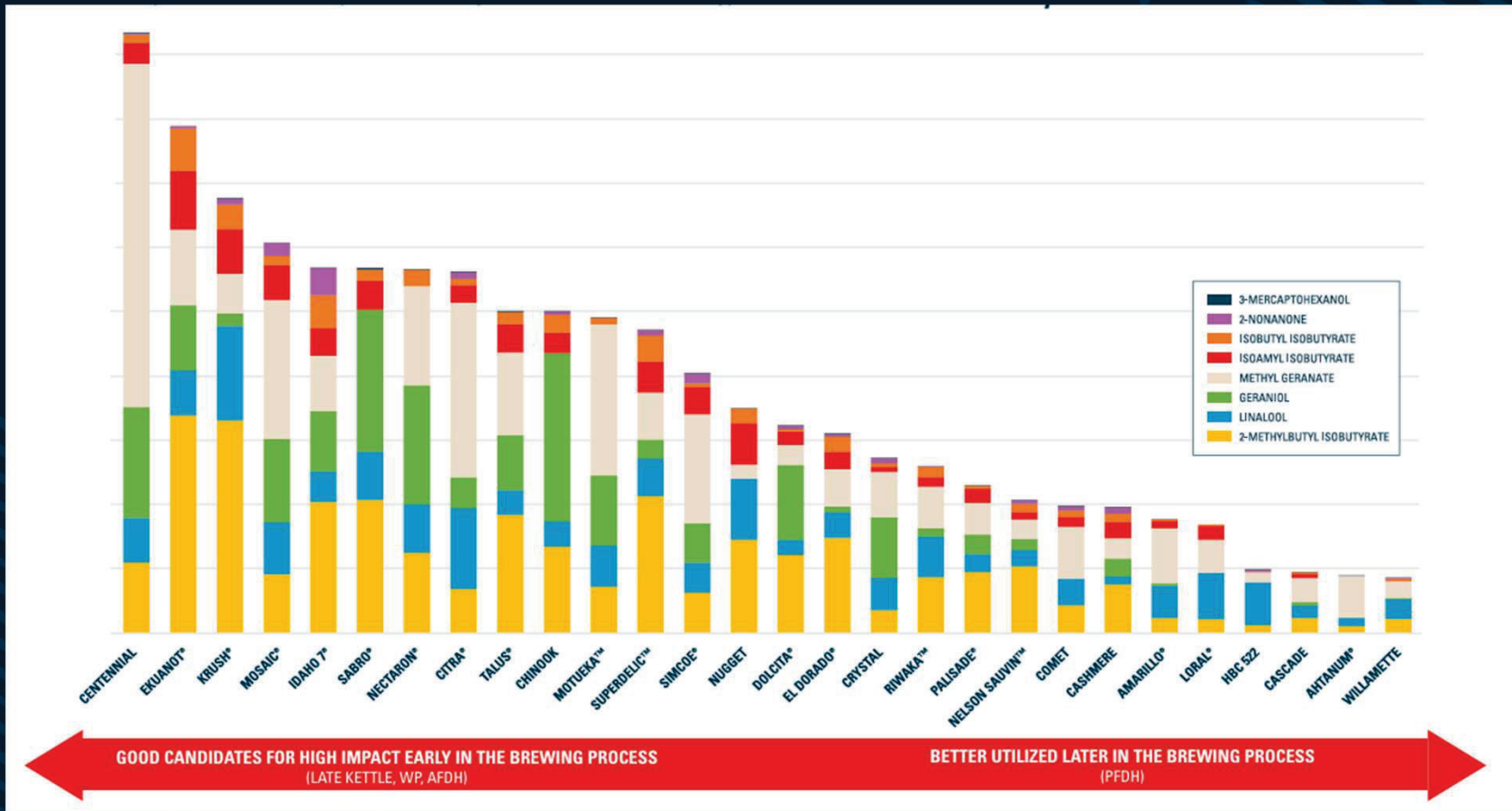


Chart Utilization: Addition Timing

Load wort streams with high survivables early

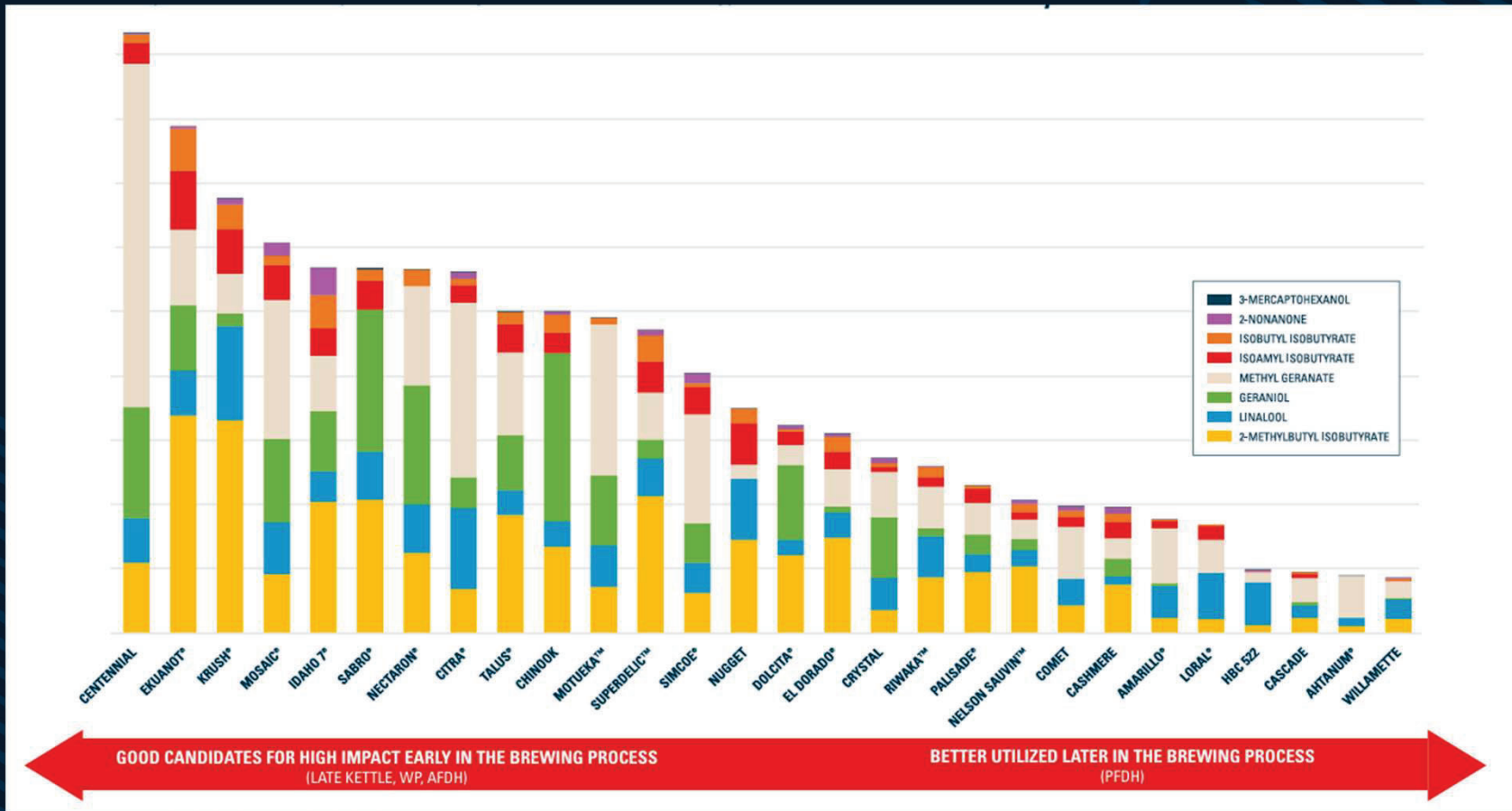
- High concentrations of survivables in whirlpool and active fermentation dry hopping can create conditions necessary for beneficial biotransformation.
- A whirlpool addition of Idaho 7® with AFDH of Sabro® and Simcoe® is likely to yield a huge flavor impact.

Blend hops to maximize beneficial concentrations

- Focus on balancing high concentrations when creating blends.
- Loral® is high in linalool and Talus® is high in geraniol, the two of them are likely to work well in concert. Loral® and Crystal are both high in linalool and would therefore likely create a less dynamic and more one-dimensional blend.



CY 2025 Survivables Chart



5-year Anniversary of CryoPop®

- Born from the survivables research and released in 2021, this specially curated blend of hops delivers massive tropical, stone fruit and citrus aromas into your final beer!



**HOP &
BREW
SCHOOL**

THANK YOU!

