

COLLAB HOUR



Weekly Webcast
for Members

Are Older Hops Still Any Good?

A Science-based Panel Discussion





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Situation Analysis:

Perception:
I need the most current crop year to brew good beer.



Reality:

- The current crop harvest:
 - USA, Germany, Czech
- What's out there on Spot?
 - Current inventories
- What's not available?
- What to look for
- How to make the best (or better) of it



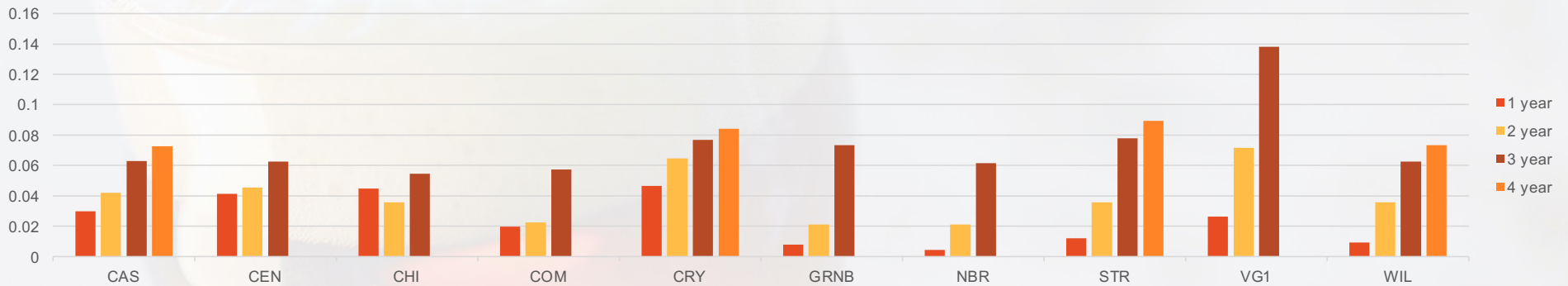
**Alpha
Degradation
over time:**

Predictable



hOLLINGBERY
& SON, INC. HOPS

HSI Increase by Year



CAS n=17
CEM n=11
CHI n=14
COM n=4
CRY n=5

GRNB n=3
NBR n=4
STR n=4
VG1 n=10
WIL n=4

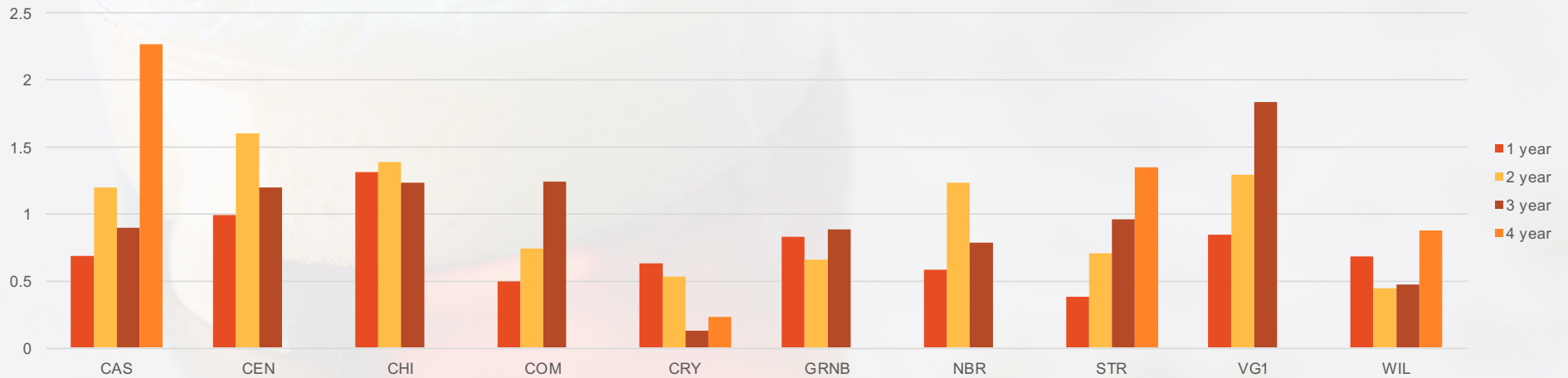
Hop Storage Index (HSI) is a measure of the degradation of alpha and beta acids during storage and handling of hops. As hops age, the levels of specific compounds within the hops change. Acids tend to decrease over time, while degradative compounds associated with oxidation increase. We've seen an increase in HSI per year, but not at the same rate in each variety. But, generally speaking, HSI does not increase dramatically as long as the bags are continuously kept cold (freezing or below) and are absent of oxygen (no bags left unsealed/nitrogen-purged for longer than a few days).

As an example, a lot of 2017 Cascade was originally tested with an HSI of 0.324 in 2017; in 2020 it's HSI was 0.346; and in August 2022 the HSI was 0.392.



hOLLINGBERY
& SON, INC. HOPS

% AA Loss Year-to-Year



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GRNB n=3

CEM n=11

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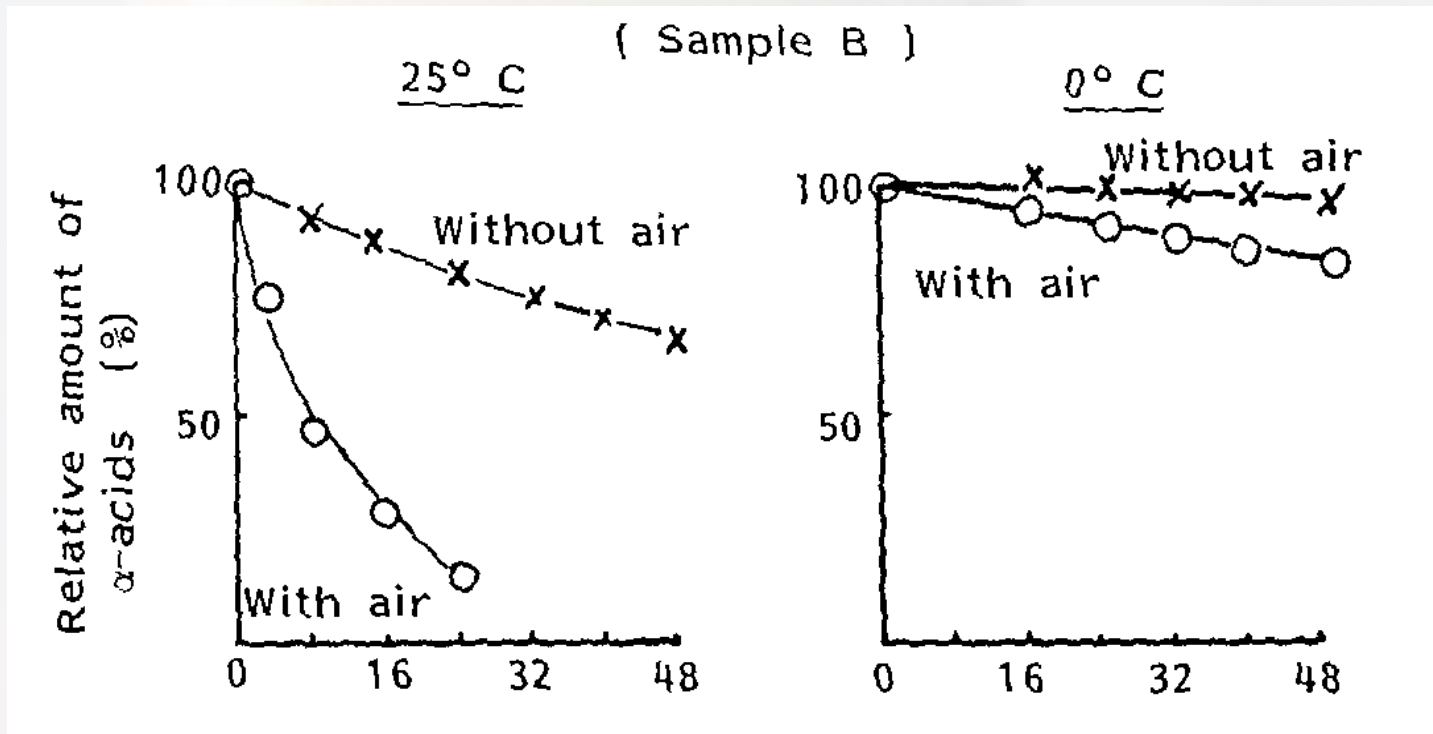
Year-to-year, there is almost always an alpha acid loss in every lot. But depending on variety, that rate could increase over the years, or decrease over the years. This demonstrates the importance of having up-to-date analysis on older lots.

Using the same 2017 Cascade lot as an example from the previous slide, the lot originally tested at 6.8%AA in 2018; in 2020 it tested at 6.5%AA; and in August 2022 it tested at 5.2%AA.

Alpha Loss Depends on Temp and Air

While Alpha degradation is going to happen, the Alpha loss can be curtailed dramatically through proper Hop storage

Properly stored at 0° C, and in a nitrogen flushed bag Alpha Loss can be significantly reduced

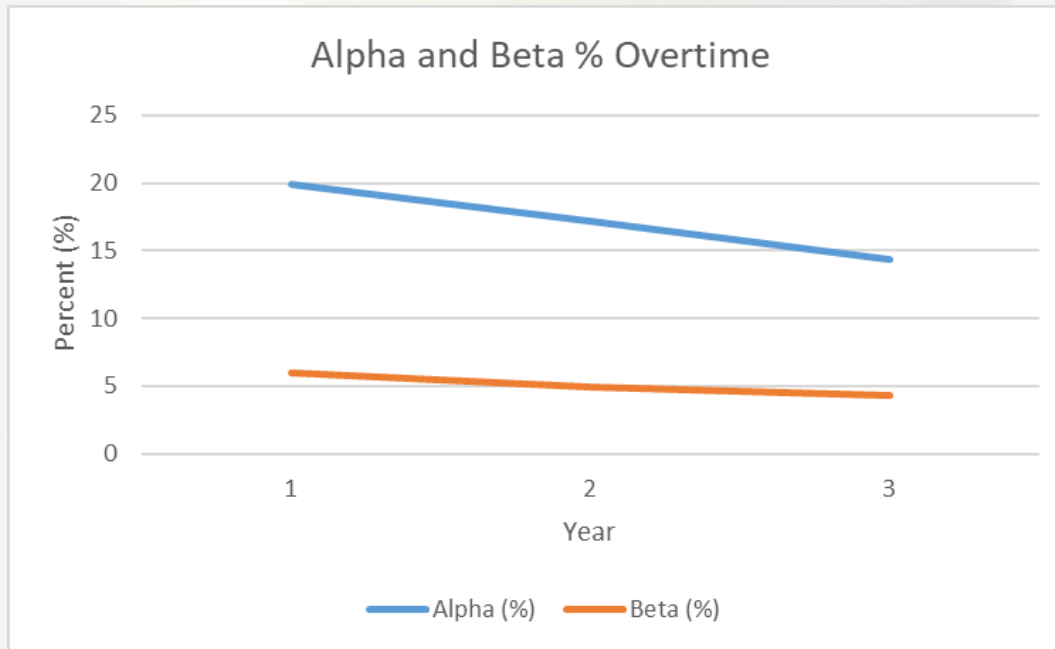


Source - Journal of the American Society of Brewing Chemists



Longer Term Degradation of Alpha and Beta

- Alpha Varieties can lose up to 15.5% of their Alpha in 1 year
- Below Zeus example lost 28% of its Alpha in the 2-year study
- Some Aroma Varieties have lost as much as 20% in the first year



<u>Year</u>	<u>Alpha (%)</u>	<u>Beta (%)</u>
1	19.9	5.97
2	17.2	4.92
3	14.4	4.35



Alpha, mostly
predictable when
**STORED
PROPERLY.**

But what about
Aroma & Flavor?



Hop Storability

• Forced aging study: 2021

- Ambient, freezer, refrigerator and heated sample conditions
- Samples stored in vacuum sealed bags with some air exposure
 - Testing planned to repeat in 2022/2023 with mylar sealed & flushed foils

• Alpha loss & oils comparison

- Alpha decrease from 11.9% to 9.1% by HPLC
- Alpha decrease from 7.4% to 5.8% by UV-Spectro
- Total oil content drop from 2.0 ml/100g to 1.4 mL/100g
- Decrease/Increase in certain terpenes

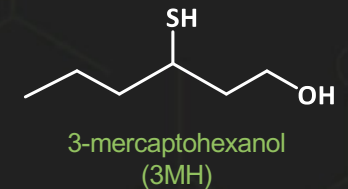
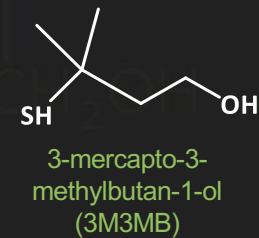
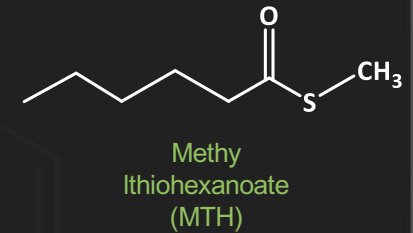
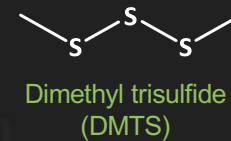
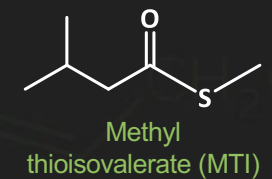
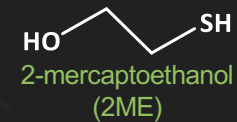
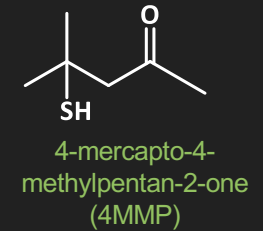
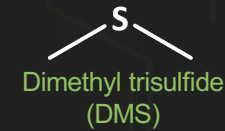
• Initial Findings

- Cooler temperatures are best for longer term storage
- Vacuum sealed bags work OK, but mylar with inert gas are the better storage conditions
- Avoid large temperature fluctuations
- Alpha will degrade, but fairly slowly with good storage
- Volatile compounds still change over time

Hop Storability

• Thiol compounds:

- **2ME/DMS** – 2-mercaptoethanol/dimethyl sulfide: grilled, gas/ vegetal, cooked corn
- **4MMP/MTI** – 4-mercapto-4-methylpentan-2-one/methyl thioisovalerate: catty, black currant/ cheesy, fermented fruit
- **DMTS** – dimethyl trisulfide: savory, garlic, sulfurous
- **3M3MB** – 3-mercapto-3-methylbutan-1-ol: savory, soup
- **MTH** – methyl thiohexanoate: guava, passionfruit, grapefruit
- **3MH** – 3-mercaptohexanol: passionfruit, guava, tropical, grapefruit



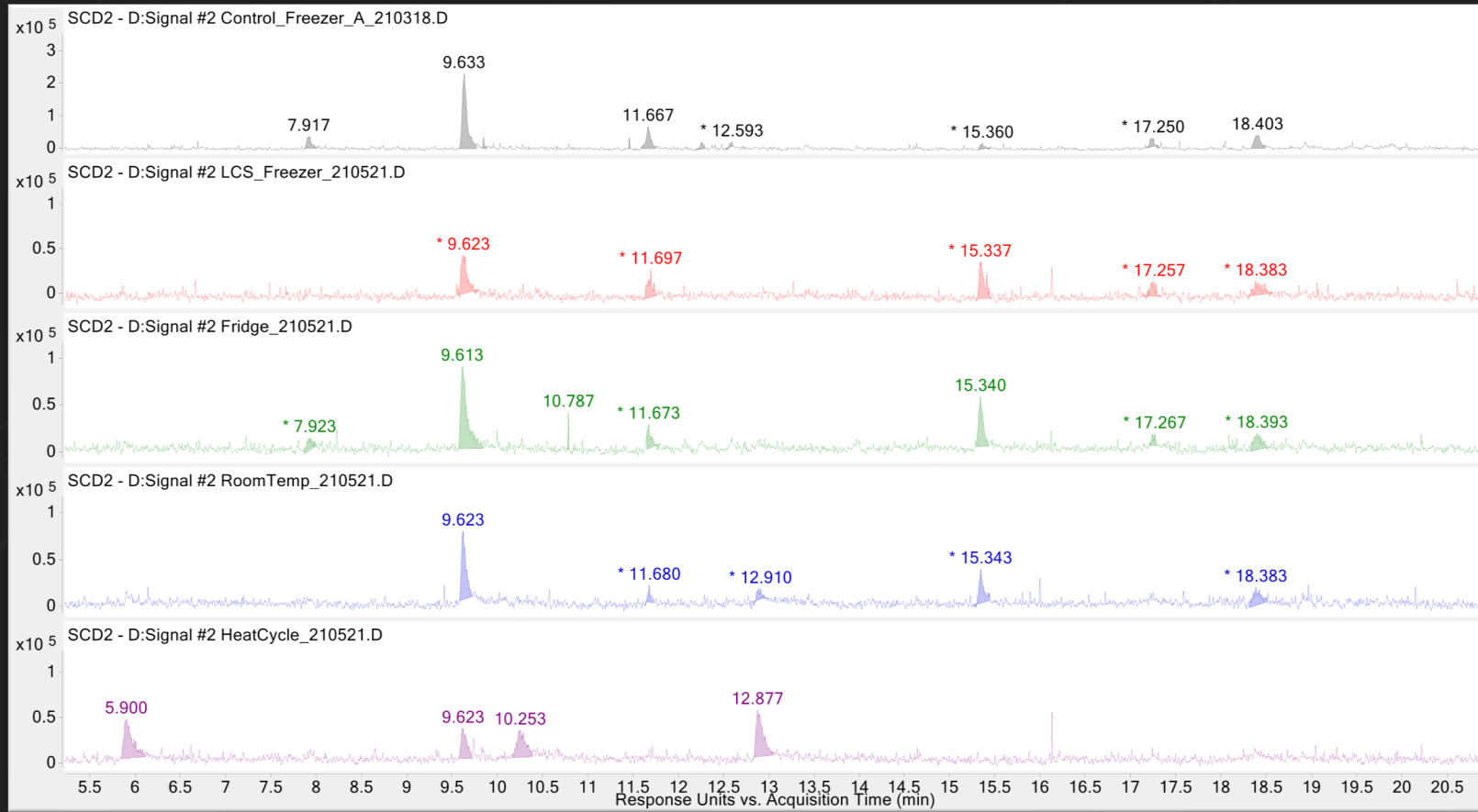


Figure 1. Detected free thiol chromatograms for T0 and 2 month samples.

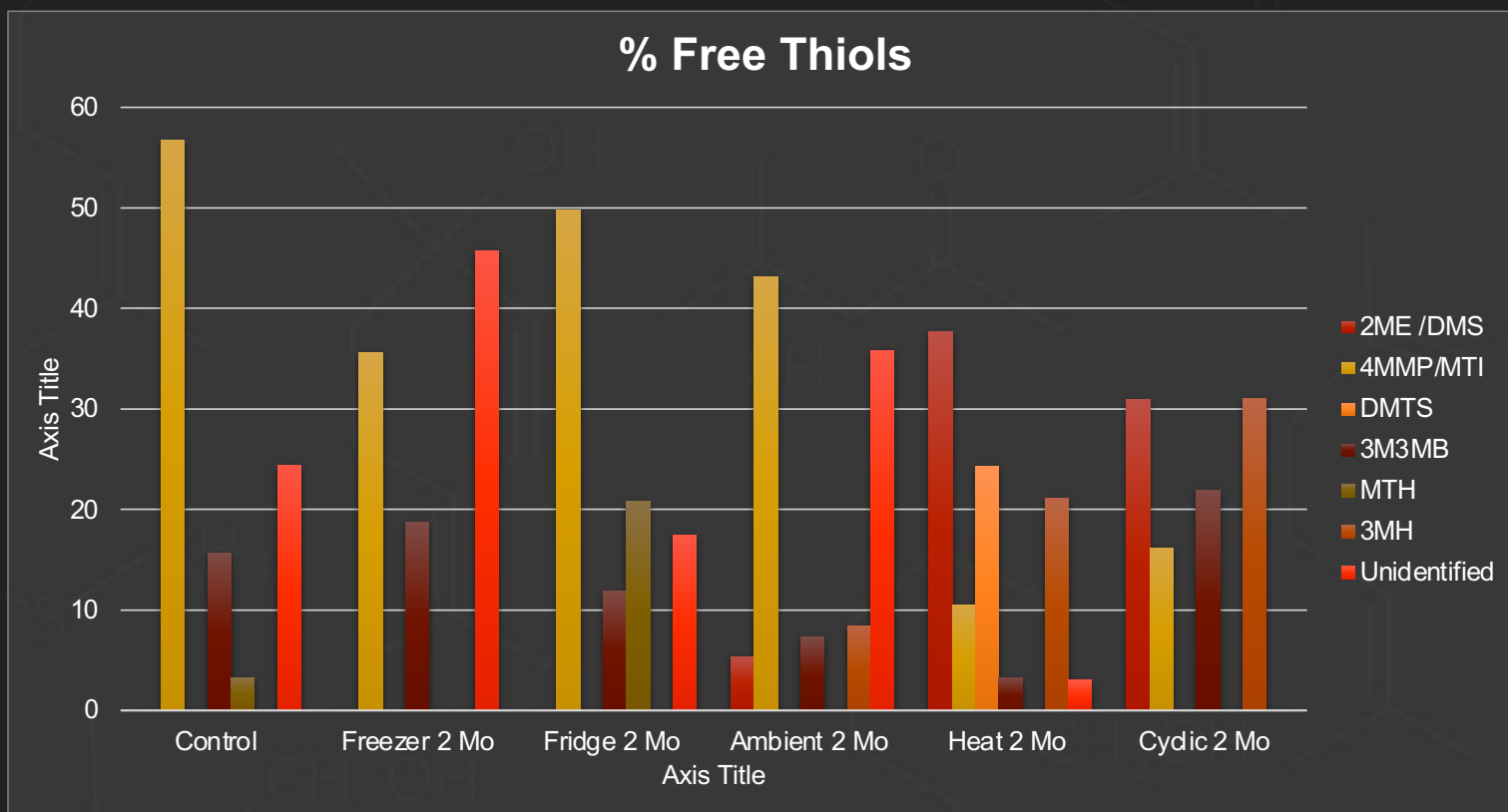


Figure 2. Free thiols as % of total thiols detected w/respect to PAR testing according to established HopTechnic® procedures for GC-FID/SCD, specifically control sample and 2 month time point samples.

Table 2. Alpha acid percent of two pellet lots tested in 2018 and 2022

	2018	2022	% Difference
Lot A	11.9%	9.1%	23.5%
Lot B	7.4%	5.8%	21.6%

Lot A was a T45 pellet sample from CY2018. Initial alpha and final alphas were tested by HPLC. For this sample, samples were tested from freshly opened mylar foils stored at -20°C.

Lot A was a T90 pellet sample from CY2018. Initial and final alphas were tested by UV Spectrophotometry. Samples were collected from vacuum sealed food bags stored at 0°C.

Compound	2018 % Composition	2022% Composition
Myrcene	59.8	53.1
Humulene	14.5	18.8
Caryophyllene	5.0	6.3
Farnesene	4.9	5.9
Geraniol	0.1	0.05
Limonene	0.6	0.7
Linalool	0.0	0.6
α -pinene	0.1	0.1
β -pinene	1.0	0.9
2-undecanone	0.1	0.6

Table 3. Percent composition of terpenes for T45 pellet sample tested in 2018 and 2022. Total oil was found to be 2.0 ml/100g initially and decreased to 1.4mL/100g after 4 years. Sample was stored in mylar foils, flushed with inert atmosphere at -20°C.

Discussion - Question & Answers





THANKS!

