

Impacts of Pressure on Brett Fermentation

Chris Saunders & Jonah Greenbaum-Shinder
homebrew@escarpmentlabs.com



Jonah

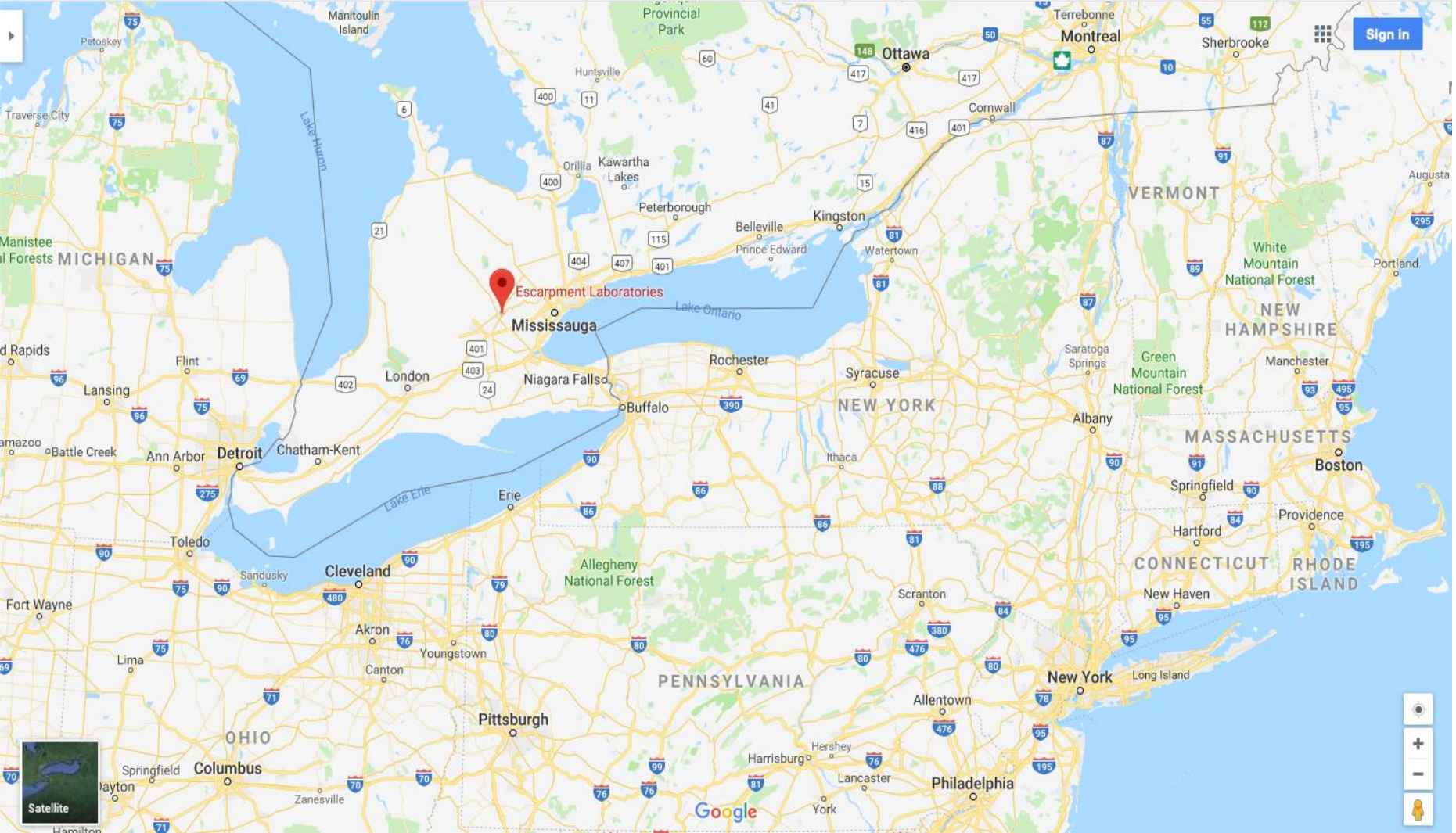
- Homebrew Lead
- Mostly Brews: Saisons & Pale Ales
- Favourite Styles: Mixed Fermentation Saisons w/Brett
- Favourite Yeast:
 - Lager: Biergarten
 - Ales: New World Saison Blend
- Other: Koji/Tempeh Research, Sourdough, "Being Funny"



Chris

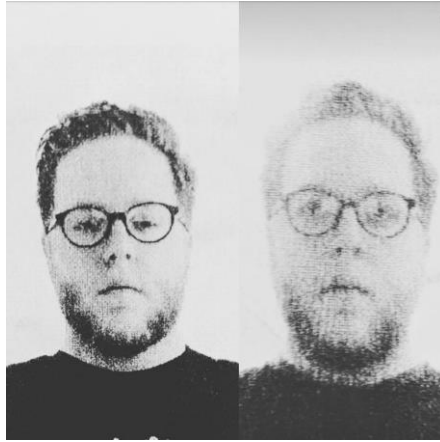
- Quality Control & Automation at Escarpment
- Mostly Brews: < 5% ABV
- Favourite Styles: German style lagers and wheats.
- Favourite Yeast:
 - Lagers: Isar
 - Ales: Voss
- Other: Fermented foods, lo-alc (beer, kombucha, water kefir)



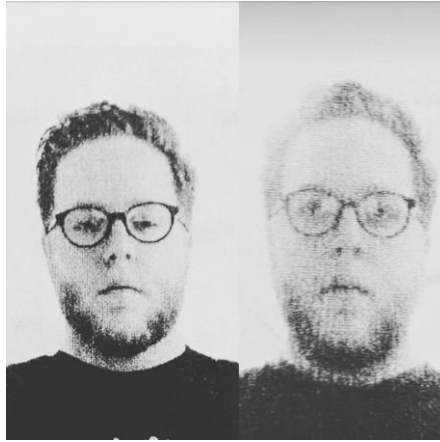


The Inspiration

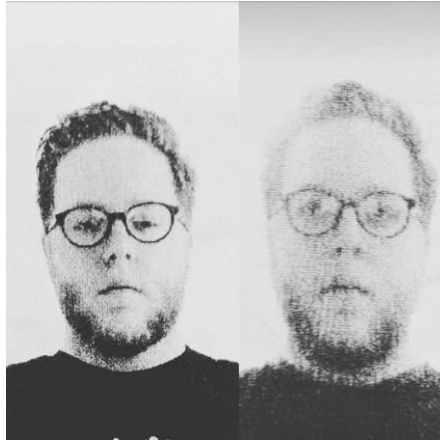
This is Richard



He's our boss



He likes to do science



“People say that putting Brett under pressure makes funkier beers. We should like test that and find out if that’s true. We can send samples to the University for testing to get actual numbers”

What is “Funk”?

Blanket term for flavour characteristics often associated with Alternative Fermentation Beers.

Can come from numerous microbe sources such as *Brettanomyces*, *Lactobacillus* & *Pediococcus*

Many industrial breweries consider these characteristics to be flaws.



Milk the Funk and Brett + Pressure

“It is speculated that the extra stress of pressure within the bottles helps to create this complexity.”



*"I split a batch [of wort co-pitched with sacch/brett and] fermented one in a glass carboy ... the other in a **keg at 15 psi**. [Shared samples with my club and] ... the **beer fermented under pressure was definitely *not* funkier** than the carboy ... the [no pressure beer] ... seemed to have a more distinctive brett-character."*

“Sometimes on shorter term and less funky beers, I will co-pitch Sacch and Brett in primary, then coax some funk by transferring after 2-4 weeks to keg and letting it sit under pressure for a month.”

*“No research to my knowledge.
Some pro and home brewers have
seen an anecdotal quickening of
maturation under pressure”*

It is *speculated*



Have seen ***anecdotal***



Contradictory observations

But we have ✨🔬
SCIENCE 🔬✨

Our Approach

Gas Chromatography

What is actually present in a tested sample

Sensory Panel

What people actually perceive when sitting down and tasting a beer



What is Gas Chromatography?

A device that measures the interaction time of different compounds with the walls of the device (a column). This information is recorded and based on known values can determine what the numeric concentration of different compounds are.

The technology we used is Headspace Solid Phase Micro-extraction Gas Chromatography Mass Spectroscopy



It's a computer with a really good nose



Compounds often seen in
“Funky” beer?

What is “Funk” - Hexanoic Acid

- Fatty Acid
- Typical sensory detection threshold 8ppm
- Common Descriptors:
 - Sweaty
 - Cheesy
 - Goaty
 - Fatty
 - Etc
- How to replicate?
 - Let goat cheese oxidize for ~2 weeks (for Chris anyway)

What is “Funk” - Ethyl butyrate

- Ester
- Typical sensory detection threshold 300ppb
- Common Descriptors:
 - Pineapple
 - Mango
 - Tropical Fruit
 - Etc
- How to replicate?
 - Smell / taste overly ripe tropical fruits such as mango or pineapple

What is “Funk” - 4-Vinylguaiaicol

- Phenol
- Typical sensory detection threshold 300ppb
- Common Descriptors:
 - Cloves (most common)
 - Nutty
 - Spicy
- How to replicate?
 - Clove spice
 - Cooked Buckwheat

What is “Funk” - 4-Ethylphenol

- Phenol
- Typical sensory detection threshold ~400ppb
- Common Descriptors:
 - Barnyard
 - Horse blanket
 - Spicy
 - Smoky
 - Medicinal
 - Etc
- How to replicate?
 - Check out your local farm
 - Ferment strawberries with brett for medicinal



What is “Funk” - 4-Ethylguaiaicol

- Phenol
- Detection at 600ppb
- Common Descriptors:
 - Smoke
 - Spice
 - Clove
- How to replicate?
 - Campfire
 - Clove Studded Steamed Hams

Hypothesis

By fermenting the same wort under different conditions we should taste a difference in the amount of “funkiness” of these beers.

This will be tested by fermenting beers under the following conditions:

- No Pressure (aka blow off)
- 15 PSI after 2 weeks
- 15 PSI for entire duration of fermentation



Wort Production

Target: 40L (Jonah - 1.052, Chris - 1.040)

Grain Bill: ~70% Pilsner, ~22% Munich I, ~8% White Wheat

Hopping:

- First wort hop with Magnum for 21 IBU
- 15m whirlpool with Tradition (0.6g/L; ~5 IBU)

Fermentation: Cool out to ~20°C, pitch and ferment in lab (23 - 27°C ambient)

Separate variables for each: OG, Yeast Pitched, etc.



Fermentation

Brew #1 - Jonah

New World Saison Blend

- Blend North American Saison Sacch & two Brett Strains

Brew #2 - Chris

Old World Saison Blend

- Blend of two traditional saison yeasts

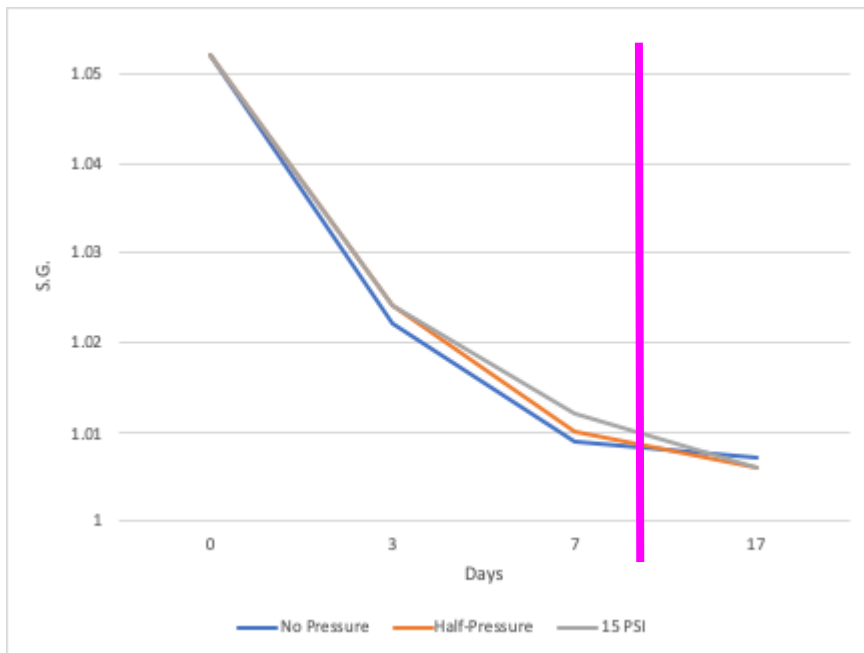
Brett L & Brett B

- Classic brett strains seen in many Belgian mixed fermentation beers

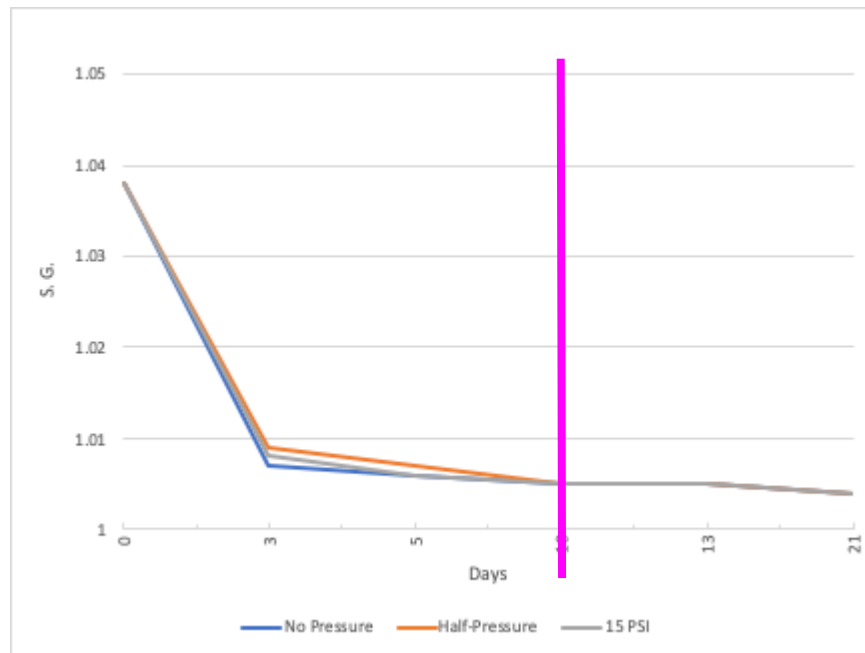


Attenuation

Brew #1 - NW Saison Blend



Brew #2 - Old World Blend + Bretts B & L



“Two week” beer placed under pressure (No pressure for first 10 days)

Sample Preparation for Testing

After primary fermentation, force carbonated then packaged into 750mL champagne bottles. Stored warm for 4 months.

Samples pulled and frozen until entire project was ready for gas chromatography

- 1 Month pulled and frozen before carbonation
- 4 Month (carbonated) sample collected and frozen until ready for GC

Before sending to GC, samples were sterile filtered to “Lock-In” flavour compounds

Sensory Evaluation

Product evaluated at two points - Initially after carbonation, after 4 months bottle aging.

Evaluation performed using Quantitative Descriptive Analysis

0
None

5
Lots

Funky - Barnyard



That's neat. But let's see
the numbers



Let's Focus

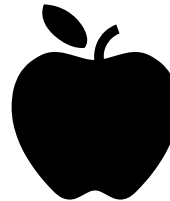
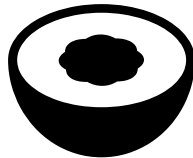
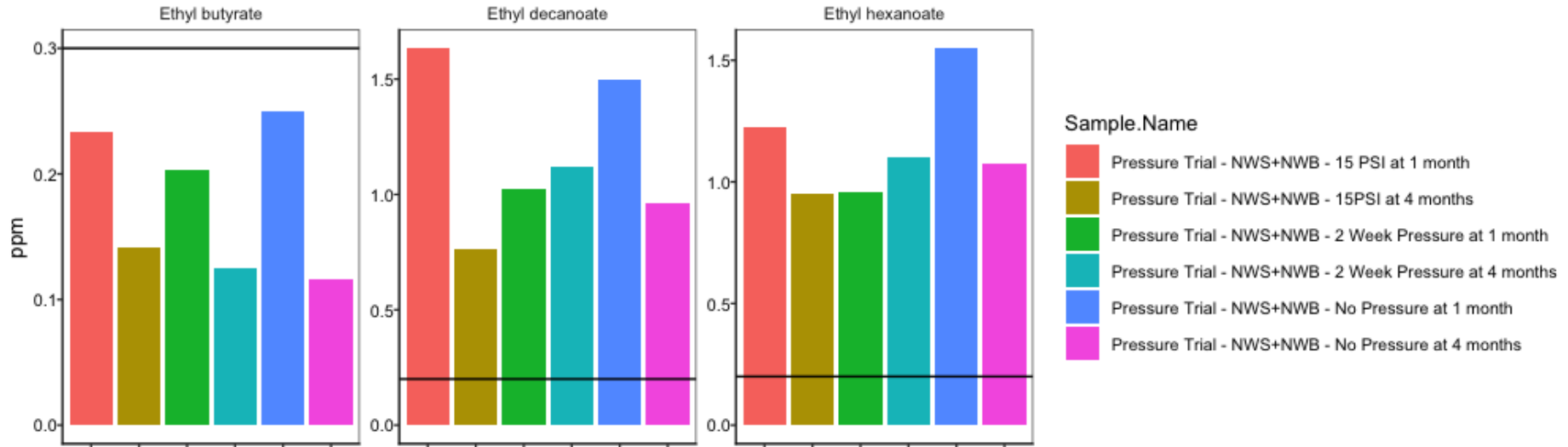
A lot of data was collected and not all of it is relevant.

Some of the samples also had data-points that were so close it's not even worth comparing

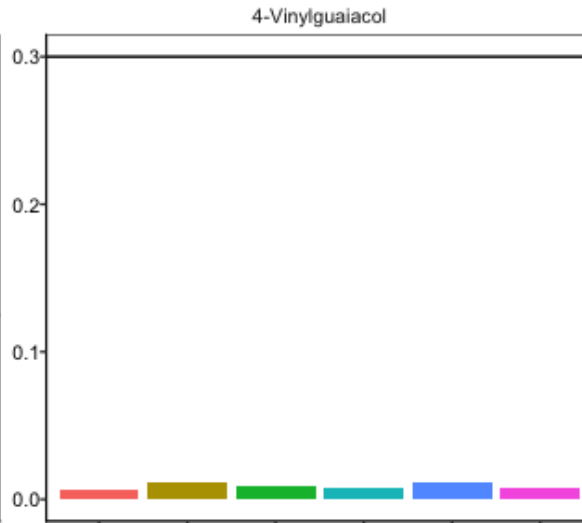
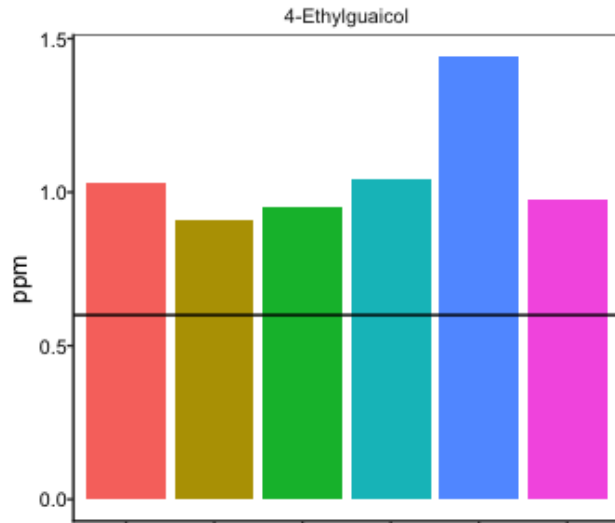
However, there's a few compounds in the data that are pretty interesting:

Phenols	Esters	Fatty Acids
Smoky, Clove, etc	Tropical Fruit, Pomme Fruit, etc.	Cheesy, Goaty, Sweaty, etc.

GC Results | Esters | New World Blend



GC Results | Phenols | New World Blend

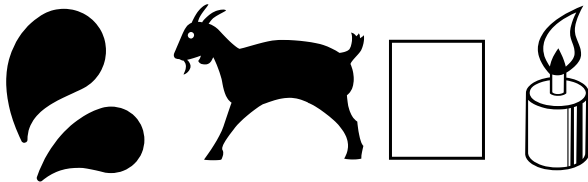
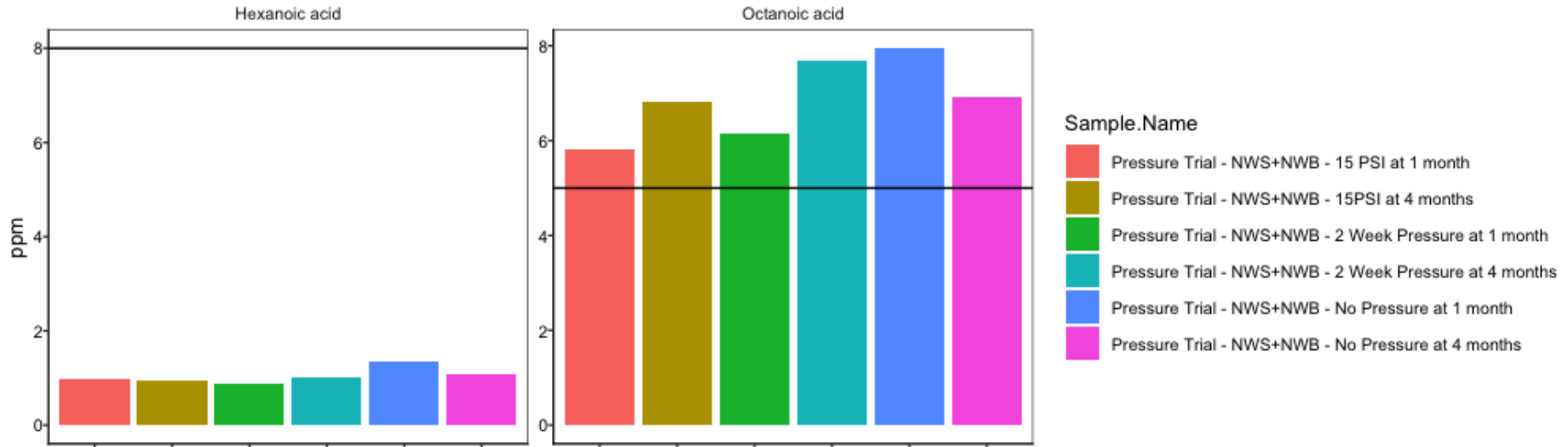


Sample.Name

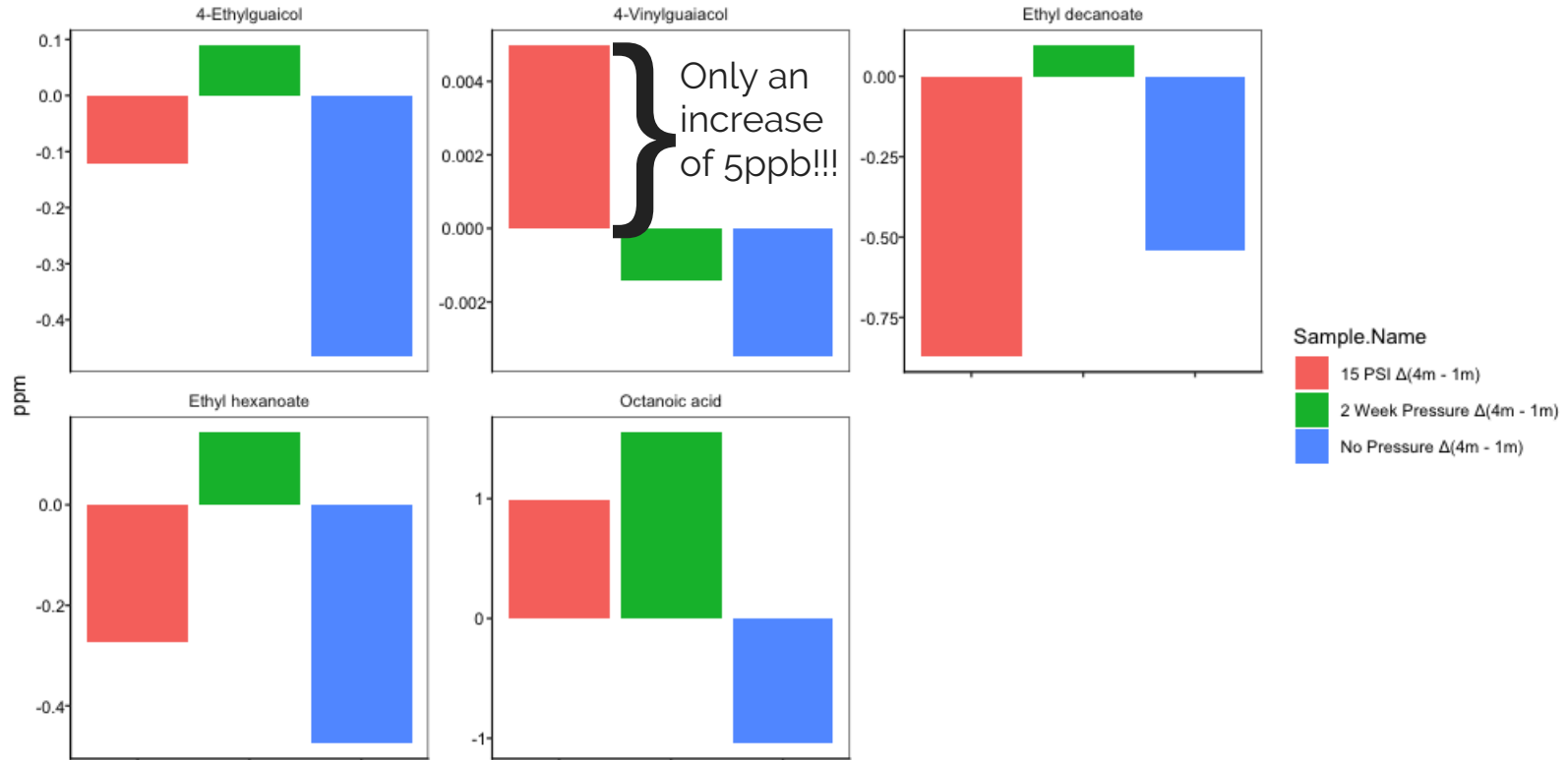
- Pressure Trial - NWS+NWB - 15 PSI at 1 month
- Pressure Trial - NWS+NWB - 15PSI at 4 months
- Pressure Trial - NWS+NWB - 2 Week Pressure at 1 month
- Pressure Trial - NWS+NWB - 2 Week Pressure at 4 months
- Pressure Trial - NWS+NWB - No Pressure at 1 month
- Pressure Trial - NWS+NWB - No Pressure at 4 months



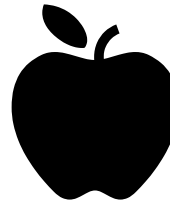
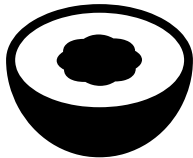
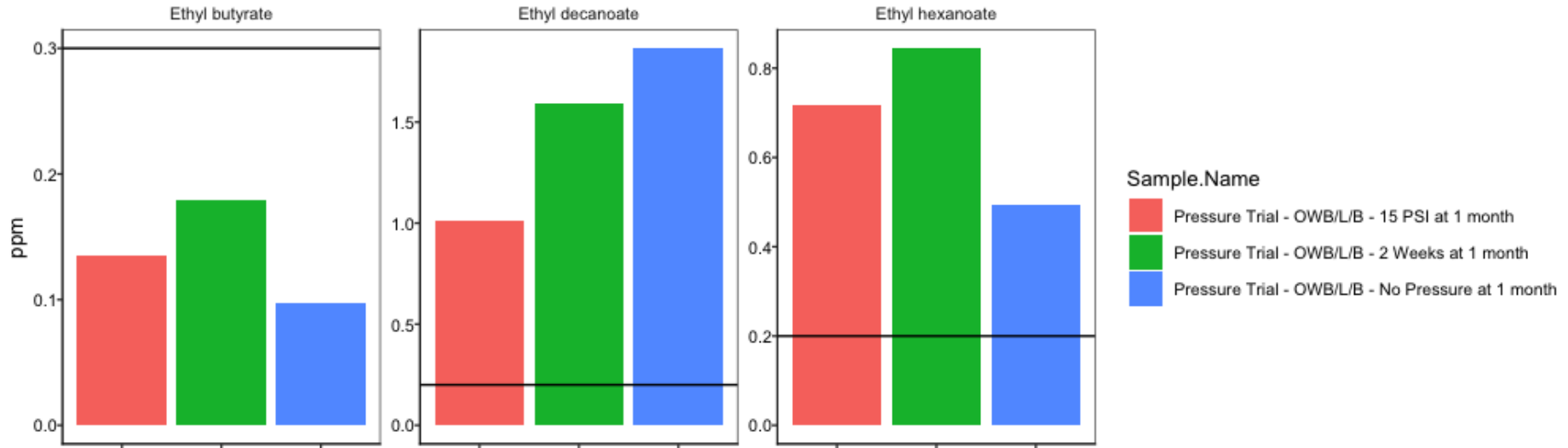
GC Results | Fatty Acids | New World Blend



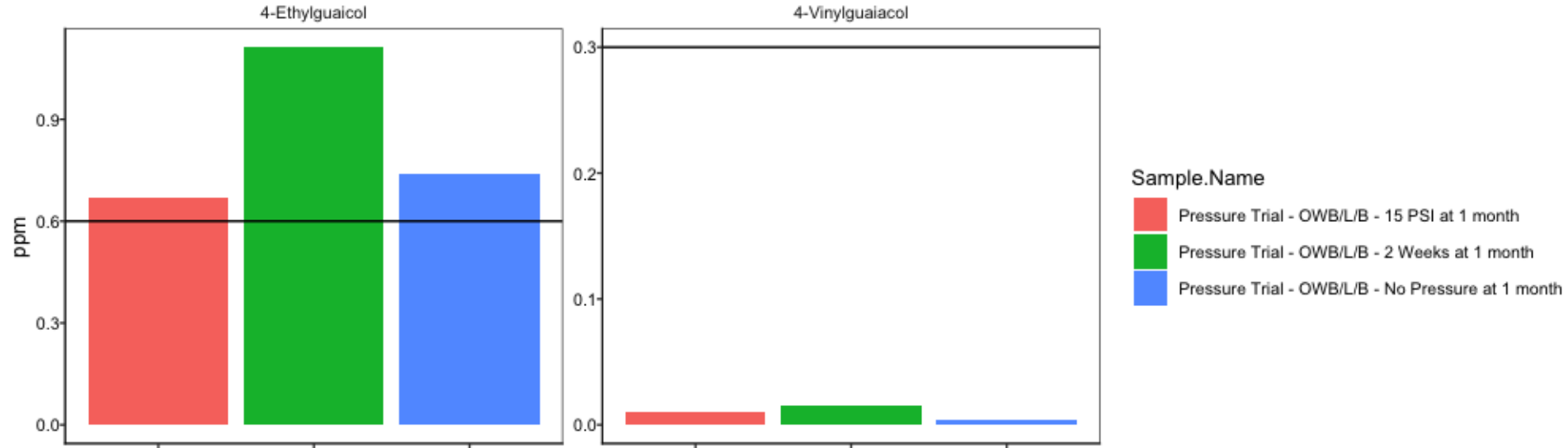
Change in NWB flavour metabolites over time



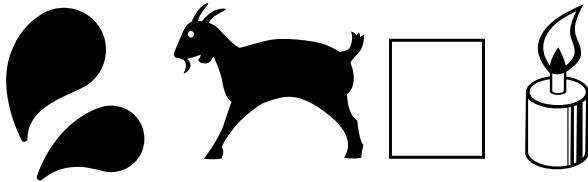
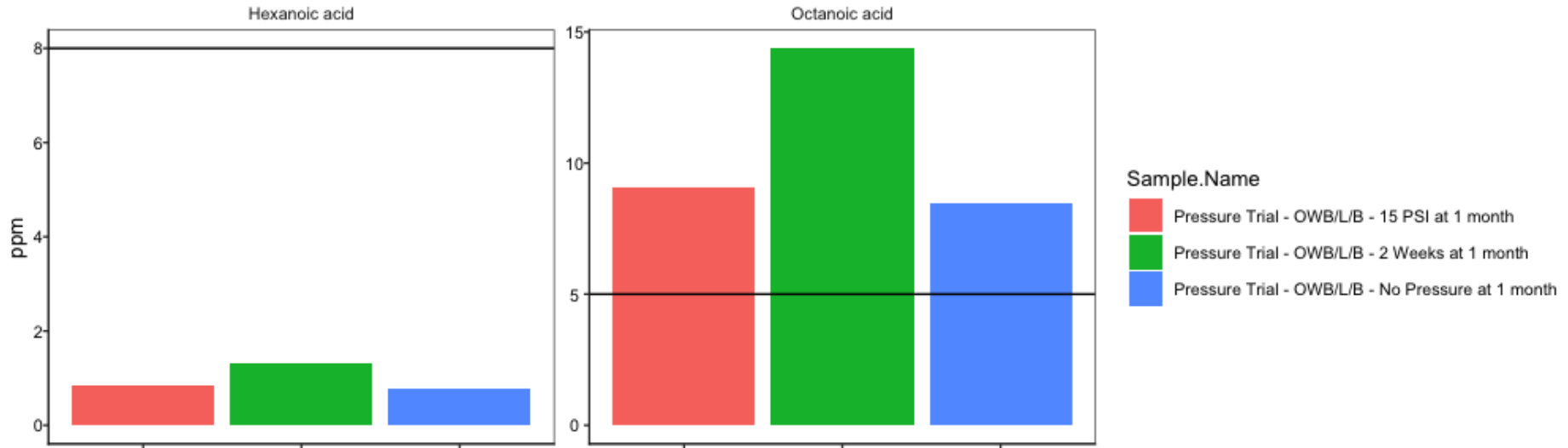
GC Results | Esters | Old World + Bretts



GC Results | Phenols | Old World + Bretts



GC Results | Fatty Acids | Old World + Bretts



But what was tasted?

Sample Presentation to Panel

Samples are given random numbers and members of the team show up to taste them and fill out online forms for data collection.

Panel performance can vary depending on:

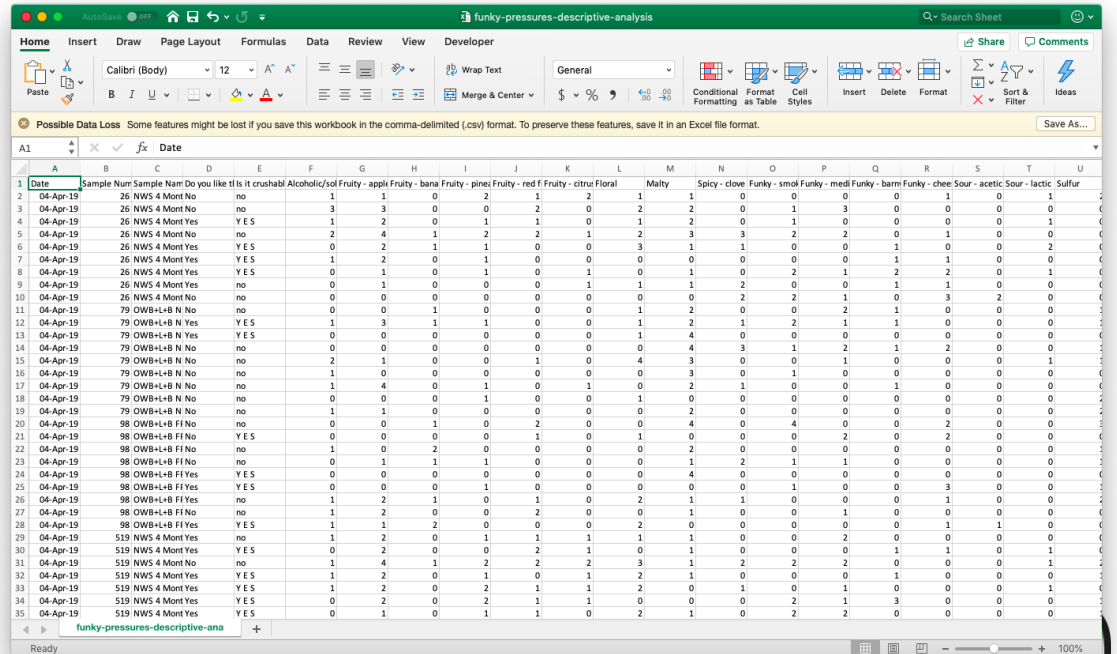
- Smells
- Mood
- Time of Day (i.e. after eating a spicy lunch)



Sensory Data

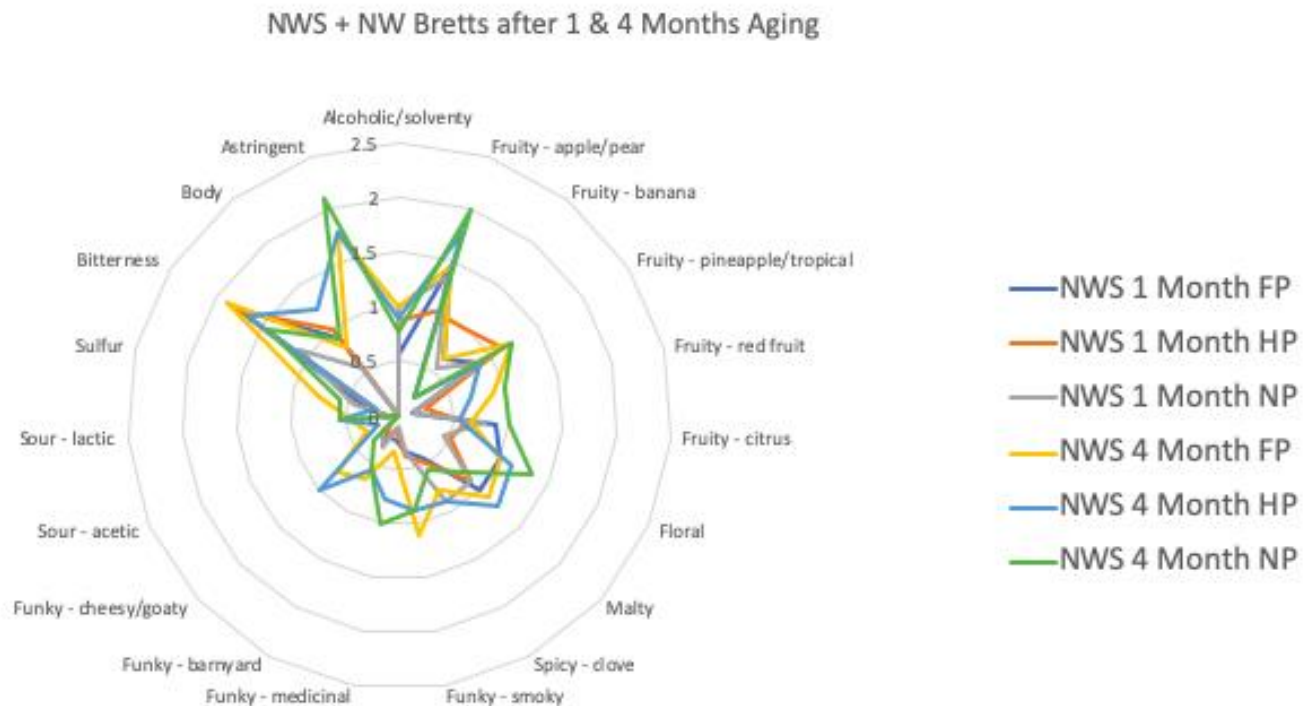
Pull it all in and start crunching those numbers!

For sensory data we went with the average answer per sample



Date	Sample Num	Sample Name	Do you like it	is it crushabl	Alcoholic/sol	Fruity - apple	Fruity - bana	Fruity - pine	Fruity - red f	Fruity - citrus	Floral	Malty	Spicy - clove	Funky - smok	Funky - medi	Funky - barn	Funky - chee	Sour - acetic	Sour - lactic	Sulfur
04-Apr-19	26	NWS 4 Mont No	no	1	1	0	2	1	2	1	1	1	0	0	0	1	0	1	0	0
04-Apr-19	26	NWS 4 Mont No	no	3	3	0	0	2	0	2	2	0	1	3	0	0	1	0	0	0
04-Apr-19	26	NWS 4 Mont Yes	YES	1	2	0	1	1	0	1	2	0	1	0	0	0	0	0	1	0
04-Apr-19	26	NWS 4 Mont No	no	2	4	1	2	2	1	2	3	3	2	2	0	1	0	0	0	0
04-Apr-19	26	NWS 4 Mont Yes	YES	0	2	1	1	0	0	3	1	1	0	0	1	0	0	2	0	0
04-Apr-19	26	NWS 4 Mont Yes	YES	1	2	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0
04-Apr-19	26	NWS 4 Mont Yes	YES	0	1	0	1	0	1	0	1	0	2	1	2	2	0	1	0	0
04-Apr-19	26	NWS 4 Mont Yes	no	0	1	0	0	0	1	1	2	0	0	1	1	0	0	0	0	0
04-Apr-19	26	NWS 4 Mont No	no	0	0	0	0	0	0	0	0	2	2	1	0	3	2	0	0	0
04-Apr-19	79	OWB+L+B N No	no	0	0	1	0	0	0	1	2	0	0	2	1	0	0	0	0	0
04-Apr-19	79	OWB+L+B N Yes	YES	1	3	1	1	0	0	1	2	1	2	1	1	0	0	0	0	0
04-Apr-19	79	OWB+L+B N Yes	YES	0	0	0	0	0	0	1	4	0	0	0	0	0	0	0	1	0
04-Apr-19	79	OWB+L+B N No	no	0	0	0	0	0	0	0	4	3	1	2	1	2	0	0	0	0
04-Apr-19	79	OWB+L+B N No	no	2	1	0	0	1	0	4	3	0	0	1	0	0	0	0	1	0
04-Apr-19	79	OWB+L+B N No	no	1	0	0	0	0	0	0	3	0	1	0	0	0	0	0	0	0
04-Apr-19	79	OWB+L+B N No	no	1	4	0	1	0	1	0	2	1	0	0	1	0	0	0	0	0
04-Apr-19	79	OWB+L+B N No	no	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
04-Apr-19	79	OWB+L+B N No	no	1	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
04-Apr-19	98	OWB+L+B Fi No	no	0	0	1	0	2	0	0	4	0	4	0	0	2	0	0	0	0
04-Apr-19	98	OWB+L+B Fi No	YES	0	0	0	0	0	1	0	1	0	0	0	2	0	2	0	0	0
04-Apr-19	98	OWB+L+B Fi No	no	1	0	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0
04-Apr-19	98	OWB+L+B Fi No	no	0	1	1	1	0	0	0	1	2	1	1	0	0	0	0	0	0
04-Apr-19	98	OWB+L+B Fi Yes	YES	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0
04-Apr-19	98	OWB+L+B Fi Yes	YES	0	0	0	1	0	0	0	0	0	1	0	0	3	0	0	0	0
04-Apr-19	98	OWB+L+B Fi Yes	no	1	2	1	0	1	0	2	1	1	0	0	0	1	0	0	0	0
04-Apr-19	98	OWB+L+B Fi No	no	1	2	0	0	2	0	1	0	0	1	0	0	1	0	0	0	0
04-Apr-19	98	OWB+L+B Fi Yes	YES	1	1	2	0	0	0	2	0	0	0	0	0	0	1	1	0	0
04-Apr-19	519	NWS 4 Mont Yes	no	1	2	0	1	1	1	1	1	1	0	0	2	0	0	0	0	0
04-Apr-19	519	NWS 4 Mont Yes	YES	0	2	0	0	2	1	0	1	0	0	0	1	0	0	1	0	0
04-Apr-19	519	NWS 4 Mont No	no	1	4	1	2	2	2	3	1	2	2	2	0	0	0	0	1	0
04-Apr-19	519	NWS 4 Mont Yes	YES	1	2	0	1	0	1	2	1	0	0	0	1	0	0	0	0	0
04-Apr-19	519	NWS 4 Mont Yes	YES	1	2	0	2	1	1	2	0	1	0	0	1	0	0	0	1	0
04-Apr-19	519	NWS 4 Mont Yes	YES	0	2	0	2	1	1	0	0	2	1	3	0	0	0	0	0	0
04-Apr-19	519	NWS 4 Mont Yes	YES	0	1	0	1	1	0	2	1	0	2	2	0	0	0	0	0	0

Analysis

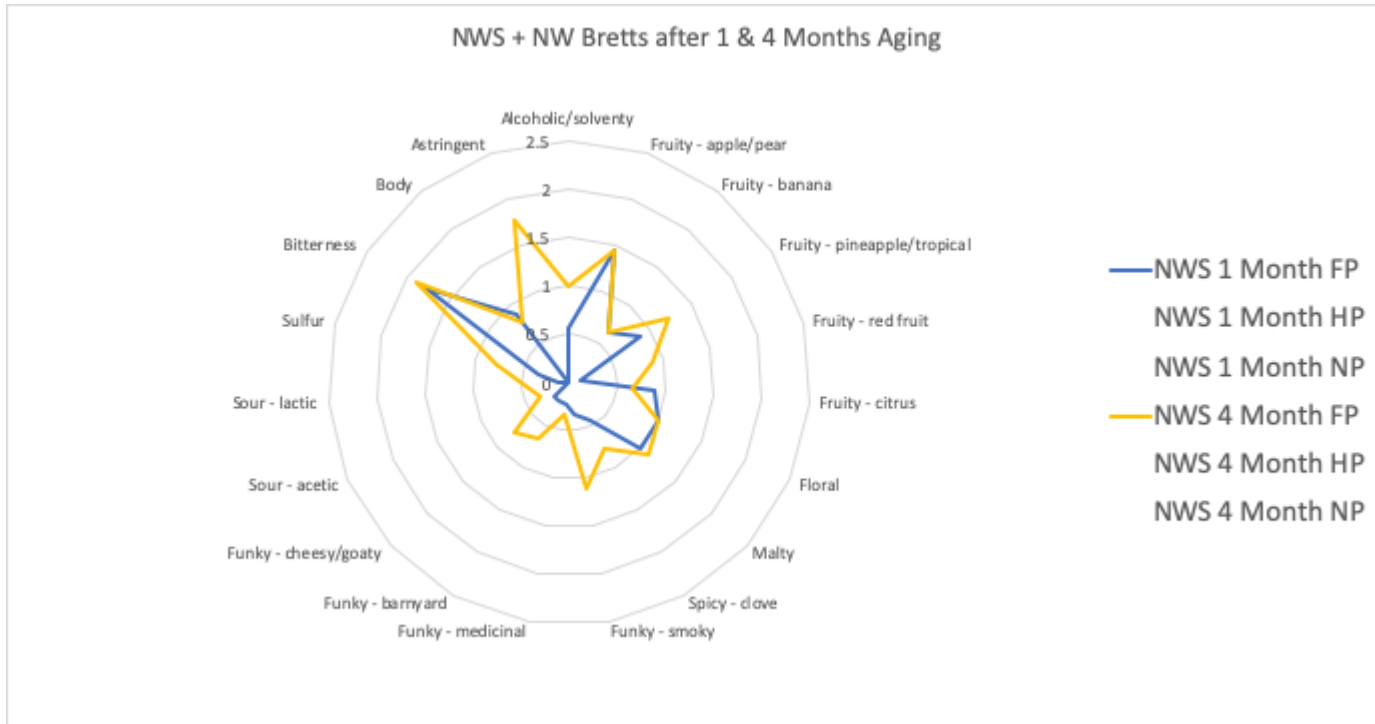


Umm... so... uh... yeah.

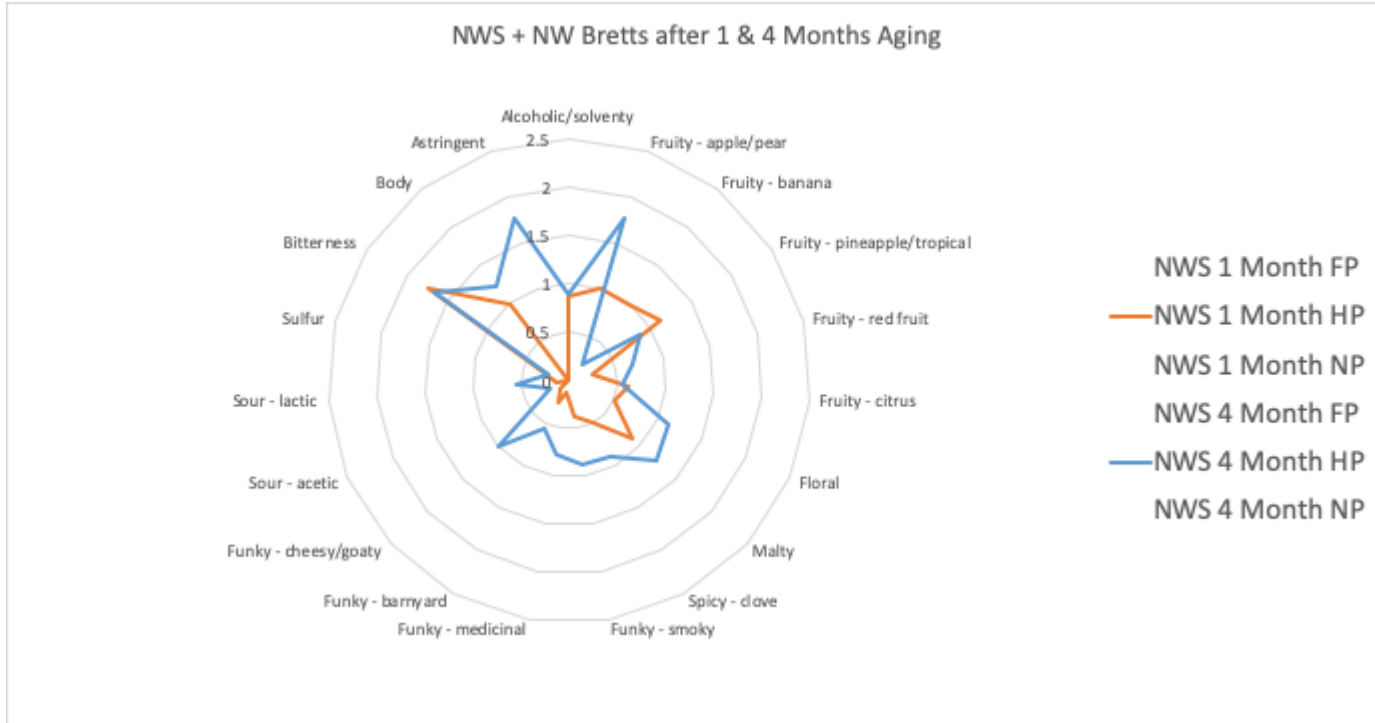


Let's focus on each pair of
data points

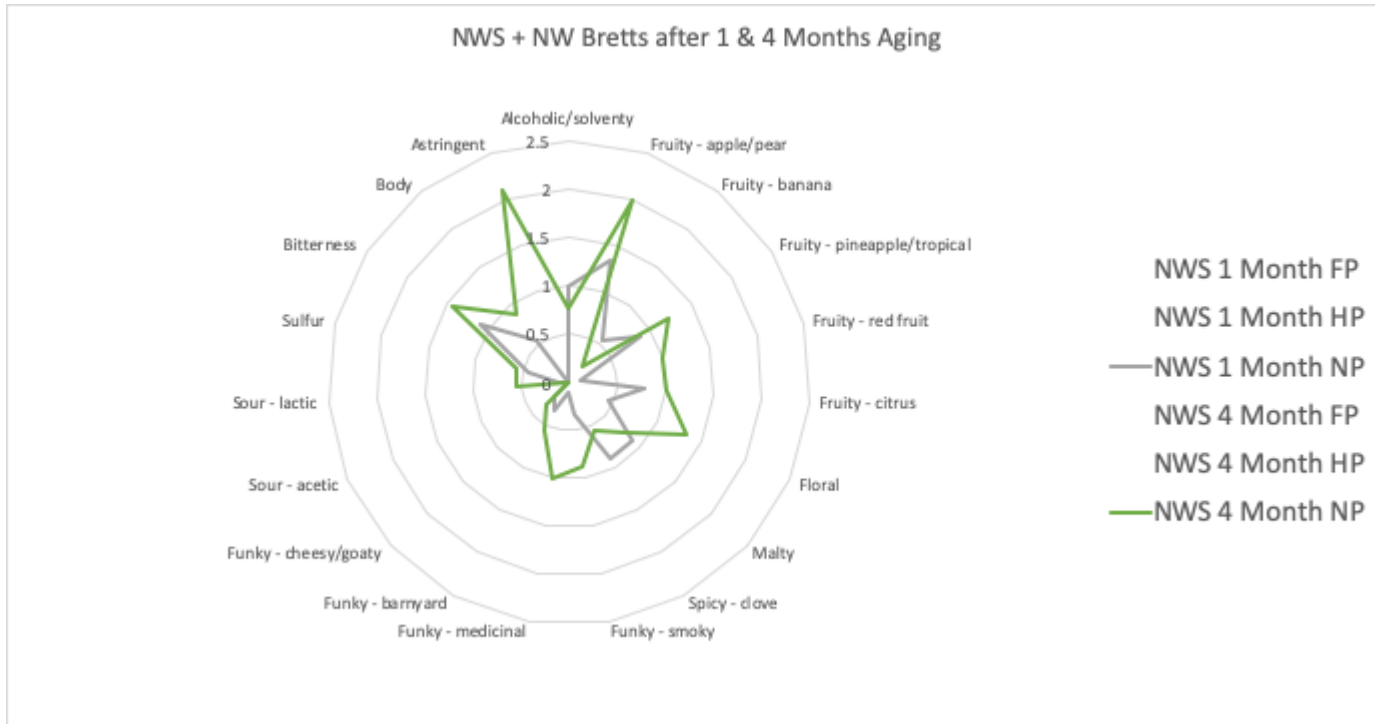
New World Blend @ 15 PSI



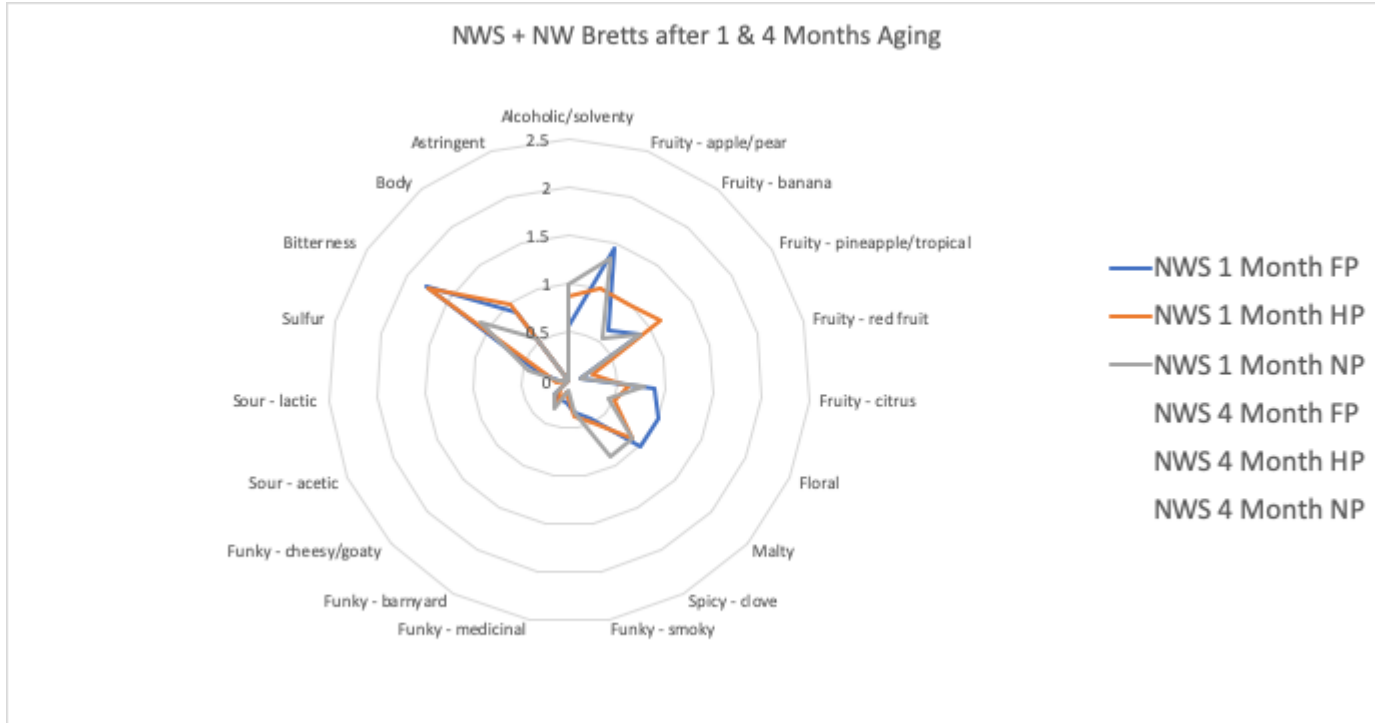
New World Blend @ 15 PSI after 2 Weeks



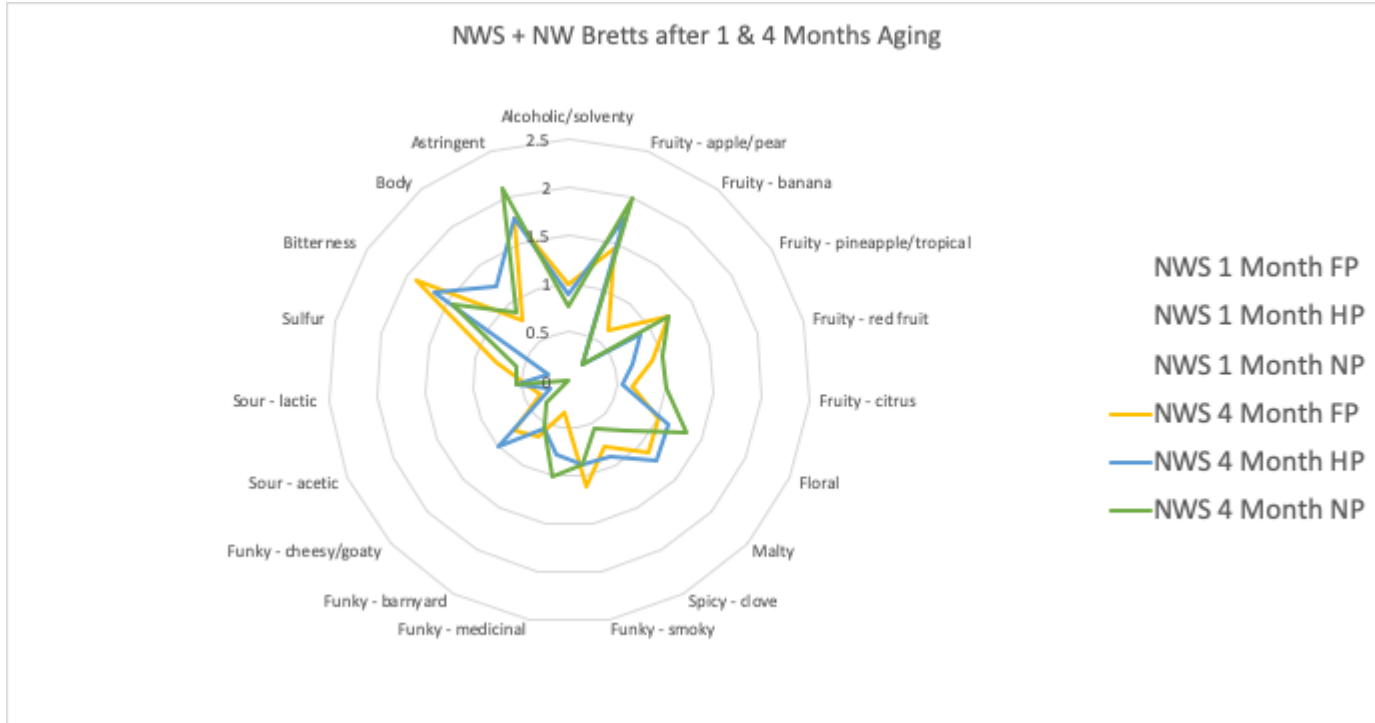
New World Blend @ No Pressure



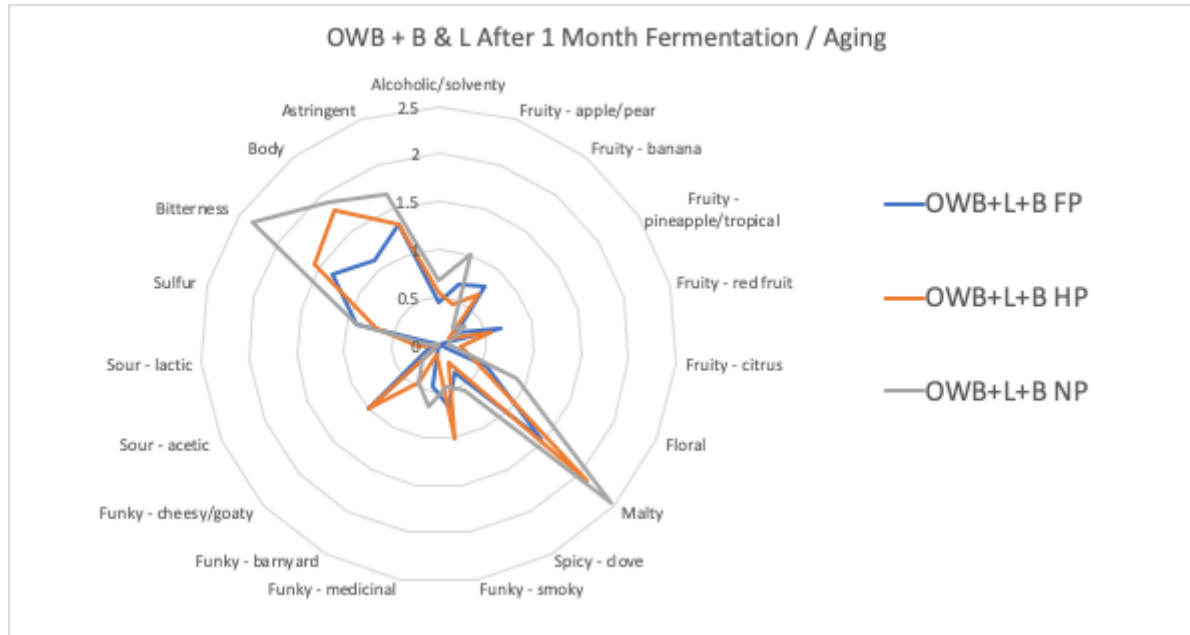
NW Blend under Various Conditions @ 1 Month



NW Blend under Various Conditions @ 4 Months



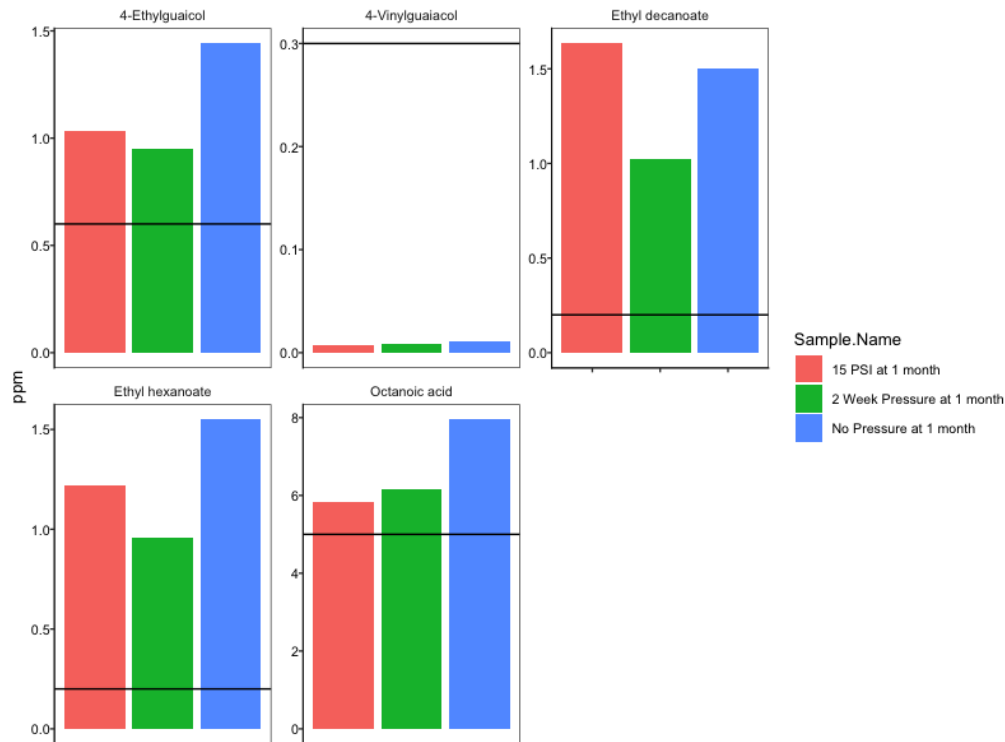
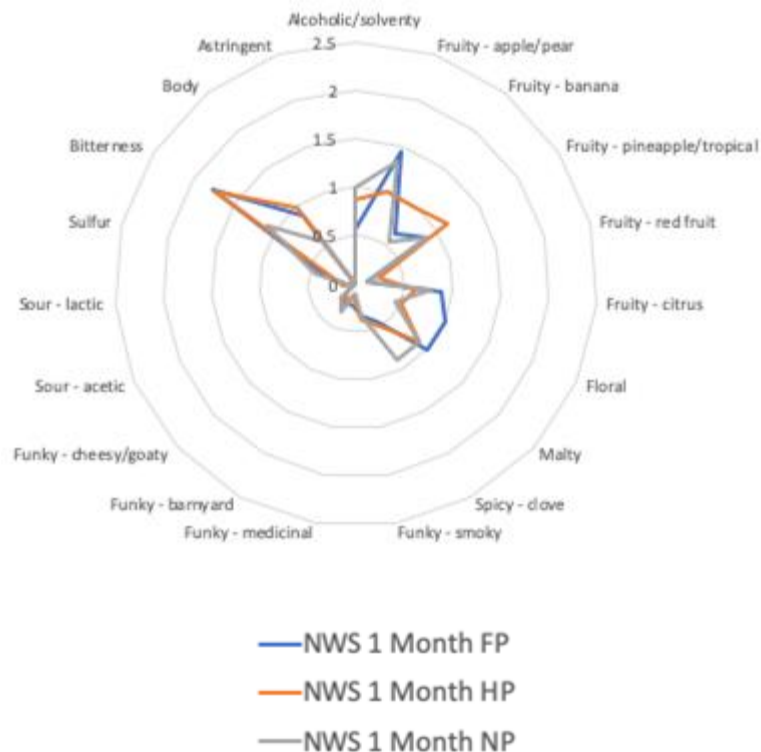
OWB + Bretts under various conditions



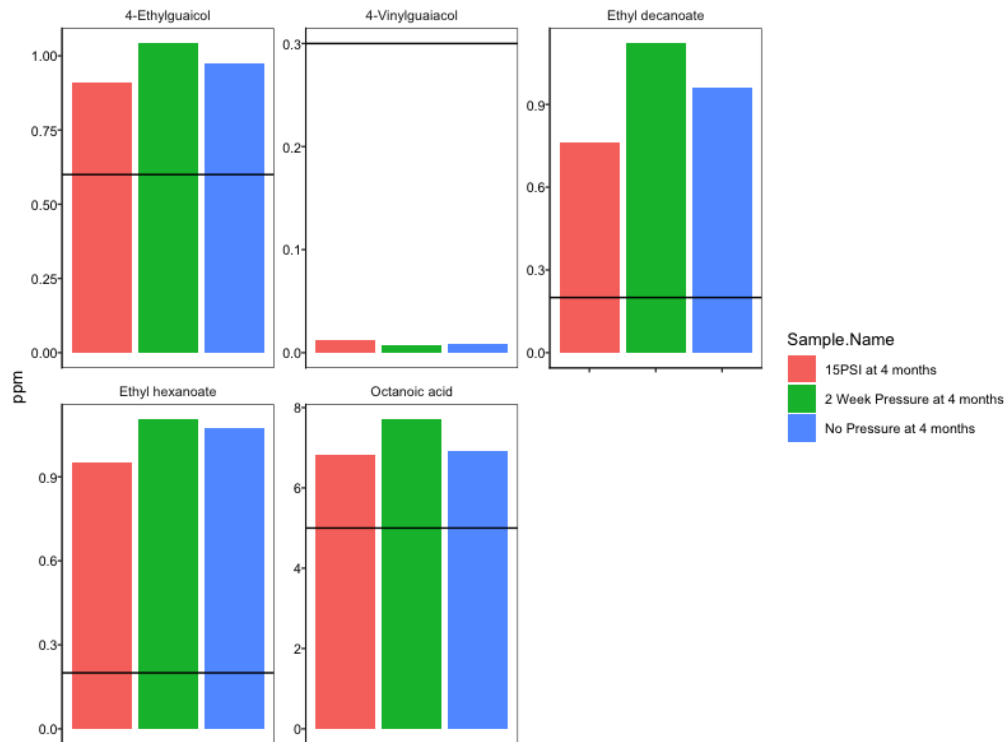
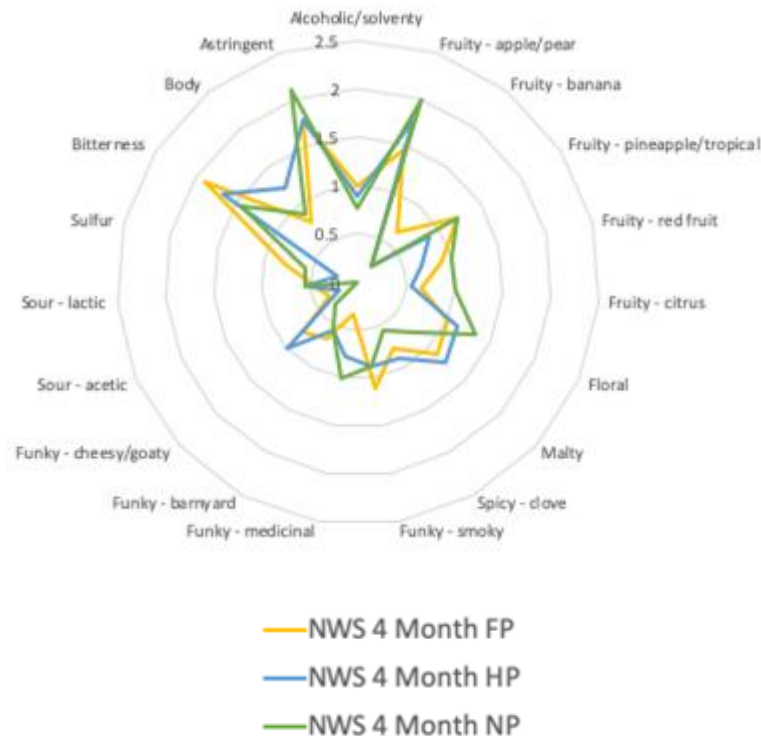
Sensory Data vs GC

How calibrated is the panel? Did the panel pick up on some funk?

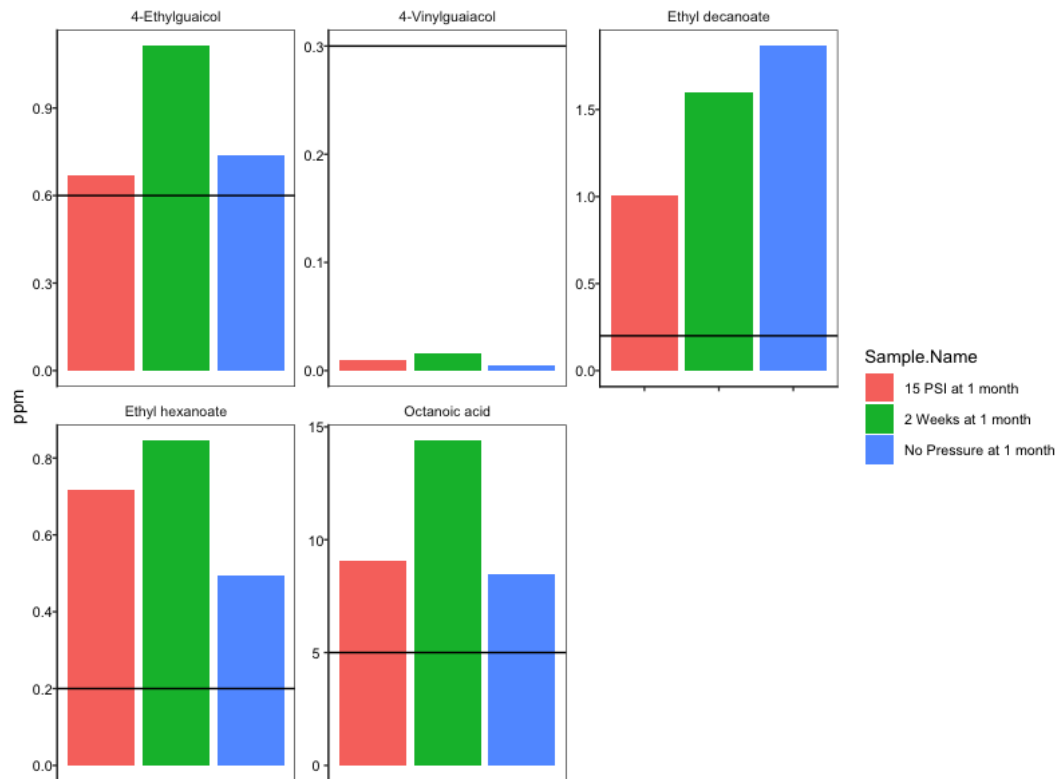
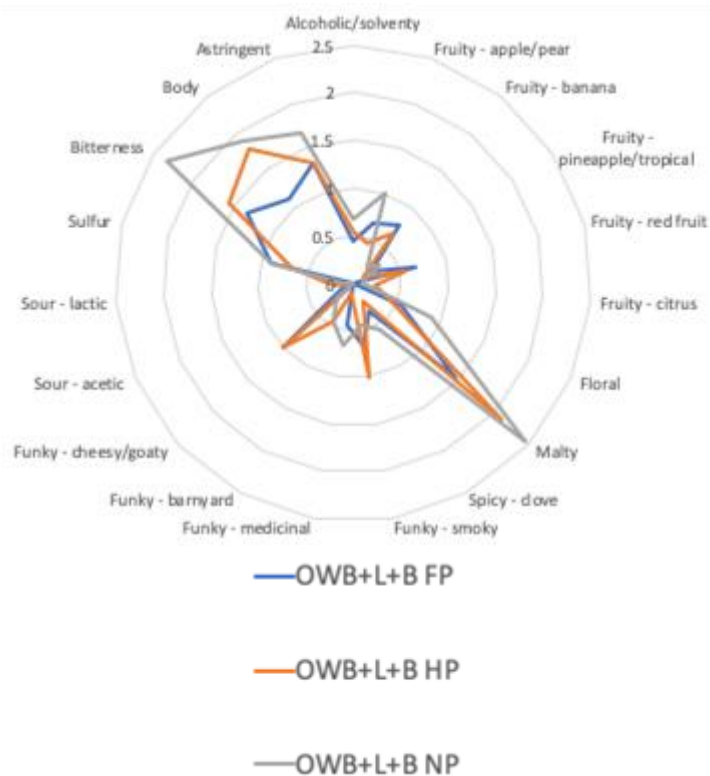
Sensory Panel v. GC | NWB @ 1 Month



Sensory Panel v. GC | NWB @ 4 Months



Sensory Panel v. GC | OWB + Bretts @ 1 Month



Trends?

Concentration of esters dissipate over time due to volatility

Beers that underwent pressure seemed to have lower concentrations of some esters across both trials

There isn't a massive difference in the measured amount of “funky” characteristics in the beers placed under pressure

In the second experiment, our panel noticed a slightly funkier beer with the half-pressure experiment. Our GC data also showed an increase in some of those fatty acids

Keep in mind, our New World experiment has drastically different data. Many variables are at play!



*"I split a batch [of wort co-pitched with sacch/brett and] fermented one in a glass carboy ... the other in a **keg at 15 psi**. [Shared samples with my club and] ... the **beer fermented under pressure was definitely *not* funkier** than the carboy ... the [no pressure beer] ... seemed to have a more distinctive brett-character."*

“Sometimes on shorter term and less funky beers, I will co-pitch Sacch and Brett in primary, then coax some funk by transferring after 2-4 weeks to keg and letting it sit under pressure for a month.”

Are beers under pressure funkier?

Probably not.



Beer fermented under
pressure can be less
estery!



Fewer esters ➡ Less “noise”?

Funky characteristics are more noticeable?

BUT I WANT FUNKIER BEER!



Many ways to increase funk

- Phenolic yeast strains can possibly provide a funkier perception
- Increase the presence of funky precursors in the wort (i.e. Ferulic Acid rests)
- Ferment warmer for increased ester production (including those funky esters)



So where can we go with this?

- With the data right now it's hard to confidently make conclusions
- Even across both experiments we couldn't really see any extremely obvious trends!

What we'd like to do

- Scale down the batch sizes in order to
 - Decrease wort variability by using single consistent wort stream across months of experimentation
 - Broaden the scope of Sacch + Brett combos to see if strain selection makes a difference
 - Have tighter control over fermentation temperatures
- Each one of these could be a project on their own!



Now go and be Funky!

Questions?

escarpmentlabs.com

homebrew@escarpmentlabs.com

