

CRAMMING COMPOUNDS



BUILDING BETTER IPA

THROUGH HOP CHEMISTRY AND INNOVATION



DAN BROUILLETTE | LUMEN BEER COMPANY | OMAHA, NE

HOW WE **TRADITIONALLY** EVALUATE HOPS

ALPHA ACIDS



TOTAL OIL



SENSORY SHEET

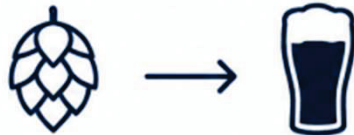


HOP RUB

ARE THESE **ACTUALLY** TELLING US
WHAT ENDS UP **IN THE GLASS?**

ALPHA ACIDS: WHY WE **DON'T** USE THEM TO PICK HOPS

WHAT ALPHA ACIDS TELL US



BITTERNESS

Alpha acids become iso-alpha acids in the boil and create bitterness.



They do **NOT** tell us what the hop will smell like.

THE PROBLEM



There is little to no relationship between alpha acids and fruity aroma compounds.



Two hops can have the same alpha acids but very different fruit-forward aroma.



Modern hazy IPAs are about citrus, tropical, and passionfruit aromas—not bitterness.



ALPHA ACIDS TELL US HOW BITTER A HOP CAN MAKE OUR BEER.

THEY DON'T TELL US HOW FRUITY IT CAN MAKE IT.

WHY **TOTAL OIL** CAN BE MISLEADING

DESIRABLE FOR FRUIT-FORWARD HAZY IPAS

-  LINALOOL
-  GERANIOL
-  METHYL GERANATE
-  3MH
(THIOL PRECURSOR)

CITRUS • TROPICAL • PASSIONFRUIT •
SWEET FRUIT

TOTAL OIL

MANY DIFFERENT COMPOUNDS



OTHER MAJOR OIL COMPONENTS

-  MYRCENE
-  HUMULENE
-  CARYOPHYLLENE

RESIN • HERBAL • WOODY • SPICY

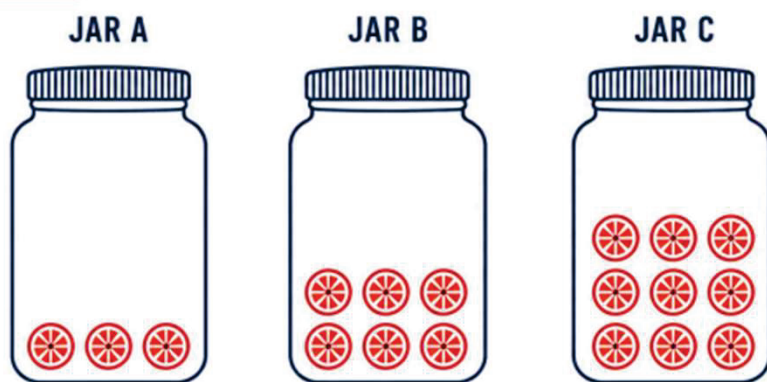


TOTAL OIL
MEASURES **QUANTITY.**



COMPOUND ANALYSIS
MEASURES **COMPOSITION.**

WHY **SENSORY** ALONE ISN'T ENOUGH



WHICH JARS WOULD YOU CHECK "CITRUS" ON?



SENSORY TELLS US
WHAT IS PRESENT.



CHEMISTRY TELLS US
HOW MUCH IS PRESENT.



ANSWER:
ALL OF THEM.

This is exactly what happens
during hop sensory.

Every jar smells citrusy.

Every brewer checks
the citrus box.

WHY THE TRADITIONAL HOP RUB **ISN'T ENOUGH**

THE HOP RUB GIVES US A LIMITED AND MISLEADING PICTURE.



**WE RUB WHOLE LEAF
THEN WE USE PELLETS**

Pelletization changes
aromatic and sensorial
qualities.



**LIMITED
SAMPLE SIZE**

We only rub the
samples we receive.
That's a tiny portion
of what's actually
available.



**SUBJECTIVE &
INCONSISTENT**

Different people,
different days,
different moods—
different rub results.



**THE HOP RUB IS A STARTING POINT, NOT A STRATEGY.
WE NEED DATA THAT MATCHES HOW WE ACTUALLY BREW.**

WHAT IS A COMPOUND?

DEFINITION



A compound is a specific chemical made up of **two or more molecules** bonded together.

IN THE CONTEXT OF HOPS

Hops contain hundreds of different compounds. Each one contributes to aroma, flavor, and character in beer.



By understanding the individual compounds in hops,
we can make better decisions and brew more intentional beers.

COMPOUNDS THAT CAN PULL YOUR IPA AWAY FROM FRUIT

These compounds are common in hops, but they contribute aromas that compete with the citrus, tropical, and juicy character we're after.

COMPOUND	TYPICAL AROMA / FLAVOR	WHY WE KEEP IT LOW
 β-Pinene (Beta Pinene)	Pine, resin, evergreen	Piney, resinous aromas compete with tropical and citrus fruit.
 Myrcene	Herbal, green, earthy	Very abundant in raw hops but largely lost during brewing. High levels can lead to green, herbal, or resinous character.
 Humulene	Woody, herbal, noble hop character	Adds woody, earthy notes that pull focus away from fruit.
 Caryophyllene (Trans Caryophyllene)	Pepper, spice, clove, woody	Spicy, woody character can dominate and detract from juicy fruit aroma.
 Farnesene	Herbal, green apple, floral	Generally not harmful, but not something we chase in a fruit-forward beer.
 2-Nonanone	Waxy, fatty, sometimes cheesy	Can create waxy, fatty, or cheesy aromas at elevated concentrations.



These compounds aren't "bad"—they're simply **not the compounds we prioritize** when brewing a modern fruit-forward IPA.

SO WE STARTED MEASURING WHAT **ACTUALLY MATTERS TO US**

Average Citra compound concentrations from our hop product comparison.

PRODUCT	LINALOOL		GERANIOL		METHYL GERANATE	
	ppm (milligrams per kilogram)	DELIVERED AMOUNT (per typical use rate)	ppm (milligrams per kilogram)	DELIVERED AMOUNT (per typical use rate)	ppm (milligrams per kilogram)	DELIVERED AMOUNT (per typical use rate)
T90	202.9	92.0 mg (per 1 lb T90)	172.6	78.3 mg (per 1 lb T90)	510.3	231.4 mg (per 1 lb T90)
CRYO	465.1	210.9 mg (per 1 lb Cryo)	355.8	161.3 mg (per 1 lb Cryo)	945.7	391.6 mg (per 1 lb Cryo)
HYPERBOOST	3,933	43.6 mg (per 10 g HyperBoost)	1,085	25.7 mg (per 10 g HyperBoost)	9,335	5.4 mg (per 10 g HyperBoost)
DYNABOOST	1,441	43.0 mg (per 100 g DynaBoost)	435	21.0 mg (per 100 g DynaBoost)	3,094	5.0 mg (per 100 g DynaBoost)

THE RIGHT TOOL FOR THE RIGHT JOB

Each hop product helps you **maximize hop aroma and flavor** in different ways.

TOOL	BEST USE	WHY I USE IT
T90	FOUNDATION The backbone of every dry hop.	Full hop character and the backbone of every dry hop.
CRYO	COMPOUND AMPLIFIER Intensify what's already there.	Higher survivable compounds with less vegetative matter and the same beer loss.
HYPERBOOST	PRECISION TOOL Fine tune your aroma.	Packs an incredible amount of survivable compounds into a tiny addition. Great for maximizing aroma while minimizing hop load.
DYNABOOST	BALANCE TOOL Add depth, structure, and bite.	Adds survivable compounds while also contributing alpha acids that provide structure, bitterness, and bite in bigger beers. Perfect for balancing sweetness in higher ABV hazy IPAs.

NO SINGLE PRODUCT IS "BEST."

YOU HAVE TO USE THE TOOL THAT IS BEST FOR YOUR BEER.

DO YOUR OWN RESEARCH

THE MORE YOU KNOW, THE BETTER DECISIONS YOU'LL MAKE. THAT'S HOW YOU MAKE BETTER BEER.

WHAT TO CONSIDER

1



RESEARCH ALL THE COMPOUNDS

- Don't stop at the big four.
- Explore a wide range of aroma compounds.
- Understand how each one contributes to flavor and aroma.

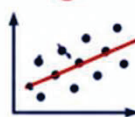
2



USE THE LOT LOOKUP TOOL

- Compare lots by compound composition.
- Filter and sort by the compounds that matter most to your beer.
- Save time. Make better selections.

3



EXPLORE CORRELATIONS BETWEEN COMPOUNDS & SENSORY ATTRIBUTES

- Look for patterns between compounds and the aromas you love (or don't).
- Not all compounds contribute equally.
- Data reveals what your palate already knows.

4



INVESTIGATE REGIONS & FARMS

- Some regions and farms consistently produce exceptional lots.
- Track the origins of the hops you love.
- Build relationships with trusted growers.

5



TRACK, COMPARE & TAKE NOTES

- Keep records of lots you use.
- Compare year over year.
- Build your own database of what works best in your beers.

6



STAY CURIOUS. KEEP LEARNING.

- The hop world is always evolving.
- Keep asking questions.
- Keep tasting.
- Keep pushing your beer forward.



DATA + EXPERIENCE = BETTER BEER

Your palate is powerful. Data makes it even stronger.
The more you learn about hops and their compounds, the more consistently you can create beers that stand out.

THINGS TO KEEP IN MIND



COMPOUNDS
VARY BY YEAR



HARVEST TIME
MATTERS



PROCESSING
IMPACTS
COMPOSITION



BEER CONTEXT
CHANGES
PERCEPTION



TRUST YOUR
PALATE

**CURIOUS
BREWERS
MAKE BETTER
BEER.**



FINAL TAKEAWAY

**GET TO KNOW
YOUR HOPS AND
HOP PRODUCTS
SO YOU CAN
MAKE BETTER BEER.**