CALI TERPENES

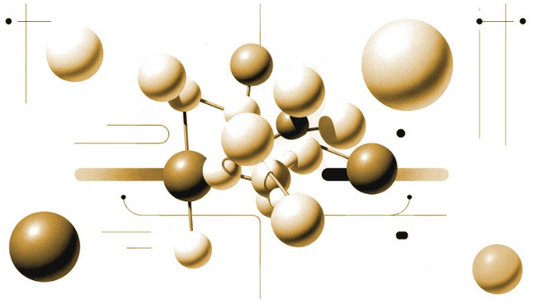
Terpene profiles: the aromatic engine of modern beer

Presented by Alvaro Bahillo Villarte



The chemistry behind the scent: what are terpenes?

Terpenes are not exclusive to hops. They are the universal aromatic language of the plant kingdom, present in citrus fruits, pines, lavender, and thousands of other plants.



Volatile Organic Compounds

They are volatile organic compounds that constitute the heart of essential oils in nature. Examples: Limonene in citrus fruits, Pinene in pine trees, Linalool in lavender.



Plant Immune System

They are not there just for the smell. In the plant, they act as a protective shield: they repel insects and predators, protect against fungi and bacteria, and help survive environmental stress.



Sensory Identity

They are directly responsible for the sensory notes that define each species. In beer, they provide the citrus, floral, resinous, or spicy nuances that we look for in hops.

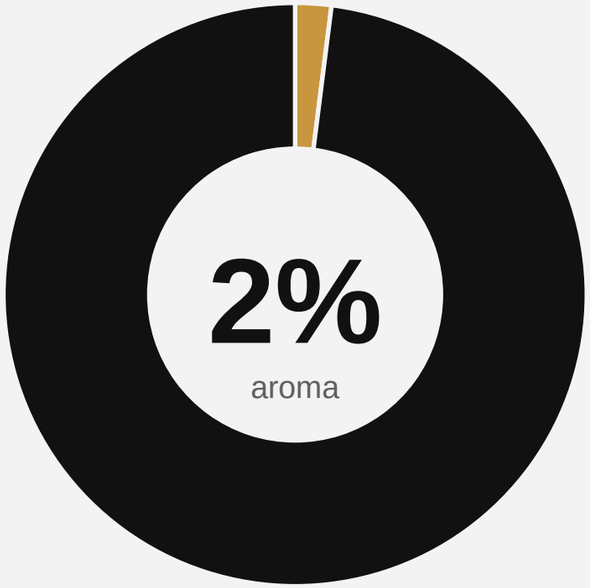


Traditional Challenge

Traditionally, the brewer obtains terpenes through lupulin, but this involves dragging along all the plant matter, with its climate variability and its operational losses.

The hop paradox

Hops are a concentrate of contradictions. To get what you want most (the aroma), you have to add what gets in your way the most (the plant matter).



2% Essential aroma oils (terpenes & thiols)

98% Non-oil fraction (vegetal solids & polyphenols)

The reality of hop pellets

Total essential oil represents a mere 0.5% – 4% of its weight.

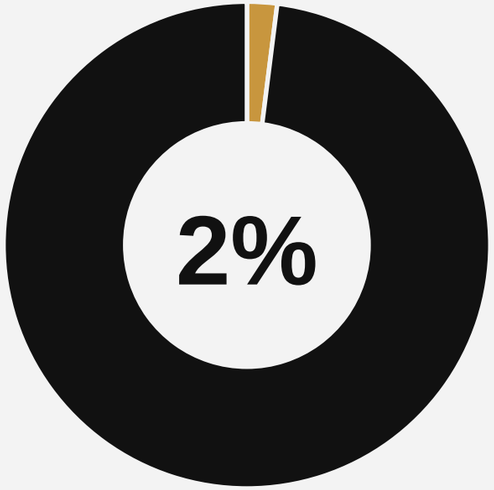
Brewing drawbacks

Absorption and volume loss: The massive amount of inert plant material acts as a sponge.

Astringency and green flavors

Profile instability: The volatile oil content fluctuates drastically from harvest to harvest due to climate.

What Cali Terpenes does



2% Essential aroma oils (terpenes & thiols)

98% Non-oil fraction (vegetal solids & polyphenols)

Reconstructing the 2% aroma fraction

1 **Decoding the 2%**

Molecular mapping (GC-MS)

2 **Sourcing from nature**

Botanical tracking and steam distillation

3 **Pure reconstitution**

The finished vial



100%

From 2% fraction to 100% purity

Discard the green, keep the soul

10 ml ≈ 10 kg of T90 pellets

Cali Terpenes: core product characteristics & capabilities



100% Natural terpenes from botanically derived sources

They reproduce the aromatic profile of specific varieties — Citra, Mosaic, Cascade...



Zero Chemical Compromises

Free from solvents, PG, premixes, or diluents. No alpha or beta acids. Clean, stable, and controlled aroma, without interfering with other technical parameters.



Precision and stability

Precise aroma batch after batch. No climate variability or dependence on agricultural contracts. Full availability for industrial production.



Total Brewmaster Control

- Eliminating process variables
- Precision sensory adjustments
- Guaranteed batch replication

Competitive and operational advantages

Concentrated terpenes transform logistics, yield, and production sustainability.

Smart Logistics

Elimination of dead storage volume. Reduction of transport costs (without a cold chain for tons of organic matter).

Zero Waste

Pellet hops act like a sponge, absorbing liters of beer. Terpenes eliminate liquid absorption and semi-solid residue (trub), maximizing sales volume.

Supply Stability

Identical aromatic profile in every batch. No climate variability, no stockouts, and no dependence on agricultural contracts. Full availability for industrial production.

Sustainability

Less weight transported and less solid waste generated. A greener, more efficient operation aligned with carbon footprint reduction goals.

When to Add Cali Terpenes?

1

Active fermentation

High CO_2 release can strip volatile aroma compounds and carry them out of the tank.

For that reason, this stage is generally less suitable for terpene addition.

2

SUITABLE TIME TO ADD TERPENES

End of fermentation

The end of fermentation is one of the suitable moments to add terpenes.

If other products are being added at this stage, terpenes can be incorporated as well.

3

SUITABLE TIME TO ADD TERPENES

Dry hop

Dry hopping is another suitable time to add terpenes.

At this stage, they can integrate well into the beer's overall aroma profile.

4

Cold Crash

The drop in temperature helps retain volatile aroma compounds in the beer.

Depending on the process, this can also be a viable stage for terpene addition.

5

SUITABLE TIME TO ADD TERPENES

Maturation

Maturation is also a suitable time to add terpenes, especially if no dry hopping is performed or if the beer is already finished.

It is also a useful stage for making final adjustments, but that is not its only purpose.



Several good options, depending on your process.

Terpenes can be added at the end of fermentation, during dry hopping, or during maturation, depending on the beer style, the production process, and the desired aroma profile.

Lagers vs Ales

LAGERS

10–20 °C
direct injection window

0%
plant polyphenols: no hop burn

The “noble” reinvention

Concentrated molecular profiles of noble hops (rich in humulene) engineered to aromatically boost classic styles.

Creative hybridization (IPLs & Hoppy Lagers)

Enables clean, crisp lager matrices to carry explosive IPA noses at a fraction of the cost, with zero plant polyphenols to completely eliminate harsh hop burn or green astringency.

Diacetyl rest synergy

Direct fluid injection at 10°C–20°C. Natural kinetic dispersion delivers identical batch-to-batch profiling with 0% risk of Hop Creep, density shifts, or buttery off-flavors.

ALES

8–12%
of finished beer recovered per batch

20–30 g/L
standard pellet load in IPAs, bypassed

The synergy

High-ester fermentation profiles are perfectly complemented and balanced by pure, intense new world terpene top-notes (Citrus, Tropical, Resinous).

The brewery win

Bypasses heavy pellet loads and recovers the finished beer that used to be lost, trapped in green sludge.

Smart multi-hop substitution

Keep a traditional pellet base for native thiols, but replace the most expensive or highest-volume variety with its Cali Terpenes liquid equivalent to cut recipe costs.

With noble hop profiles you unlock their elegant nuances for new hybrid formulations (IPAs, Wheat Beers, Amber Ales).

NoLo Beers: sterile camouflage & phase stabilization

The Matrix Challenge

Wort off-flavor

Dealcoholized batches or those brewed with maltose-negative yeast suffer from heavy, unfermented raw cereal and baking bread notes.

The Cali Terpenes Solution

Sensory camouflage

Pure terpenes cover the cereal base, injecting pristine fresh-hopped nose appeal.

Microbiological shield

100% sterile liquid. Bypasses the contamination time-bomb of pellet dry-hopping in alcohol-free media.

0.0%

Legal compliance

Contains zero plant amylases (enzymes). Guarantees a completely flat density line with zero risk of secondary fermentation or alcohol spikes within the packaging.

Forced micro-emulsification

10–20 °C

dosing temperature

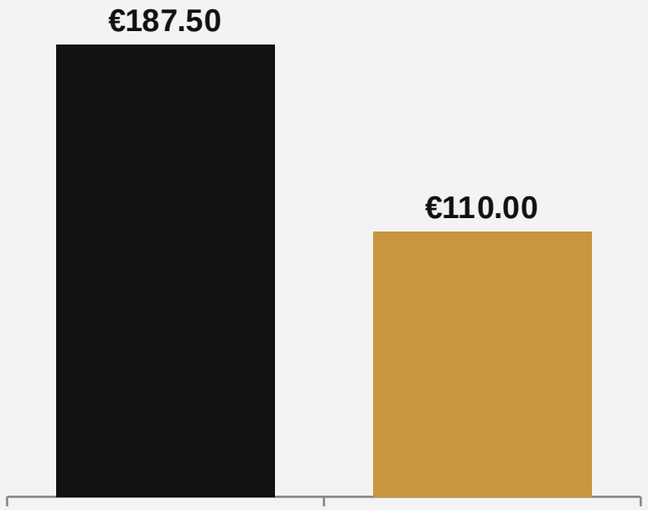
In-line turbulence

Dosing must happen at 10°C–20°C via Inline ADS (Additive Dosing System) right after the dealcoholization column. The dynamic flow shear stress forces a perfect, homogeneous molecular blend.

Yield Analysis: Case Study (HOPALAA! Brewery)

For a 900-liter batch, the comparison is definitive. Substituting 7.5 kg of traditional hop pellets with 10 ml of concentrated terpenes not only reduces direct costs, but also recovers sellable product that would otherwise be literally absorbed by the hops.

Direct raw material savings (per batch)



Hop pellets: 7.5 kg @ €25/kg · Cali Terpenes: 10 ml

€77.50

net savings per batch

41%

reduction in aromatic ingredient costs per batch

Recovered beer (zero absorption)

8–10 L

of finished beer recovered per 900 L batch

Traditional hop pellets act like a sponge: they absorb between 8 and 10 extra liters of finished beer per 900L batch, which are lost during trub and sediment purging. With terpenes, this volume turns directly into sellable product, immediately boosting the net margin of every single brew.

€3,875+

annual impact

Across 50 batches/year, the accumulated savings exceed €3,875 in raw materials alone, without factoring in the recovered finished beer volume or logistical and cold-storage savings.

Climate and Economic Resilience of Hops (2024–2026)

The global hop sector is facing a perfect storm of climate, economic, and supply chain risks. The scientific data is unequivocal: reliance on conventional hops represents a growing strategic risk.

Risk Factor	Updated Data (2024–2026)	Source
Yield decline	Projected 4% to 18% decline in European hop production by 2050 due to severe droughts.	Nature Communications, Oct 2023
Alpha-acid degradation	20% to 31% reduction in alpha-acid content caused by thermal stress on the plant.	Potopová et al., 2023, Nature Research
Price volatility	Up to 135% increase in production costs within 3 years (energy, fertilizers, labor).	BarthHaas Report 2023/2024 & Eurostat
Essential oil variance	Year-over-year variation of up to 50% in Myrcene and Linalool concentration within the same plot.	ASBC – Hop Analysis Committee
Carbon footprint	Pellet transport and cold-storage refrigeration account for 15–20% of the raw material's total CO_2 impact.	Journal of Cleaner Production, 2024

Strategic Conclusion: Cali Terpenes molecular profiles provide a real decoupling pathway from the climate and economic volatility of the hop market. Our goal is not to replace tradition, but to co-exist with existing industry practices by offering a highly compatible, secondary tool to safeguard aromatic stability batch after batch.

Thank you

Thank you for joining us on this journey through the chemistry of aroma. Terpenes are not just molecules; they are the gateway to a more consistent, more sustainable, and more delicious beer.

Discover how Cali Terpenes can transform your production

Request a personalized technical consultation

Join the aromatic revolution of modern brewing

www.caliterpenes.com