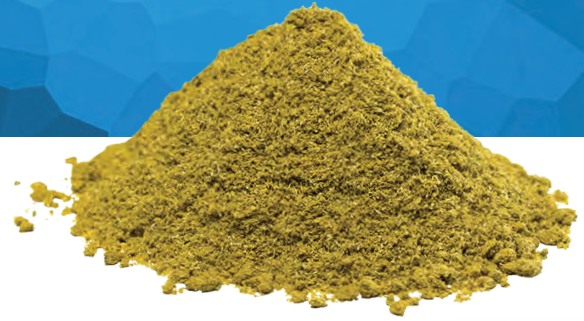


CRYO HOPS™

LupuLN2™



THE CRYO HOPS™ PROCESS

Derived from the Greek word 'kryos', meaning frost, Cryo Hops™ utilizes industry-leading, cryogenic hop-processing technology to produce two innovative hop products. Whole hop cones are separated into concentrated lupulin and bract at extremely low temperatures in a nitrogen-rich atmosphere avoiding opportunities for oxidation. The resulting simultaneously-produced products are LupuLN2™ hop powder, and Debittered Leaf, low-alpha bract and strig.

WHAT IS LupuLN2™?

LupuLN2 is the concentrated lupulin of whole-leaf hop cones containing resins and aromatic oils. It is designed to provide intense hop flavor and aroma, enabling brewers to dose large quantities of hops without introducing astringent flavors or vegetative cone material.

INTRODUCING LupuLN2™ INTO BEER

LupuLN2 can be utilized anywhere whole-leaf hops and hop pellets are traditionally applied. As a starting point for recipe formulation or modification, the estimated dosing rate of LupuLN2 is 40-50% of hop pellets by weight.

KETTLE: Adding to the kettle or whirlpool is as easy as a standard pellet addition with a quick breakup of any potential clumps that may exist from the packaging process. Early additions should be avoided to prevent boiling away LupuLN2's aroma characteristics.

WHIRLPOOL: Adding to the whirlpool is an excellent way to enhance aroma and reduce trub load from large, late additions.

KNOCKOUT OR HOPBACK: Due to LupuLN2's fine particle size, there is low risk of clogging heat exchangers. This allows for late additions in knockout or hopback, even with carryover into the fermenter.

FERMENTER: Use in the fermenter increases aroma while reducing trub from the sponge effect.

The high oil content and powder consistency of LupuLN2, can present unique challenges when dry hopping. While each brewer will need to determine what works best in their brew house and cellar, the primary recommendation is to introduce LupuLN2 through wet applications under CO₂ conditions. This could include a beer and powder filled brink pushed through a vertical racking arm, or a more elaborate inline recirculation system. Introduction through the top of the tank is effective, however, a CO₂ rouse is recommended as the high-oil powder tends to float on the surface. Dosing with hop pellets can assist in incorporation. LupuLN2 settles out during normal conditioning.

ADAPTING RECIPES: Regardless of application, early trials indicate LupuLN2 beers showcase pronounced juicy and resinous flavors with greatly reduced grassy characteristics. As a result, some brewers recommend using LupuLN2 with hop pellets to ensure the complexity and flavor(s) of the whole hop are retained.

The recommendation to assess the benefits of LupuLN2 is to adapt a regularly brewed Double IPA or IPA recipe by substituting at least 1lb/bbl of pellets for LupuLN2. The larger the substitution the larger the potential yield increase.

BENEFITS OF UTILIZING LupuLN2™

LupuLN2 enables a brewer to use large doses of hops to achieve intense hop aroma and flavor without introducing material from pellets or whole leaf products which reduce yield and can contribute undesired vegetal or astringent flavors. At lower doses, LupuLN2 can create low bitterness beers that have enhanced hop flavor with particularly juicy, resinous and fruity characteristics.

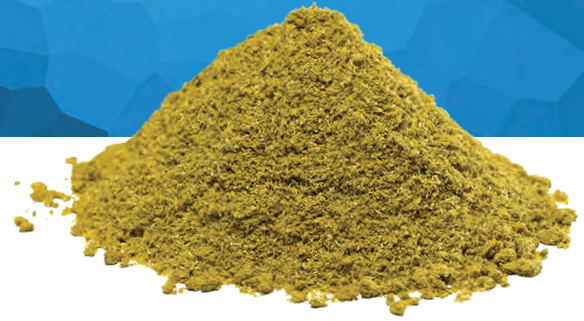
- Controlled, nitrogen-rich production environment
- Uniform particle size distribution
- Intentional preservation of the lupulin glands
- Twice the resin content of traditional hop pellets
- Intense contribution of hop flavor and aroma
- Reduced vegetal and polyphenol flavor contribution
- Cost savings & increased yield through reduced brewhouse & cellar trub

ADDITION	CURRENT RECIPE	LupuLN2™
60 or 90 Minutes	CO ₂ Hop Extract Hop Pellets	CO ₂ Hop Extract Hop Pellets
15 Minute	Hop Pellets	Hop Pellets
Whirlpool	1 lb/bbl Pellets	0.5 lb/bbl LupuLN2
Dry Hop	1 lb/bbl Pellets	0.5 lb/bbl LupuLN2

Example substitution for basic Double IPA hop bill

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COST SAVINGS & SUSTAINABILITY

LupuLN2 allows brewers to achieve equivalent or improved hop flavor using approximately half the weight of traditional pellet or whole-leaf recipes. This increases storage and shipping efficiencies throughout the entire supply chain and lowers costs. In the brewery, reduced hop material also means less wort or beer lost to trub - an average 4% yield increase. Even a 1% increased in yield (2.5 pints/bbl, \$200/bbl beer) covers the increased cost of LupuLN2 compared to pellets. In addition, for every barrel of beer gained in yield, brewers also save on malt, labor, and utilities. Combined, these factors allow brewers to experience cost savings and gains in net revenue per batch.

	PELLETS	LupuLN2™	NET SAVINGS
Revenue / bbl	\$250		
Estimated final yield increase	5%		
Dose rate	50%		
Hops (lb / bbl)	1 lb / bbl	0.5 lb / bbl	-0.5 lb / bbl
Batch yield	100 bbl	105 bbl	5 bbl
Net revenue / batch	\$25,000	\$26,250	\$1,250
Cost of hops / lb	\$10.00	\$23.83	
Total Cost of hops / batch	\$1,000	\$1,191.50	\$191.50
Net increase in revenue / batch			\$1,058.50

AVAILABILITY

	LupuLN2™ Pellets		LupuLN2™ Powder		TYPICAL LAB ANALYSIS BY UV SPECTROMETER	
	1 x 11 lbs	4 x 11 lbs	1 x 5.5 lbs	2 x 11 lbs	ALPHA	OIL
Cascade	✓	✓	✓	✓	11-13%	2.5-3.5%
Citra® HBC 394 CV	✓	✓	✓	✓	24-26%	3.5-5.5%
Columbus	✓	☐	✓	☐	23-26%	3.0-5.0%
Ekuanot™ HBC 366 CV	✓	✓	✓	✓	24-27%	6.0-7.5%
Loral™ HBC 291	✓	✓	✓	✓	18-21%	4.0-5.5%
Mosaic® HBC 369 CV	✓	✓	✓	✓	20-24%	3.5-5.5%
Palisade® YCR 4 CV	☐	☐	✓	☐	TBD	TBD
Simcoe® YCR 14 CV	✓	✓	✓	✓	21-25%	2.5-4.0%

For North American brewers, CRYO HOPS™ products are exclusively available through YCH HOPS and The Country Malt Group.

COOL PRESS PELLETING: Cryo Hops products are produced in Sunnyside, Washington and are available for purchase worldwide through YCH HOPS and/or its global distributor partners. Product availability includes Cascade, Citra® Brand HBC 394, Columbus (LupuLN2 only), Ekuanot™ Brand HBC 366, Loral™ Brand HBC 291, Mosaic® Brand HBC 369, Palisade® Brand YCR 4 (LupuLN2 only), and Simcoe® Brand YCR 14 hops. Cryo Hops products can be contracted for future years beginning in harvest 2017 or purchased on spot. LupuLN2 is available in hop powder or pellet form; debittered leaf is available as pellets. To preserve each hop's sensitive resins and oils, Cryo Hops pellets are cold pressed at a mean temperature of 63 degrees Fahrenheit. This is approximately 30 degrees cooler than average T-90 hop pellet production temperatures at YCH, and significantly cooler than other known pelleting operations.