



KETTLE REDI®

Light-stable bitterness.
Highly efficient brewing.

WHITE PAPER



Many commercial brewers package beers in clear and green bottles—which means they’re also dealing with an age-old brewing challenge: light-struck flavors in beer.

Read on to learn more about what causes this issue, and what the HAAS Innovations Team has developed to help brewers avoid it.

“Kettle Redi helps us to achieve consistently great results in our beer. It’s extremely easy to use, easy to dose, and provides excellent protection against light-struck flavor. Because of its unique formulation, Kettle Redi provides us with efficiencies that result in better yields during the brewing process. I’m very happy that we have this product.”

Lincoln Jhones Rodrigues, Head Brewer | Cervejaria Bamboa, Campo Grande, Brazil



THE CHALLENGE

Alpha acids such as humulone provide the primary source for bitterness in beer. However, alpha acids have limited solubility and contribute little bitterness without a key conversion step. During kettle boil, alpha acids undergo isomerization to isoalpha acids, such as isohumulone, that produce the majority of hop-derived bitterness.

Light-struck character in beer primarily derives from the light-induced degradation of isoalpha acids (Figure 1).¹⁻³ To inhibit this transformation, isoalpha acids are converted into light-stable, analogs such as *rho*-isohumulone (Figure 2).⁴ These compounds are resistant to conversion into 3-methyl-2-butene-1-thiol through modification of a side chain appended to the hop acid ring structure. In this case, this is achieved by converting the -C=O carbonyl functionality into an alcohol (-CH₂-OH). This transformation effectively blocks the light-struck pathway for *rho*-isoalpha acids.

John I. Haas offers a number of different light stable bittering products. An example is a product containing *rho*-isoalpha acids that is sold under the brand name, Redihop®. This product is a 30% w/w aqueous solution of *rho*-isoalpha acids that imparts pleasant, smooth, and well-rounded bitterness when used in the brewing process. Relative to isoalpha acids, tasters perceive *rho*-isoalpha acids to be approximately 70% as bitter. Another beneficial property of Redihop is that it possesses a degree of antimicrobial activity.

Rho-isoalpha acids are typically dosed into finished beer prior to filtration. While this product can be added during most hot and cold side operations, higher levels of alpha utilization are achieved during cold side additions.

FIGURE 1. Light-induced degradation of isoalpha acids to 3-methyl-2-butene-1-thiol.

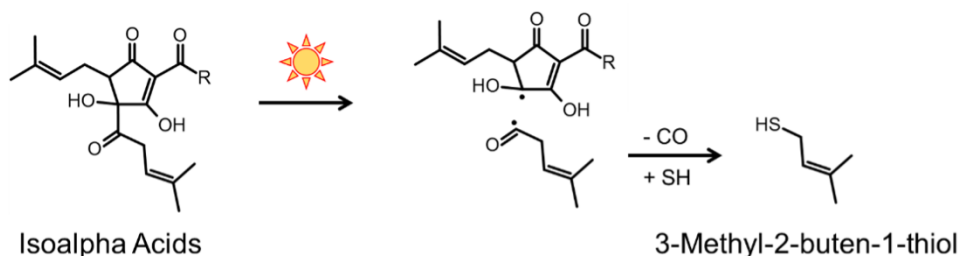
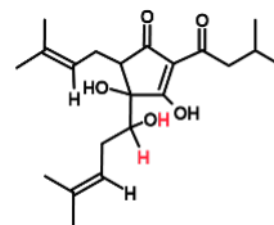


FIGURE 2. *Rho*-isohumulone



THE SOLUTION

As mentioned above, light stable bittering products can be applied at different process points during beer production. When used in the kettle, *rho*-isoalpha acids provide excellent light stable bittering properties to beer. However, since conventional *rho* products contain little to no hop oils, kettle hop flavor is not imparted to the resulting beers. There is a clear need for a hot side hop-derived product that not only delivers light stable bitterness but also potential kettle hop flavor to beer. Kettle Redi® was developed to meet these needs.



Kettle Redi Features and Benefits

Kettle Redi is an aqueous solution containing a standardized concentration of 40% rho-isoalpha acids (Table 1). Other than water, the product is 100% hop-derived and presents no labelling issues in beer. It is easily pumpable and requires no additional dosing equipment for current hop extract users. At temperatures above 35 °C, Kettle Redi is flowable and easily pourable.

Alpha utilization rates when used in the kettle are on the order of 45 - 55%. Actual utilization varies depending on plant and process conditions in the brewery. *Rho*-isoalpha acids provides 100% light stability as well as imparting a desirable quality of bitterness. The oil content of Kettle Redi is high (12 - 20%, Table 1) which is conducive for providing kettle hop flavor. The degree of kettle hop flavor achieved is dependent upon addition timing. Greater amounts of kettle hop flavor can be realized when dosed in the later stages of wort boil operations. Low beta content means that the customer is not paying a premium for material mass that is lost to trub during kettle boil.

In addition to inhibiting light struck reactions in beer, significant efficiency gains are realized through the use of Kettle Redi. The “green” solids in hops can absorb up to 10 L of wort or beer per kg of vegetative matter. These losses are significantly reduced when Kettle Redi is used in place of pellets.

Product Use and Packaging

Kettle Redi can be used as a replacement of cone hops, pellets, or extract in the kettle. The bitterness utilization is typically in the range of 45 - 55 % and mostly irrespective of the time of addition. Dosing calculations must take into account that *rho*-isoalpha acids are less bitter than normal isoalpha acids by a factor of 0.7. The quantity to be added is calculated using the *rho*-isoalpha acids content and the expected utilization. We recommend performing trials with Kettle Redi to determine its suitability, since the utilization may vary depending on plant and processing parameters. If added by means of an automatic dosing system, the extract should be warmed to 40 - 50 °C and gently agitated to ensure effective dosing.

Kettle Redi is available in 3 kg and 18 kg plastic pails.

TABLE 1. Kettle Redi Specifications

| | Kettle Redi |
|----------------------------|-------------|
| <i>Rho</i> -isoalpha Acids | 40 ± 2% |
| Isoalpha + Alpha Acids | <0.3% |
| Beta Acids | 1 - 5% |
| Oil | 12 - 20% |
| pH | 4 - 4.5 |
| Viscosity mPas (@ 50 °C) | 150 - 500 |
| Density g/ml | 0.9 - 1.1 |

“I would recommend it [Kettle Redi] – even for people who don’t use clear or green bottles. If you are going to have a beer that will have a very long shelf life, I recommend using Kettle Redi because you will never have light-struck problems. Even when you package beer in dark bottles, over time there is often light exposure, or even at the point of sale. With Kettle Redi, you have the security of knowing that the flavor will not be affected.”

João Guimarães, Brewmaster | Debron Bier

Usage Calculations

The following calculations are based on the fact that, for the same concentration in beer, *rho*-isoalpha acids (*rho*IAA) are reported to have only 0.7 sensory bitter units compared with normal isoalpha acids (IAA). Utilization of *rho*-IAA is likely to be about 45% when used in the kettle.

- › Desired Sensory Bitterness Units = BU
- › *rho*IAA required in beer (mg/L) = BU/0.7
(0.7 = bitterness of *rho*IAA relative to IAA)
- › Dosage *rho*IAA in mg/L (45% utilization assumed) = BU/0.7 x 100/45
- › Dosage in grams *rho*IAA per hL of beer = BU/0.7 x 100/45 x 100/1000
- › Dosage amount of Kettle Redi (40% *rho*IAA) in g/hL:
BU/0.7 x 100/45 x 100/1000 x 100/40 g/hL = BU x 0.79 g/hL (e.g. in order to achieve a bitterness of 12 desired sensory bitter units (12/0.7 X 100/45 X 100/1000 X 100/40) = 9.5 g/hL of Kettle Redi).

ABOUT HAAS® & BARTHHAAS®

John I. Haas is a proud member of the BarthHaas® Group. With branches in Germany, the U.S., the UK, Australia and China, they conduct business on every continent. The BarthHaas® Group is a world leader in breeding, growing, processing, and marketing hops and hop products. The group's portfolio also includes storage and logistics services, hop research and development, and application technologies for the brewing industry.



To learn more about Kettle Redi, visit our website,
contact your local HAAS sales representative,
or your favorite HAAS Distribution Partner.

johnihaas.com/kettle-redi

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