

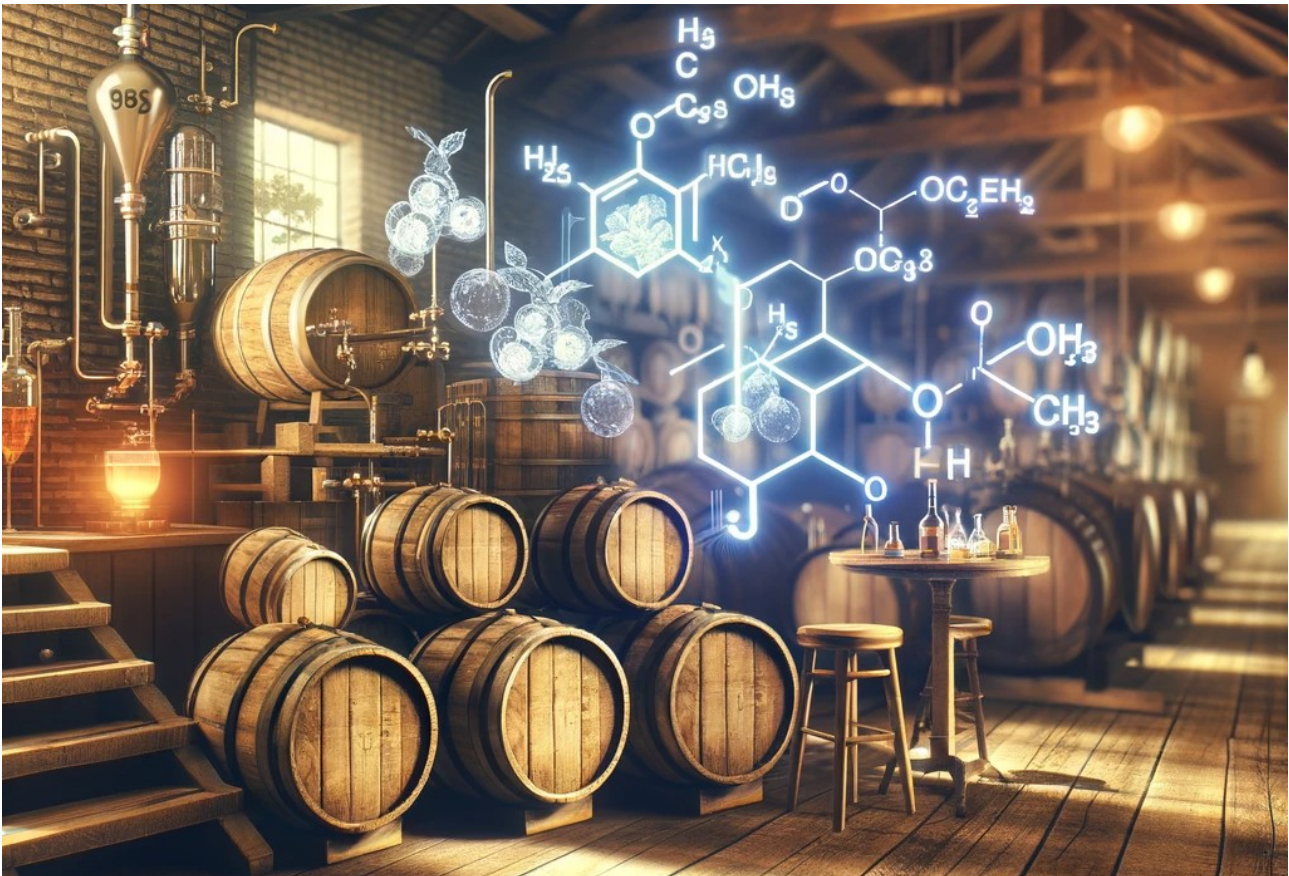
### Mastering ibu measurement in beer brewing: a technical exploration

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The International Bitterness Units (IBU) are a key aspect of crafting high-quality beer and play a pivotal role in the brewing process. In this article, we will explore various IBU measurement techniques, each offering unique contributions to the art and science of brewing. We'll delve into how these methods guide brewers in achieving the perfect balance of bitterness and taste.



## 1. The Science of IBU Measurement Methods

### Spectrophotometric Method

The spectrophotometric method stands as the most prevalent technique for determining IBU. It operates on the principle of measuring the absorbance of iso-alpha acids in beer, which are the primary contributors to bitterness. The process involves extracting these bitter compounds using a solvent and then assessing their absorbance at a specific wavelength (around 275 nm) using a spectrophotometer.

### High-Performance Liquid Chromatography (HPLC)

High-Performance Liquid Chromatography (HPLC) offers a more nuanced approach. This method separates, identifies, and quantifies the individual components of beer, including various bitter substances. HPLC excels in its ability to distinguish between different alpha acids and their isoforms, providing a detailed profile of the beer's bitterness.

In addition to the spectrophotometric and HPLC methods, it's essential to discuss the theoretical calculation of IBU, which offers a different perspective on assessing beer bitterness.

## Theoretical IBU Calculation

Theoretical calculation of IBU is based on the understanding of hop utilization and the alpha acid content in hops. The formula incorporates factors such as the amount of hops, the alpha acid percentage of the hops, the volume of the wort, the specific gravity of the wort, and the boil time. The most commonly used formula is:

$$\text{IBU} = (\text{Utilization} \times \text{AA\%} \times \text{Weight of Hops} \times 1000) / (\text{Volume of Wort} \times \text{Gravity Factor})$$

1. Utilization: This refers to the efficiency of alpha acid isomerization, which varies with boil time and wort gravity.
2. AA% (Alpha Acid Percentage): This is the percentage of alpha acids in the hops, which are the primary source of bitterness.
3. Weight of Hops: The amount of hops used, typically measured in ounces or grams.
4. Volume of Wort: The volume of the wort in which the hops are boiled.
5. Gravity Factor: A factor that accounts for the specific gravity of the wort. Higher gravity worts have reduced hop utilization.

While this formula provides a theoretical IBU value, it's important to note that it's an estimation. The actual perceived bitterness can be influenced by various factors such as the type of hops, the presence of other ingredients, and the beer's overall balance.

## 2. Methods Comparison and Insights

### Spectrophotometric Method

#### Pros:

- Relatively simple and cost-effective.
- Widely accepted and understood in the brewing industry.

#### Cons:

- Potential overestimation of IBU in the presence of certain compounds, like polyphenols.
- Less specific compared to HPLC, as it doesn't differentiate between bitter compounds.

### High-Performance Liquid Chromatography (HPLC)

#### Pros:

- Offers high accuracy and specificity.
- Capable of distinguishing between different hop compounds.

#### Cons:

- Involves significant investment in equipment and training.
- More time-consuming and complex than other methods.

### Theoretical Calculation

#### Pros:

- Allows brewers to estimate bitterness levels during recipe formulation.
- Helps in achieving consistency in brewing different batches.

#### Cons:

- It's an approximation and may not reflect the exact bitterness experienced by the consumer.

- Does not account for complex interactions that occur during brewing and fermentation.

Measurement Method	Pros	Cons
Spectrophotometric	Simple, cost-effective, well-known	Can overestimate IBU, less specificity
High-Performance Liquid Chromatography (HPLC)	Highly accurate, detailed analysis	Expensive, complex, requires expertise
Theoretical Calculation	Useful for recipe formulation, consistency	Approximation, does not fully account for brewing complexities

### 3. Comparative Analysis of IBU Measurement Methods

In summary, the decision on which IBU measurement method to use hinges on various factors, including the brewery's technical capabilities, budget, and the level of detail required for analysis. The spectrophotometric method serves as a straightforward and cost-effective option, ideal for routine checks and standard brewing processes.

On the other hand, HPLC, with its detailed analytical capabilities, is more suited for research-oriented and high-precision brewing requirements.

Adding the theoretical calculation method to our comparative table offers a more comprehensive understanding of the different approaches to IBU measurement in beer brewing.

Understanding these methods' advantages and limitations empowers brewers to make informed choices, thereby enhancing their craft and the quality of their beer.

### 4. CDR BeerLab® for IBU Analysis in Brewing

The IBU test on the CDR BeerLab® for beer and wort measures the level of bitterness by quantifying iso- $\alpha$ -acids.

This test can be conducted during boiling or fermentation phases, allowing brewers to compare actual results with theoretical calculations and maintain high-quality standards.



The **principle of the test** involves extracting iso- $\alpha$ -acids using a solvent and reading the extract at 270 nm, correlating the coloration to bitterness.

This method optimizes EBC reference method and is more efficient compared to traditional methods, taking only 6 to 7 minutes and the analysis can be performed even without an equipped laboratory.

The accuracy of the method is guaranteed by the calibration curve created with comparative tests carried out with the UKAS accredited reference spectrophotometric method (Campden BRI Method AM/003 based on EBC Analytica 9.8, 2004), as part of the comparative study of analytical methods of CDR BeerLab® and reference methods conducted by the international reference laboratory Campden BRI.

## 5. Analyses in Beer Production with CDR BeerLab®: Real-World Stories

### The study of the English brewery Hackney Brewery

It has been thought that late-hopping and dry-hopping do not contribute to IBUs in beer, however, in Hackney Brewery, an English brewery, brewers have been able to conduct an investigation into this with a CDR BeerLab®, for the in-house quality control without the need for a chemical laboratory.

The study provided insights into how different hop additions impact the beer's bitterness, offering practical utilization rates that can be applied to brewing recipes.

The brewers of Hackney Brewery considered CDR BeerLab® a valid aid for the development of the project, highlighting these features:

- **Rapid Analysis:** Unlike traditional methods that can take 15 to 30 minutes and require a laboratory, CDR BeerLab® allows for the bitterness of a beer sample to be recorded in approximately 6 to 7 minutes at production line too.
- **User-Friendly:** The process can be performed by anyone, without the need for a specialized laboratory technician.
- **Sensitivity to Brewing Techniques:** The study demonstrated that CDR BeerLab® could effectively measure IBU values during different brewing stages – including late-hop additions and dry-hopping, which are crucial in modern brewing styles.

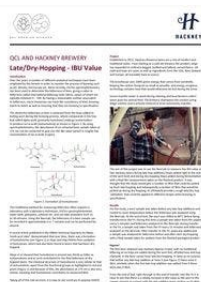
In conclusion, the CDR BeerLab® presents a quick, user-friendly, and insightful approach for IBU analysis, especially beneficial in modern brewing practices where different hopping stages significantly impact the beer's bitterness profile.

In the case study, in addition to CDR BeerLab®, UV/Vis spectrophotometry is also mentioned as a method for determining IBU.

Here is a summary table showing the comparison between the characteristics of the traditional UV/Vis spectrophotometry method and the CDR BeerLab® method for measuring IBU as highlighted in the case study.

Measurement Method	UV/Vis Spectrophotometry	CDR BeerLab®
Principle	Extraction of iso- $\alpha$ -acids, measurement at a specific wavelength (275nm)	Extraction of iso- $\alpha$ -acids, reading of the extract at 270 nm
Time Required	15-30 minutes	6-7 minutes
Expertise Required	Requires a specialized laboratory technician	Can be performed by anyone
Necessary Equipment	Spectrophotometer, glassware, solvents, etc.	CDR BeerLab®

Method Complexity	More complex, requires a laboratory	Simple and fast, no laboratory needed
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## “The Effect of Late and Dry-Hopping on IBU Value”

Download the complete case study on the research conducted at Hackney Brewery, written by Dr. Lee Walsh, QCL, exclusive distributor of CDR BeerLab® in the UK

[Discover more](#)

## The opinion of the brewers of the Italian brewery BrewFist

Furthermore Matteo Ambrosetti – BrewFist (Italian brewery) Lab Technician - said about CDR BeerLab® IBU test: “Of all the kits first and foremost, the one I use the most is the Bitterness (IBU), an analysis that with the classical method is performed in at least 55 minutes with the possibility of considerable error. Instead using the CDR BeerLab® kit, the analysis time is reduced to a total of 5-6 minutes. What is important above all is the ease of execution. In fact, the menu is intuitive and anyone can perform the analysis without, let’s say, having a university scientific background. It is possible to have a result in a very short space of time with a very, very limited margin of error because everything is very carefully designed and the possibility of making mistakes is very remote”.



[Watch the video](#) where the brewers of BrewFist tell their experience with CDR BeerLab®

## Conclusions

In conclusion, the CDR BeerLab® stands out as a comprehensive, user-friendly and reliable in results solution for IBU measurement.

While the conventional methods, like Spectrophotometry and HPLC, offer their own advantages in terms of specificity and detail, CDR BeerLab® introduces a rapid, accessible approach, crucial for modern brewing styles and in-house quality control.

It effectively bridges the gap between the complex, time-intensive traditional methods and the need for quick, reliable results in various brewing stages.

# CDRBeerLab®

This integration of the features of the diverse methodologies enriches the brewer's toolkit, enhancing both the science and art of beer brewing.