FOODLAB®
Quality control systems for food and beverage

BEERLab®

Beer and water analysis directly in your brewery

Simone Bellassai
Chemist & Enologist
CDR FOODLAB division manager

CDR conducts its business in heterogeneous sectors.

SECTORS

Telematics systems

Automatic toll collection terminals.

Medical diagnostics

Systems for hematology and hemostasis.

Food diagnostics

Systems for rapid analysis of food and beverage.

FOODLAB®

Quality control systems for food and beverage

Food and Feed

- Milk and Dairy Products
- Egg Products
- Tomato / Vegetable puree

➢ CDR FoodLab®

Beverage

- Wine
- Beer and Water
- Cider

➢ CDR WineLab®

➢ CDR BeerLab®

➢ CDR CiderLab

Oils and Fats

- Seed Oil
- Palm Oil
- Olive Oil
- Fryng Oil
- Animal and Vegetable Fat
- Nuts / hard-shelled fruits

➢ CDR FoodLab®

➢ CDR OxiTester

➢ CDR PalmOilTester

BEERLab®

CDR FOODLAB® is a range of chemical analysis systems, easy to use and versatile, that allows to determine a wide panel of parameters on food and beverage.

CDR FOODLAB® is composed by thermostated analyzers based on photometric technology that uses LED emitters.

Analysis kits use pre-filled reagents in package of 10 tests, designed and produced by CDR.

CDR BeerLab ® system

Pipette for the sampling

Disposable and pre-vialed reagents

It allows the brewmaster to realize a complete in-house Quality Control of the entire beer making process

CDR BeerLab®

Water Analysis

Wort Analysis

Beer

INSTRUMENT's FEATURES

- ✓ No maintenance
- ✓ Reading part made by **LEDs**
- ✓ No calibrations !!
- ✓ 16 analysis in about 10 mins (analysis by session)
- ✓ Multitasking mode (different analysis at the same time)
- ✓ 3 year warranty
- ✓ Touch screen where you can follow step by step the procedures

INCUBATION PART

READING PART

REAGENTS' FEATURES

- ✓ Pre-filled cuvettes
- ✓ Reagents ready to use
- ✓ Precision sampling
- ✓ Reagents already calibrated
- ✓ Long shelf life of the reagents

What are the most important CDR BeerLab® advantages compared to the standard reference methods?

Reduced the time consuming

Very easy handling

The reagents ready to use

You DON'T NEED a laboratory

NO maintenance

The system is already calibrated

Everyone can run analysis with CDR BeerLab®!!

CDR BeerLab ® analysis

Fermentable sugars
Alcohol by volume
Zinc

↓

ALCOHOL FERMENTATION MANAGEMENT

SO_2

↓

SULPHITE CONTENT

FAN

↓

BEER STABILITY
YEAST NUTRITION

Calcium
Magnesium
Potassium
Sulphate
Bicarbonate
Zinc

Starch
pH

↓

MASHING MANAGEMENT

Colour

Bitterness

↓

IBU MANAGEMENT

Total lactic acid

↓

MICROBIOLOGICAL PROBLEMS

Water analysis

Beer and Wort analysis

CDR BeerLab® system

CDR BeerLab®

All the analyses on
Beer and Water

CDR BeerLab® Jr

All the analyses on
Beer except IBU.
No analyses on water.

CDR BeerLab®

and the Beer making process

BEERLab®

Beer production and in-house testing

Mashing

Boiling and bittering

Fermentation

Conditioning

Mashing

In this phase you can analyze

pH

Generally between 5,3 - 5,6
Depends on the value of the water pH
It influences very much
the saccharification process

Determination of the optimal pH for the saccharification process

Colour

In this phase is possible
to control the extraction
and the evolution
of the color

Standardization of the colour

Sugars

The fermentable sugars
content gives you
the potential alcohol

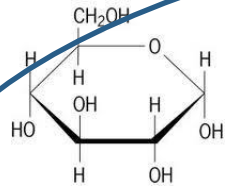
Potential alcohol determination

Starch Test

Iodine test performed
in the photometric way
detection limit di 0,1 g/L !!

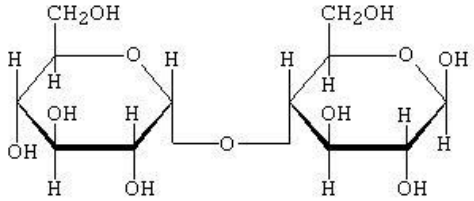
It allows to determine with certainty the completion of the conversion of starch in fermentable sugars (glucose, fructose, maltose, maltotriose)

Focus on Sugars….



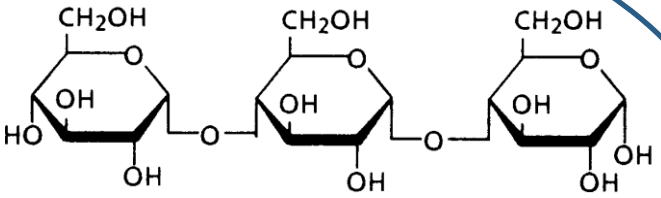
Glucose

Fermentable



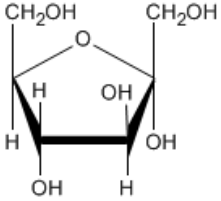
Maltose

Fermentable



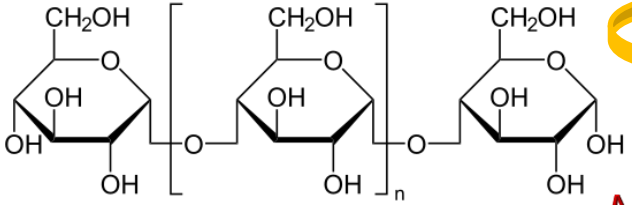
Maltotriose

Partially fermentable



Fructose

Fermentable



Dextrines

NOT FERMENTABLE !!

CDR Fermentable Sugars Kit

New kit coming soon

Boiling and bittering
Hoping

The temperature of the wort is increased up to 100 °C and, depending on the recipe, the hop is added to make bitter at certain levels the future beer

In this phase:

- Sterilization of wort
- Isomerization of iso-alpha acids
- Concentration of wort
- Coloring of wort
- Inactivation of enzymes
- Coagulation of proteins and complexes polyphenols-proteins

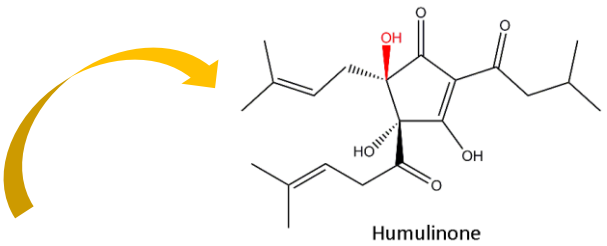
In this phase is possible a real-time control of the *IBU yield* of your recipe

Boil duration about 60 minutes

Focus on the hops ….

The hop cones in the female flowers are rich in secondary metabolites:

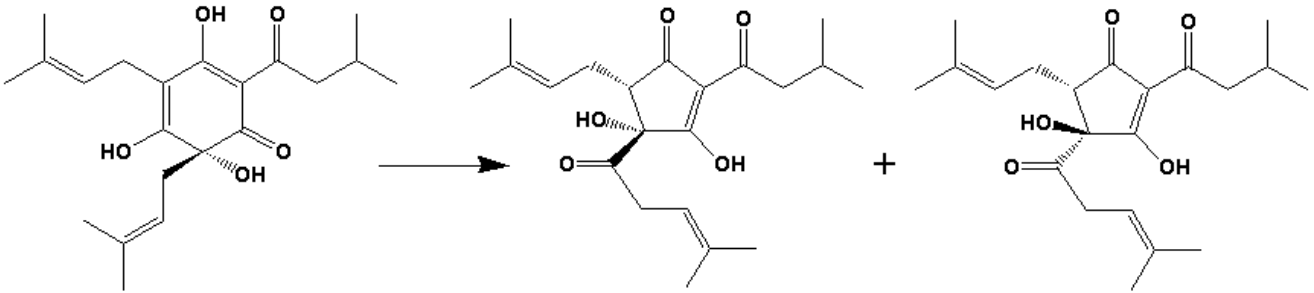
- Resins (alpha and beta acids) → The isomers are more soluble in water
- Essential oils
- Polyphenols



Humulinone

Formed in hops and pellet hops by oxidation

Isomerization of Humulone



Humulone | *Cis*-Isohumulone | *Trans*-Isohumulone

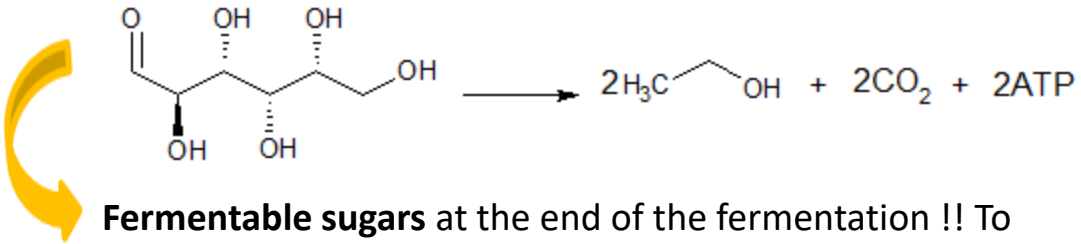
International Bitter Unit

CDR BeerLab® uses the optimized EBC reference method

The analysis can be performed directly at every step of the beer production process

You have the possibility to study your recipe optimizing the additions of the hops and monitoring the actual extraction of the bitter

Alcoholic Fermentation and FAN analysis



Fermentable sugars at the end of the fermentation !! To evaluate with accuracy its end and, to have, measuring them at the beginning the potential alcohol of your “future” beer

The importance of **F**ree **A**mino **N**itrogen analysis

It is important to have **high FAN values** before the fermentation to guarantee the right nutritional status for the yeasts

It is important to have **low FAN values** in the finished beer to avoid off-flavors and to extend the biological stability

https://www.brewersassociation.org/attachments/0001/4752/Malting_Barley_Characteristics_For_Craft_Brewers.pdf

Conditioning

Beer maturation

Diacetyl rest

Natural Stabilization Process
Precipitations of tannin protein complexes

The problem of VDKs

Vicinal **D**i**K**etones test (**VDKs**)
will be available soon !!

Bottling

After maturation fermentable sugars are analyzed

An exact content of sugar is added
to produce the desired gassing

The residual fermentable sugars is a powerful tool
to avoid unpleasant problems of over gassing in the bottle

Very important:
final analysis of *alcohol by volume* in beer
and *Total* SO_2

Total SO_2 analysis

SO_2 is produced during the fermentation by yeasts

The legal limit is 10 mg/L. Over this limit it has to be written on the label «contain sulfites»

It is a very important quality control test for the breweries

CDR BeerLab® determines the Total SO_2 using the EBC reference method

Water Analysis

Water forms about 95% of the finished product

The water quality control is very important for obtaining a “reproducible” beer from the taste and sensory point of view

It is not true that water is always the same !!!

Water Analysis

The sum of **Calcium (Ca^{2+})** and **Magnesium (Mg^{2+})** constitutes Hard

Very hard waters affect negatively drinkability

Sulphates (SO_4^{2-}) affect bitterness perception

Chlorides (Cl^-) affect the body of the beer

Bicarbonate (HCO_3^-) works as buffer and prevents lowering of pH w
pH is too high before mashing

Zinc (Zn^{2+}) for the fermentation management

CDR BeerLab®

PUBLICATIONS

Before…
Just a few UK references

http://www.qclscientific.com/pdfs/BeerLab/BeerLab%20User%20List.pdf

Pubblications

Assessment of the CDR BeerLab® Analyser
March 2016
Campden BRI
food and drink innovation

CDR BeerLab®: Bad&Co experience

CDR BeerLab®: The effect of Late and Dry-Hoping on IBU value

CDR BeerLab®: Analysis of Mashing in the brewery

Pubblications

Assessment of the CDR BeerLab® Analyser

March 2016

by

Alcohol by volume
Colour
pH
Bitterness

Campden BRI is a research association located in UK serving all sectors of the food and drink industry.

Campden BRI was formed by the merger of **Brewing Research International** with **Campden & Chorleywood Food Research Association**

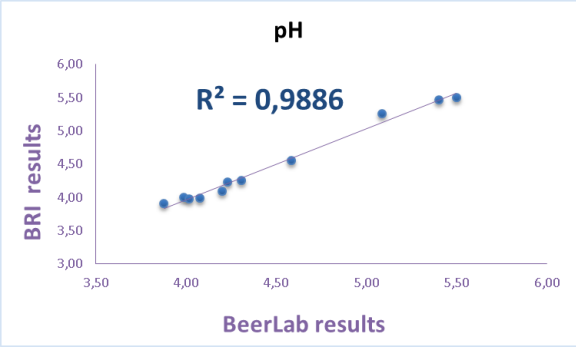
Assessment of the CDR BeerLab® Analyser

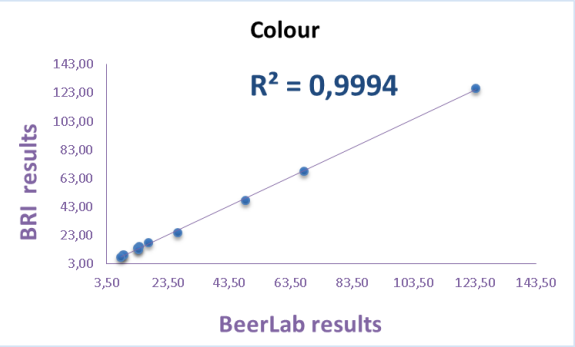
We have trialled the CDR BeerLab Analyser to establish whether it could meet the requirements for analysing a number of important beer and wort quality parameters.

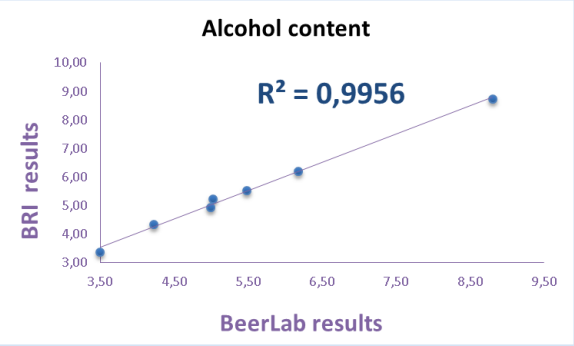
In our work with the CDR BeerLab Analyser we found that:

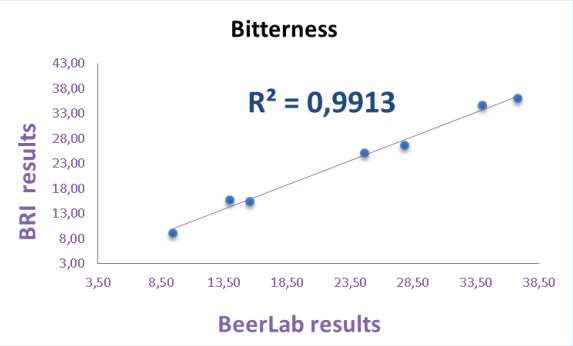
- The instrument was easy to use
- The user interface was logical and user friendly
- No calibration is required
- Compared to traditional alcohol and bitterness methods, the CDR BeerLab methods were much quicker
- The system has a low environmental impact due to minimal waste production and the very low sample and reagent volumes required

Assessment of the CDR BeerLab® Analyser









Assessment of the CDR BeerLab® Analyser

Extracts from Summary

… the CDR BeerLab analyser has been shown to **give comparable performance** in the measurement of pH, colour, bitterness and alcohol **to established methods**. ……

Accuracy of the CDR BeerLab with regards to agreement with the declared values of **ABV was very good** for all sample types. ……

… **precision values** for the CDR BeerLab, for all analyses, are **well within the tolerances expected for spectrophotometers** in the brewing industry

The low reagent and sample volumes required for analysis not only **reduces reagent costs** but also **reduces the amount of waste produced**, thereby providing analysis with a **low environmental impact**.

In the case of **alcohol and bitterness**, the CDR BeerLab methods are **faster than traditional methods** (in the case of bitterness significantly faster) and **all methods** tested during this evaluation show close **agreement to the reference method**.

Bad Co Case study

QCL

BAD Co. Brewery

BAD Co. was established to create craft-brewed beers with outstanding flavours and impact, inspired by the American approach to ale production and the current British craft brewing renaissance.

Just months later a brand new, state-of-the-art brewery was installed at their Dishforth site, doubling brewing capacity to 20BBL of beer per shift. The new plant includes a whirlpool facility, allowing the hop flavours and aromas to become even more prominent in the finished brew.

With the new brewery installation, head brewer Paul Holden-Ridgeway was keen to introduce quality control to the brewery, to improve consistency and track any changes during the brewing process from start to finish.

Using the CDR BeerLab, supplied by QCL, the brewery has been able to test beer and wort for ABV, Bitterness, Colour, pH, and Fermentable Sugars; essential parameters for the taste and appearance of any beer.

The results of all tests on the BeerLab are stored with a time, date and operator stamp, which can be exported as CSV or XML files, making it easy to trend results and spot any changes during the brewing process that may affect the finished product.

BAD Co. has also been using the BeerLab to test brewing water for Calcium, Magnesium, Bicarbonates, Chloride, Potassium and Sulfates.

Having in-house quality control has proven essential in the pursuit of a listing with national retailers and BAD Co. has recognised this by purchasing the BeerLab to compliment the increased brewing capacity and a new canning line.

"Since its installation, we have found the analyser to be accurate and easy to use. We are looking to list BAD Co. beer with a well-known national retailer and we wouldn't be able to do that without in-house quality control using the BeerLab".

Paul Holden-Ridgeway, Head Brewer BAD Co.

A validation study was run by Campden BRI, comparing the ABV, Bitterness, pH, and Colour tests on the BeerLab with reference methods and the final report of this validation is one of the key points that attracted Paul to the BeerLab. The summary of the report states;

"...in the majority of cases and based on current data there is no statistically significant evidence for a difference in bitterness and alcohol measurements for beer when using the BeerLab Touch versus the reference methods."

For more information please visit: www.qclscientific.com/beerlab

QCL Case Study 003CS-FD
QCL Ltd | Riverside | Forest Row Business Park | Forest Row | East Sussex | RH18 5DW
t 01342 820820 f 01342 820825 e sales@qclscientific.com w www.qclscientific.com
QCL are the exclusive UK and Ireland distributors for CDR

http://www.qclscientific.com/cdrbeerlab.html

Bad Co Case study

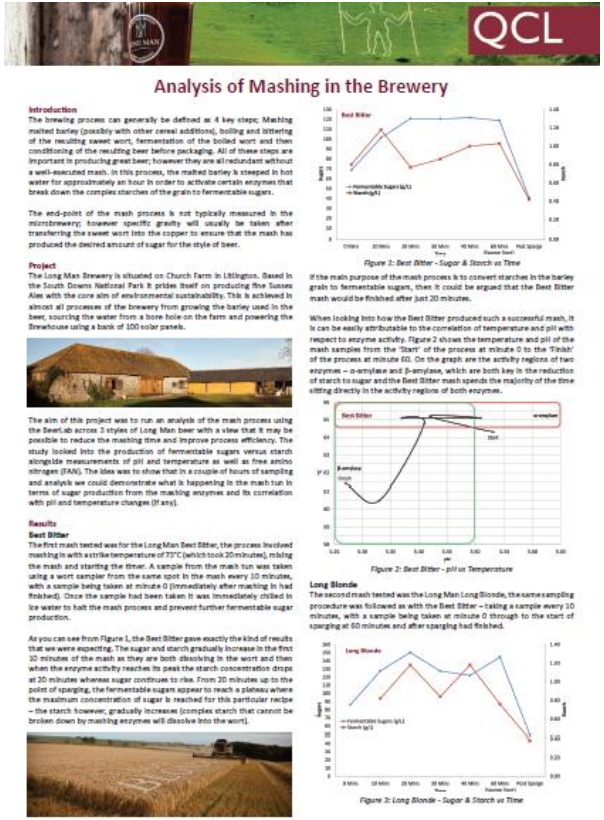
With the new brewery installation, head brewer Paul Holden-Ridgeway was keen to introduce quality control to the brewery, to improve consistency and track any changes during the brewing process from start to finish.

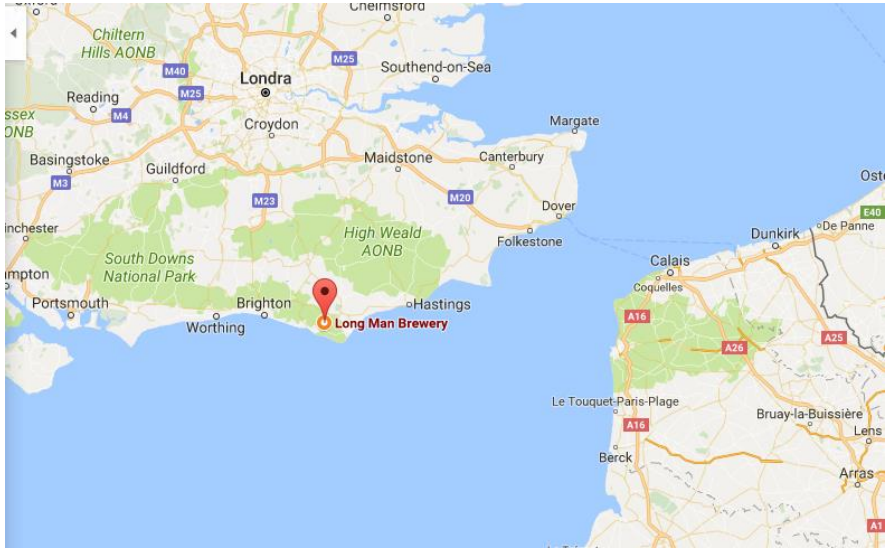
Using the CDR BeerLab, supplied by QCL, the brewery has been able to test beer and wort for ABV, Bitterness, Colour, pH, and Fermentable Sugars; essential parameters for the taste and appearance of any beer.

BAD Co. has also been using the BeerLab to test brewing water for Calcium, Magnesium, Bicarbonates, Chloride, Potassium and Sulfates.

Having in-house quality control has proven essential in the pursuit of a listing with national retailers and BAD Co. has recognised this by purchasing the BeerLab to compliment the increased brewing capacity and a new canning line.

Long man brewery case study





http://www.qclscientific.com/cdrbeerlab.html

Long man brewery case study

The aim

Demonstrate that it is possible to reduce the mashing time improving the process efficiency

3 kind of Beers

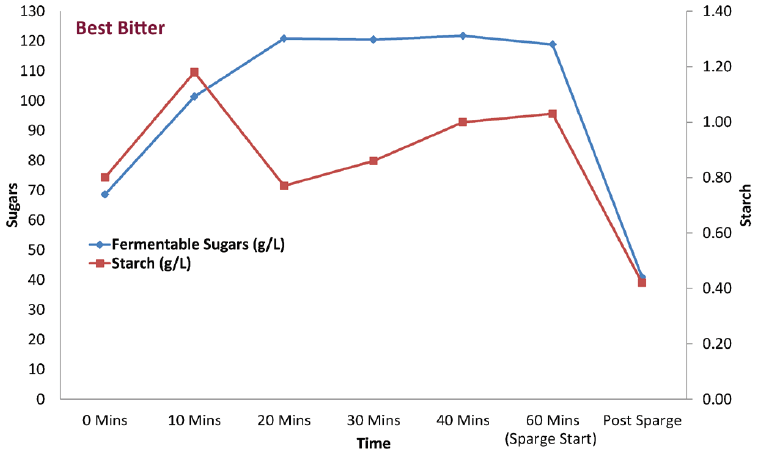
- Best Bitter
- Long Blonde
- APA

Analysis

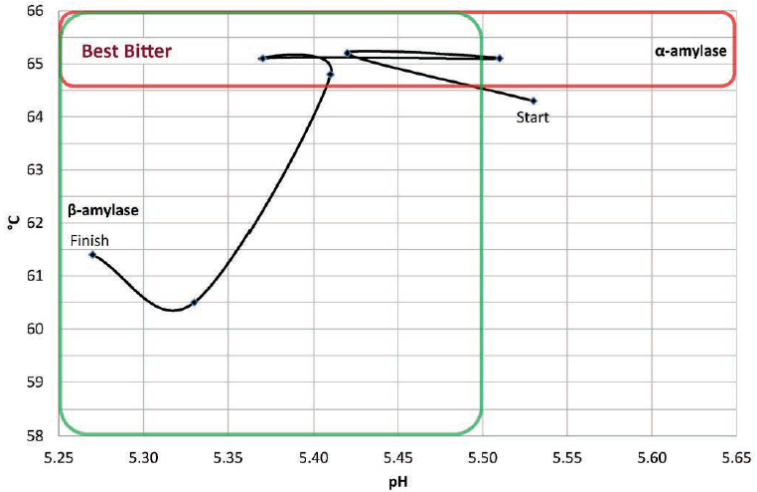
- Fermentable Sugars
- Starch
- pH
- FAN

Long man brewery case study

Best Bitter beer



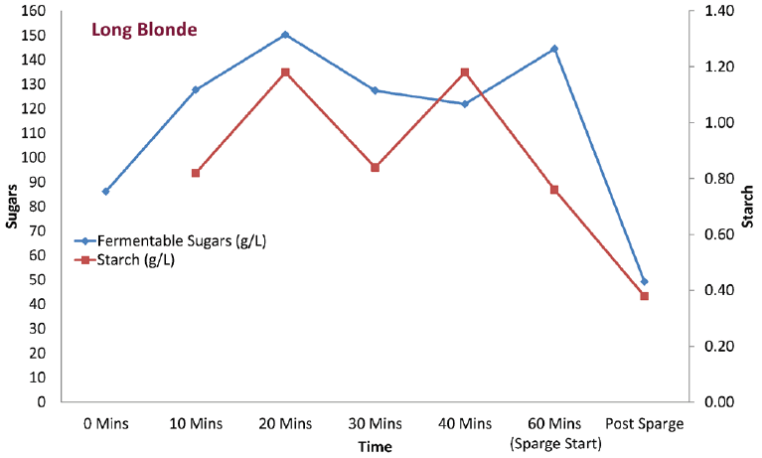
In 20 minutes they have completely converted all the starch in fermentable sugars!!

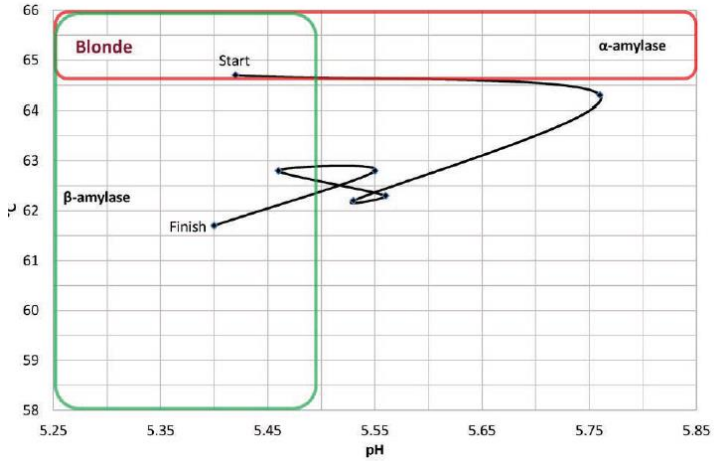


Mash spends the majority sitting directly in the activity region for both enzymes

Long man brewery case study

Long blonde beer



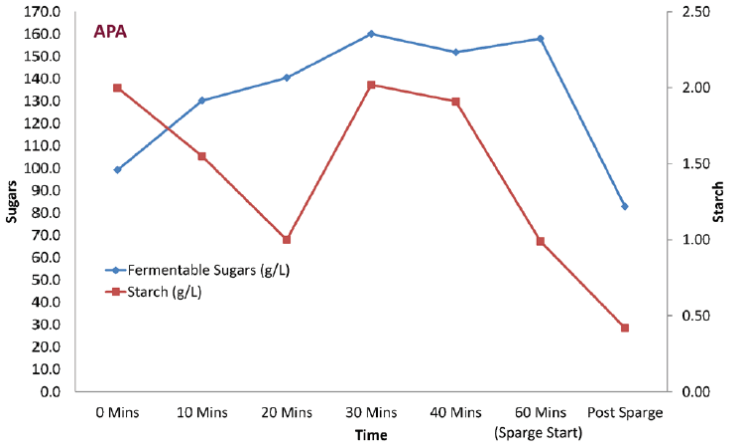


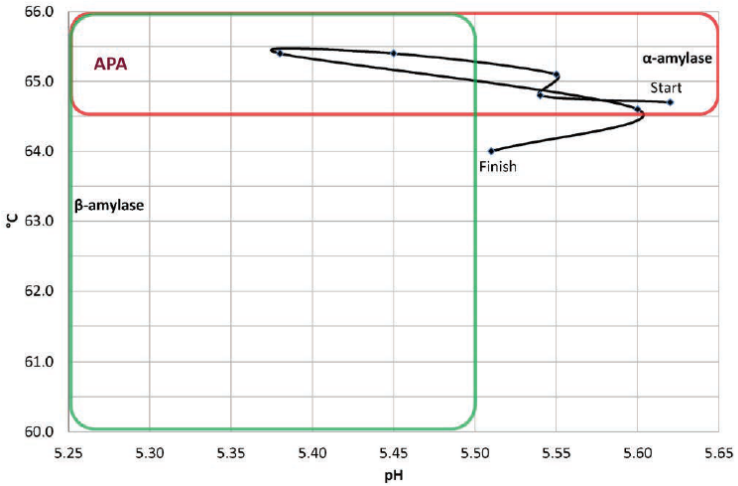
It needs around 60 minutes
to have all the starch converted
in fermentable sugars

Mash spends
the majority sitting outside
the activity region for both
enzymes

Long man brewery case study

APA





After 20 minutes fermentable sugars reach a “plateau”.

Mash spends the majority sitting in the activity region for alfa-amilase enzyme

Long man brewery case study

Free Amino Nitrogen analysis

A sample of each beer was taken post boil and tested for FAN. 2 of them was found with a low level of FAN for an healty yeast growth.

By knowing the FAN for each brew, yeast nutrient can be adjusted to ensure healty ,yeast growth, **avoiding stuck fermentations** and **saving time and yeast**

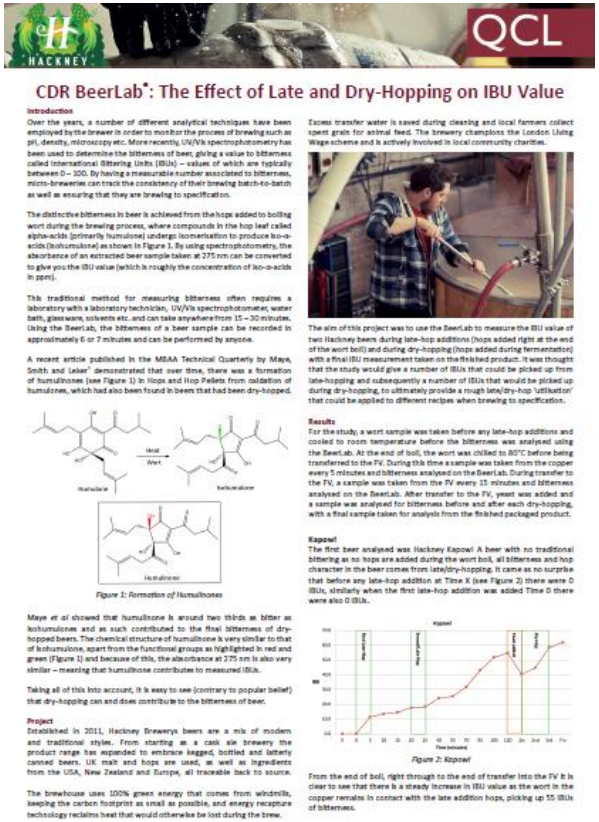
FAN is important in beer as well **to extend its shelf life and to avoid off-flavours**

Long man brewery case study

Summarizing…

- Fermentable sugars and starch analyses can give you the possibility to shorten the mashing time
- FAN analysis gives you the possibility to manage at best the yeast growth avoiding to lose time and money
- With CDR BeerLab YOU are able to improve your in-house testing improving the efficiency of your beer making process

Hackney brewery case study



QCL

CDR BeerLab®: The Effect of Late and Dry-Hopping on IBU Value

Introduction

Over the years, a number of different analytical techniques have been employed by the brewer in order to monitor the process of brewing such as pH, density, microscopy etc. More recently, UV/Vis spectrophotometry has been used to determine the bitterness of beer, giving a value to bitterness called International Bittering Units (IBUs) – values of which are typically between 0 – 100. By having a measurable number associated to bitterness, micro-breweries can track the consistency of their brewing batch-to-batch as well as ensuring that they are brewing to specification.

The distinctive bitterness in beer is achieved from the hops added to boiling wort during the brewing process, where compounds in the hop leaf called alpha-acids [primarily humulone] undergo isomerisation to produce iso-α-acids (isohumulone) as shown in Figure 1. By using spectrophotometry, the absorbance of an extracted beer sample taken at 275 nm can be converted to give you the IBU value (which is roughly the concentration of iso-α-acids in ppm).

This traditional method for measuring bitterness often requires a laboratory with a laboratory technician, UV/Vis spectrophotometer, water bath, glassware, solvents etc. and can take anywhere from 15 – 30 minutes. Using the BeerLab, the bitterness of a beer sample can be recorded in approximately 6 or 7 minutes and can be performed by anyone.

A recent article published in the MBAA Technical Quarterly by Maye, Smith and Leker[1] demonstrated that over time, there was a formation of humulinones (see Figure 1) in Hops and Hop Pellets from oxidation of humulones, which had also been found in beers that had been dry-hopped.

Figure 1: Formation of Humulinones

Maye *et al* showed that humulinone is around two thirds as bitter as isohumulones and as such contributed to the final bitterness of dry-hopped beers. The chemical structure of humulinone is very similar to that of isohumulone, apart from the functional groups as highlighted in red and green (Figure 1) and because of this, the absorbance at 275 nm is also very similar – meaning that humulinone contributes to measured IBUs.

Taking all of this into account, it is easy to see (contrary to popular belief) that dry-hopping can and does contribute to the bitterness of beer.

Project

Established in 2011, Hackney Brewerys beers are a mix of modern and traditional styles. From starting as a cask ale brewery the product range has expanded to embrace kegged, bottled and latterly canned beers. UK malt and hops are used, as well as ingredients from the USA, New Zealand and Europe, all traceable back to source.

The brewhouse uses 100% green energy that comes from windmills, keeping the carbon footprint as small as possible, and energy recapture technology reclaims heat that would otherwise be lost during the brew.

Excess transfer water is saved during cleaning and local farmers collect spent grain for animal feed. The brewery champions the London Living Wage scheme and is actively involved in local community charities.

The aim of this project was to use the BeerLab to measure the IBU value of two Hackney beers during late-hop additions (hops added right at the end of the wort boil) and during dry-hopping (hops added during fermentation) with a final IBU measurement taken on the finished product. It was thought that the study would give a number of IBUs that could be picked up from late-hopping and subsequently a number of IBUs that would be picked up during dry-hopping, to ultimately provide a rough late/dry-hop 'utilisation' that could be applied to different recipes when brewing to specification.

Results

For the study, a wort sample was taken before any late-hop additions and cooled to room temperature before the bitterness was analysed using the BeerLab. At the end of boil, the wort was chilled to 80°C before being transferred to the FV. During this time a sample was taken from the copper every 5 minutes and bitterness analysed on the BeerLab. During transfer to the FV, a sample was taken from the FV every 15 minutes and bitterness analysed on the BeerLab. After transfer to the FV, yeast was added and a sample was analysed for bitterness before and after each dry-hopping, with a final sample taken for analysis from the finished packaged product.

Kapowl

The first beer analysed was Hackney Kapowl. A beer with no traditional bittering as no hops are added during the wort boil, all bitterness and hop character in the beer comes from late/dry-hopping. It came as no surprise that before any late-hop addition at Time X (see Figure 2) there were 0 IBUs, similarly when the first late-hop addition was added Time 0 there were also 0 IBUs.

Figure 2: Kapowl

From the end of boil, right through to the end of transfer into the FV it is clear to see that there is a steady increase in IBU value as the wort in the copper remains in contact with the late addition hops, picking up 55 IBUs of bitterness.

http://www.qclscientific.com/cdrbeerlab.html

Hackney brewery case study

The aim

Demonstrate that (contrary to popular belief) dry-hoping can and does contribute to the bitterness of the beer

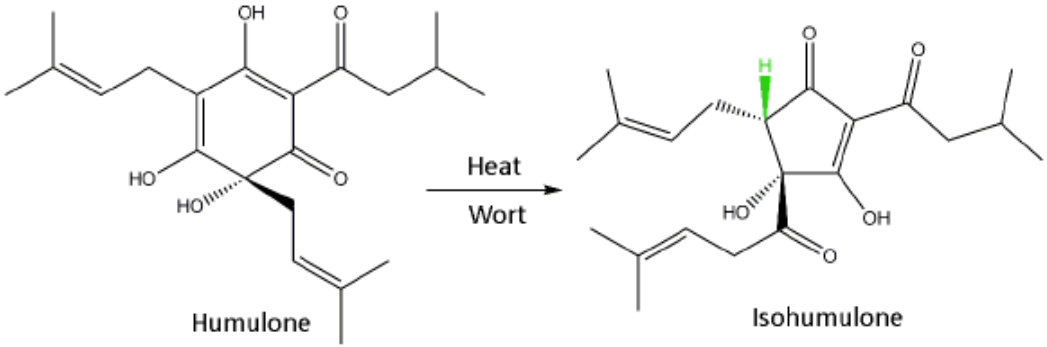
2 kind of Beers

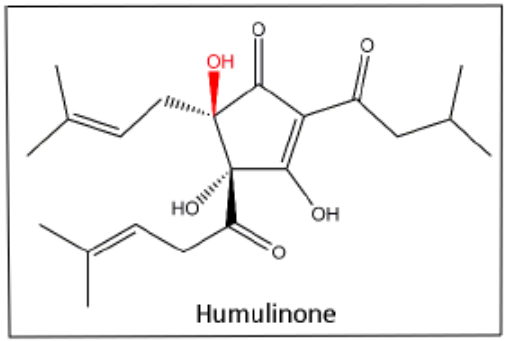
- Kapow!
- APA

Bitterness (IBU)

Hackney brewery case study

Formation of Humulinone



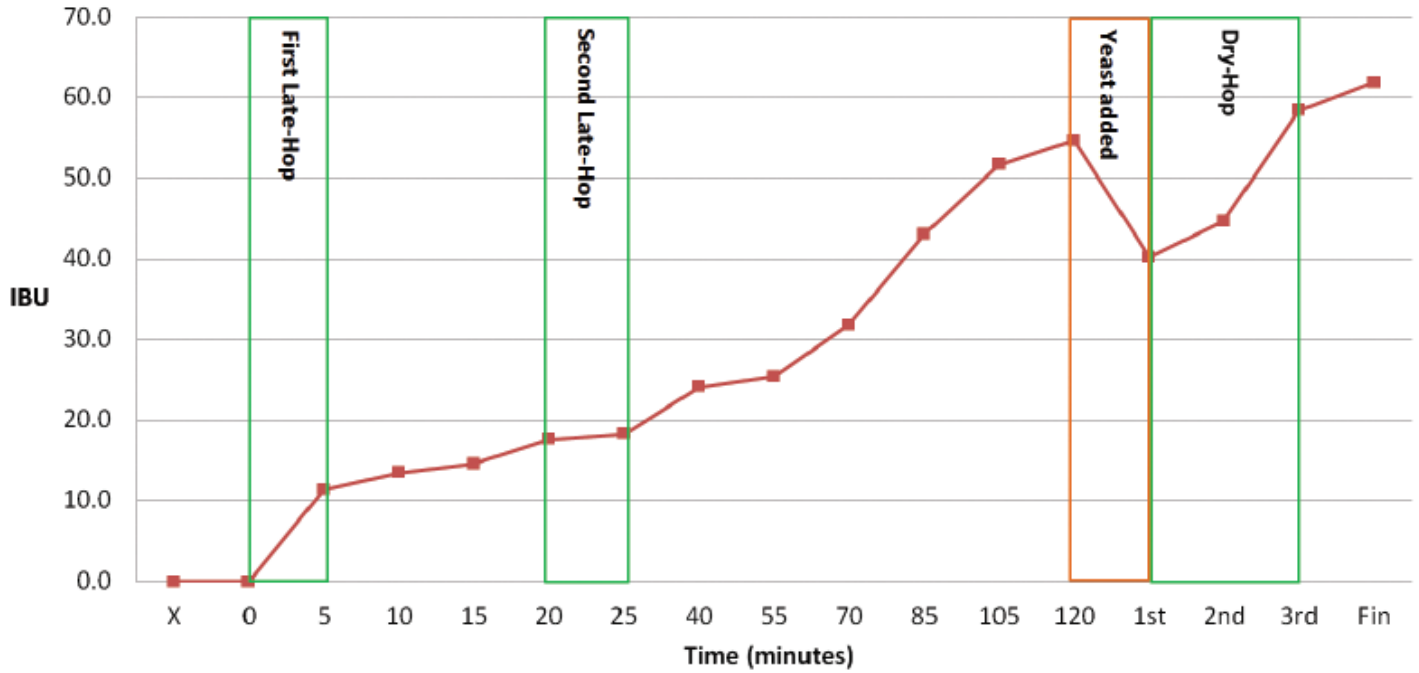


Formed in hops and pellet hops by oxidation

Hackney brewery case study

No hops in boiling

Kapow!



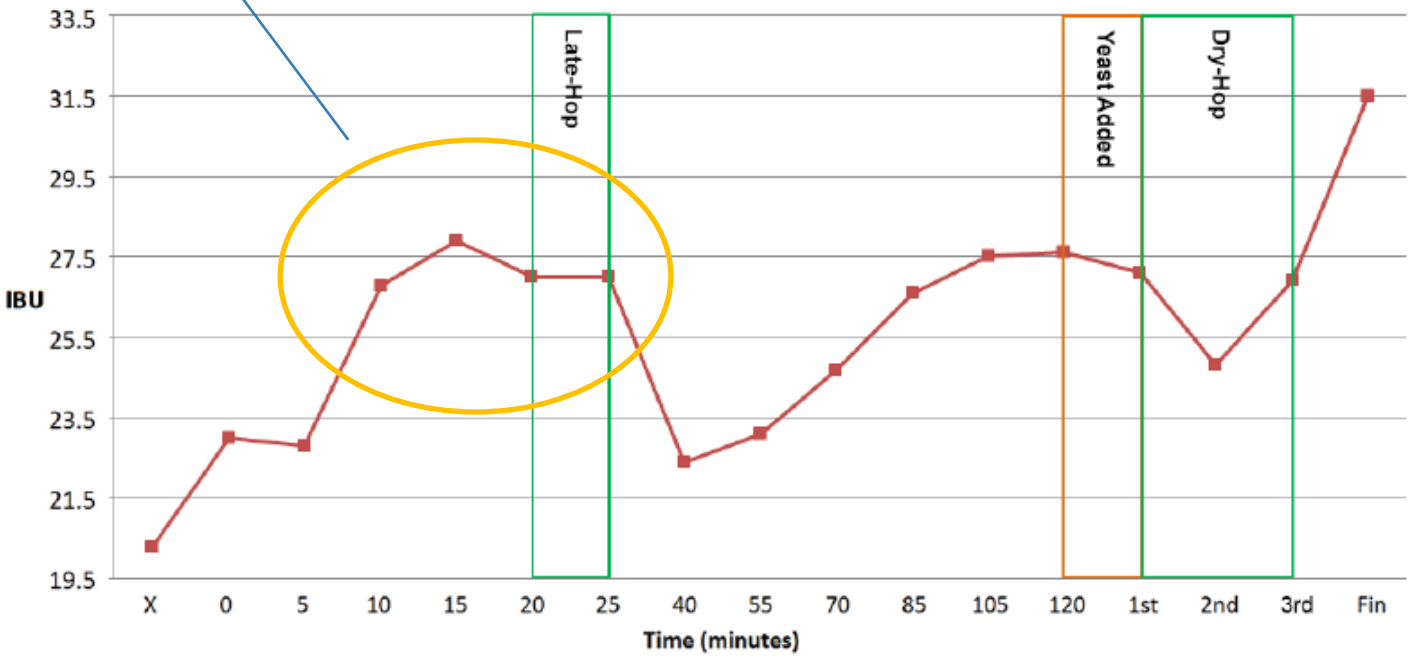
20 IBU of increment

Hackney brewery case study

Sampling problem from the copper

APA

Hops in boiling



7 IBU of increment

Hackney brewery case study

Kapow!

	1st Late-Hop	2nd Late-Hop	Dry-Hop	Alpha-Acid
Hop 1	1.25 Kg	1.25 Kg	6.00 Kg	11.6 %
Hop 2	1.25 Kg	1.25 Kg	5.00 Kg	9.6 %
Hop 3	1.00 Kg	4.00 Kg	6.00 Kg	14.5 %

→ 20 IBU from dry-hopping
17kg of hops

APA

	1st Late-Hop	2nd Late-Hop	Dry-Hop	Alpha-Acid
Hop 1	0.55 Kg	-	-	14.6 %
Hop 2	1.25 Kg	3.75 Kg	5.00 Kg	8.5 %
Hop 3	-	-	5.00 Kg	10.5 %

→ 7 IBU from dry-hopping
10 kg of hops

Long man brewery case study

Summurizing…

- It is well demonstrated the contribution of the late and dry hoping to IBU
- You are able to check your hops, as a raw material, monitoring the IBU yeld during the beer making process
- With CDR BeerLab YOU have the IBU reference method in your brewery!

Conclusions

- CDR BeerLab® gives to the brewmaster the possibility TO CREATE a complete and accurate in-house quality control directly in the brewery!
- CDR BeerLab® can be used by everyone! NO chemical skills required!
- With CDR BeerLab® YOU are able to save money and time improving ,at the same time, the quality of your beer!

BEERLab®

Coming soon…

- Yeast Viability
- Vicinal DiKetones (VDKs)
- Dextrines content

Thanks for your attention

Simone Bellassai

Chemist & Enologist

CDR FoodLab division manager

s.bellassai@cdr-mediared.it

Follow us on