CDR Paper 1701

CDR BeerLab® method for the determination of total SO_2 in beer.

This study demonstrates the great accuracy and repeatability of CDR BeerLab® method for the determination of total SO_2 in beer samples. It allows the brewers to improve at best the execution of this analysis directly in the brewery.

Abstract

Sulfites are widely used as additives in beverages to prevent spoilage by oxidation and bacterial growth during production and storage.

In particular, sulfur dioxide is considered as the most important factor in preserving the shelf life of beer, because inhibits beer oxidation. In fact, it is employed by breweries as potassium matabisulfite ($K_2S_2O_5$), commonly abbreviated E224.

As the accurate determination of total sulfur dioxide in beer is essential to ensuring regulatory compliance, several methods have been developed.

CDR proposes a new method, easier and faster than traditional procedures, starting from a EBC (European Brewery Convention) method optimization.

CDR BeerLab® estimates the quantity of total SO_2 in beer, thanks to one single device, easy to use and in total autonomy. In this way the brewer is able to improve the quality control in all the beer production phases.

Introduction

Sulfur dioxide (SO_2) is recognized as the most important factor in delaying flavor staling and lengthening the shelf life of the beer.

SO_2 and sulfites in various forms show an antioxidant activity or rather they are compounds that can act by decreasing molecular oxygen levels, scavenging chain-initiating and chain-propagating free radicals, chelating metals, or decomposing peroxides. (Halliwell, Gutteridge, & Aruoma, 1987). In this way, they have a significant role as inhibitors of oxidative damage to achieve the stability of beer quality.

Sulfur dioxide is employed by breweries as potassium metabisulfite ($K_2S_2O_5$), commonly abbreviated E224. When it is dissolved in water or beer, E224 releases free sulfite ions, which are responsible for the antioxidative properties of the mixture.

Many different methods are used to determine the sulfite content, including for example, various version of the classical Monier-Williams method, the gas chromatographic methods using the technique of headspace GC and the colorimetric procedures such as the p-rosaniline.

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The colorimetric method using rosaniline hydrochloride was adopted by the American Society of Brewing Chemists (ASBC) and it proved to be quite acceptable until the last few years when questions about carcinogenicity of the p-rosaniline were raised. Another colorimetric method for total SO_2 in beer is recommended by EBC (European Brewery Convention). Sulfur dioxide is distilled from acidified 25 mL samples into a buffered DTNB solution, with a nitrogen carrier gas, and the absorbance is measured at 415 nm. (Li & Zhao, 2006).

CDR BeerLab® uses EBC reference method making it simpler, quicker and suitable for all brewers.

The aim of CDR BeerLab®

CDR BeerLab® is the beer analysis system designed to perform quality controls during all the brewing phases. In the CDR laboratories was developed a new method to quantify total SO_2 in commercial beer samples. This new method is much faster than traditional procedures to determine sulfites.

Application for the customers

CDR BeerLab® analyzer is based on photometric technology, equipped with LED emitters, reading cells and 37°C thermostated incubation cells.

The method uses a reagent in pre-filled cuvette. 200 uL of degassed beer are added in it and the reaction is blanked. After the addition of 50 uL of R2 reagent and 180 seconds of incubation time, the reaction is measured at the wavelength of 430nm. All reagents are supplied ready to use, then operators do not have to handle toxic or carcinogenic compounds.

There is no need of a dedicated laboratory or to wash either containers or traditional glassware because CDR BeerLab® analysis system allows to perform test on beer in total autonomy.

CDR BeerLab® method

The CDR BeerLab® method estimates the quantity of the analyte (total SO_2) in several samples of beer.

Method linearity was tested in deionized water and it was calibrated with standard solutions of $K_2S_2O_5$ (MW = 222.33 g/mol), in a concentration range from 2 mg/L to 25 mg/L. All samples were measured as triplicates.

The calibration curve is shown in Figure 1.

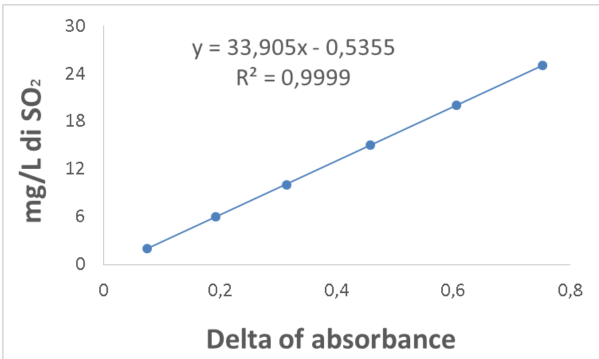

Figure 1 *Total SO_2 correlation graph.*

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Correlation data are obtained by the linear equation, exactly K = 33.9 and Q=- 0.5 with an R^2 of 0,999.

At the bottom of these results, 7 different commercial beer samples, in terms of colour, IBU and alcohol by volume were analyzed, after a degassation for few minutes (Table 1).

	Colour (EBC)	ABV%	IBU
Beer 1	8	4.50	7.3
Beer 2	158	7.50	13.0
Beer 3	79	5.60	20.0
Beer 4	25	6.10	38.0
Beer 5	8	12.0	28.0
Beer 6	7	4.90	15.2
Beer 7	14	5.40	18.3

Table 1 *Chemical features of the analyzed beers.*

A volume of 50 uL of potassium metabisulfite was added to each sample of beer and the Δ Absorbance was measured at 430 nm. The analyte concentration was calculated both according to the linear correlation and according after the additions.

Then, following each addition, recovery was calculated, and in this way, an estimate of the amount of the analyte present within the beer samples was measured.

Result and discussions

The results from the CDR BeerLab® tests are summarized in Table 2. First, a fixed amount of metabisulfite, for all the commercial beers was added in order to remove the possible reaction of it. Then the recovery was calculated after a second addition of metabisulfite.

	Conc. (mg/L)	Measured conc. (mg/L)	Recovery (%)
Beer 1	18.5	17.8	96.2
Beer 2	24.2	23.6	97.5
Beer 3	27.7	27.6	99.6
Beer 4	12.7	11.7	92.1
Beer 5	12.8	13.4	104.7
Beer 6	20.6	19.5	94.7
Beer 7	27.7	26.3	94.9

Table 2 *Recovery results for CDR BeerLab® Total SO_2 method.*

Table 2 shows the great recovery for all the beers were analyzed. It is interesting to note that the repeatability of CDR BeerLab® method is validated by the analysis of one beer sample carried out 10 times and the method showed an excellent standard deviation (Table 3).

	Total SO_2 result (mg/L)
Repetition 1	6.4
Repetition 2	6.7
Repetition 3	6.3
Repetition 4	6.4
Repetition 5	6.4
Repetition 6	6.4
Repetition 7	6.3
Repetition 8	6.5
Repetition 9	6.3
Repetition 10	6.4
AVERAGE	6.4
STANDARD DEV.	0.12

Table 3 *Repeatability test of CDR BeerLab® Total SO_2 analysis.*

The results obtained demonstrate that CDR BeerLab® is a method able to quantify total SO_2 in real beer samples.

CDR BeerLab® turns out to be reliable for the assessment of total sulfur dioxide in beer, then it can be considered as a cornerstone for the whole package of analysis about CDR BeerLab® system.

Conclusions

CDR BeerLab® is a versatile system specifically developed by CDR to respond to the needs of master brewers and breweries of any size.

CDR BeerLab® analysis system allows to perform tests with one single instrument, more rapidly and easily than traditional methods.

Thanks to CDR BeerLab® analysis system, it is also possible to perform sulfur dioxide analysis, in addition to all the other parameters on beer.

References

Halliwell, B., Gutteridge, J., & Aruoma, O. (1987). The deoxyribose method: a simple "test-tube" assay for determination of rate constants for reactions of hydroxyl radicals. *Analytical Biochemistry 165*, 215-219.

Li, Y., & Zhao, M. (2006). Simple methods for rapid determination of sulfite in food products. *Food control 17*, 975-980.