

## Zinc and Calcium Determination in Wort Samples using Flame Atomic Absorption Spectroscopy

### ***Introduction:***

In collaboration with Brewery Ommegang, the Center for Craft Food and Beverage at Hartwick College has implemented internationally recognized and validated methodologies for the measurement of key analytes throughout the brewing process. Together both organizations have strived to make high-end scientific analysis both accessible and available to the local craft brewer. One such analysis is the ion content of wort, particularly calcium and zinc.

Calcium ions play a critical role in the brewing process, as calcium has been shown to increase total soluble nitrogen and free amino nitrogen levels in wort, improve wort runoff, improve wort clarification and protein coagulation, and has also been shown to increase yeast flocculation and growth.

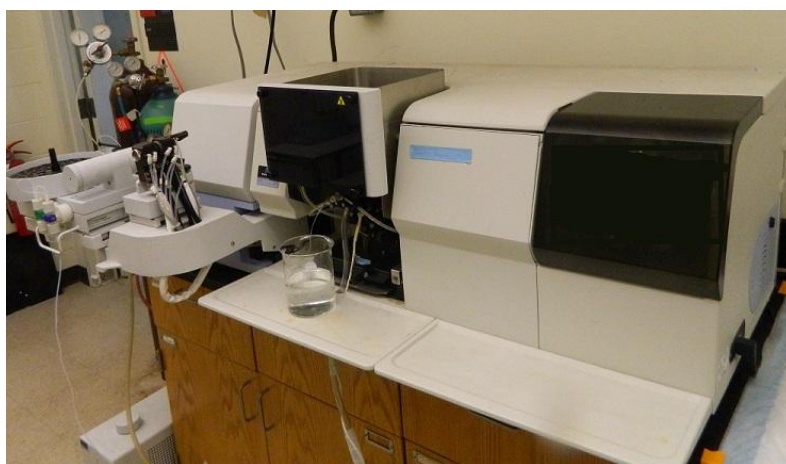
Zinc ions are essential for an effective and vigorous fermentation, as most yeast strains require a concentration of 0.1-0.3 mg/L. The presence of zinc is essential for the structure and function of many enzymes, where it can be involved in the active site (zinc-metalloenzymes). However, zinc can inhibit yeast growth and fermentation at higher concentrations under certain circumstances.

Therefore, it is essential to determine both zinc and calcium concentrations in wort samples to maintain consistency and efficiency within the brewing process. This whitepaper describes the analysis of calcium and zinc in wort samples using Atomic Absorption Spectroscopy.<sup>1</sup>

### ***Instrumentation:***

Atomic absorption spectroscopy (AAS) is a spectroanalytical technique used to determine chemical elements quantitatively by using the absorption of optical radiation (light) by free atoms in the gaseous state.

Hartwick College Center for Craft Food and Beverage has Perkin Elmer AAnalyst300 with Flame Atomic Absorption and Graphite Furnace Atomic Absorption Spectroscopy capabilities (Figure 1). Currently it can quantify iron, copper, calcium, and zinc in wort and beer samples.

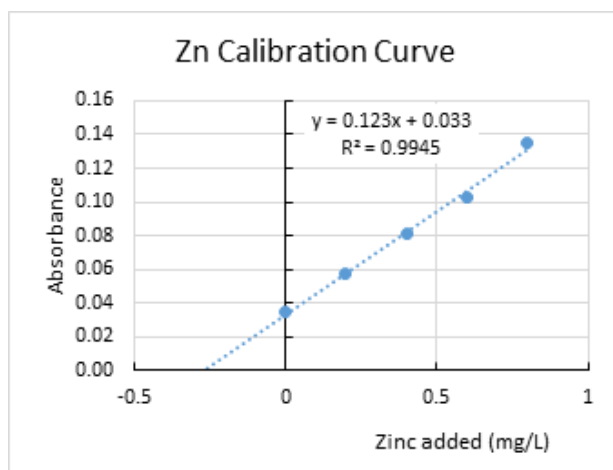


**Figure 1:** Perkin Elmer AAnalyst300 with Flame Atomic Absorption and Graphite Furnace Atomic Absorption Spectroscopy capabilities.

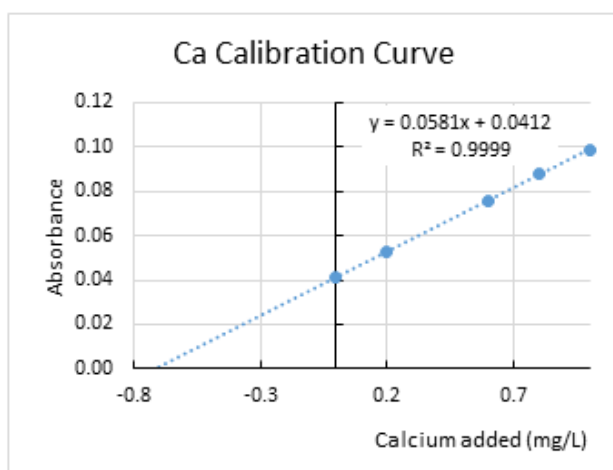
### ***Experimental:***

The analysis of zinc and calcium in wort samples from Ommegang Brewery follows the methods described in the American Society of Brewing Chemists (ASBC) Methods of Analysis.<sup>2,3</sup>

## Results:



**Figure 2:** Standard addition calibration curve for Zn in wort matrix.



**Figure 3:** Standard addition calibration curve for Ca in wort matrix.

**Table 1:** Analysis of Zn and Ca in wort samples from Ommegang Brewery.

Lab ID	Zn (mg/L)	Ca (mg/L)
Sample 1	0.27	71
Sample 1R	0.33	65
Sample 2	0.27	32
Sample 3	0.29	30
Sample 4	0.33	51

## Discussion:

The zinc and calcium content in wort samples were determined using a standard addition calibration curve in order to obtain accurate results and to minimize the matrix effect. The  $R^2$  values close to 1 in the calibration curves show good linearity between the metal concentrations and instrument response.

## Conclusion:

The Perkin Elmer AAnalyst300 Atomic Absorption Spectroscopy spectroanalytical technique demonstrates an ideal solution for zinc and calcium concentration determination in wort and beer samples. Currently Hartwick's Center for Craft Food and Beverage has the infrastructure, instrumentation, and personnel required for analyzing metals in wort and beer samples with high precision and accuracy.

## References:

1. American Society of Brewing Chemists. Report of Subcommittee on Atomic Absorption Spectrophotometry. Journal 39'89, 1981.
2. ASBC Methods of Analysis, online. Wort Method 15. Zinc by Atomic Absorption Spectrophotometry (International Method). Approved (1982), rev. (2010). American Society of Brewing Chemists, St. Paul, MN, U.S.A. doi: 10.1094/ASBCMOA-Wort-16
3. ASBC Methods of Analysis, online. Beer Method 20 (C). Calcium - Atomic Absorption Spectrophotometry (International Method). Approved (1972), rev. (1975). American Society of Brewing Chemists, St. Paul, MN, U.S.A. doi: 10.1094/ASBCMOA-Beer-20