Studies of food spoilage and processes to increase shelf life

Instruments to which this note applies: BioCal 2000

Target use: Research and Quality Control related to food spoilage and effectiveness of conservation methods

Introduction

Spoilage refers to all types of processes that reduce the quality of a food product, either by its appearance or its suitability for human consumption. Spoilage often occurs through enzymatic activity, oxidation or microbial growth (bacteria, mold, yeast). While spoilage many times is associated with a change in appearance, it may start long before visible signs appear. Isothermal calorimeters measure heat release continuously, and can therefore be used to determine the time at which the spoilage process actually begins. By measuring the thermal power from the sample, it is also possible to determine the kinetics of the reaction, i.e. the rate at which the spoilage is progressing.
Therefore, isothermal calorimeters are a convenient and cost effective tool to quickly assess how spoilage develops in different food items, and which preserving methods work best, simply by comparing their isothermal calorimetry curves. Using a large sample cell calorimeter such as BioCal 2000, with 125 ml glass or stainless steel ampoules, increases the range of applications by making it possible to study food items such as pieces of meat or cheese and whole small fruit.

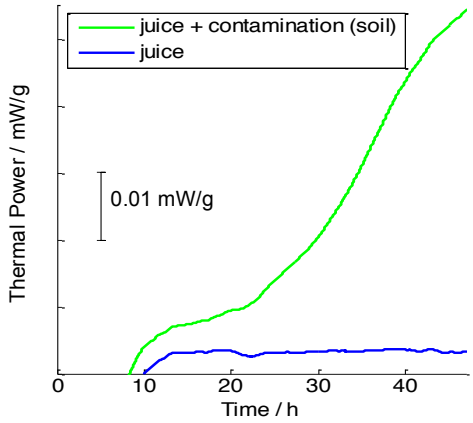
This Application Note shows the thermal activity in two samples of fresh mixed juice containing blueberries and black currents.

Test Protocol

Both sample containers were charged with about 100 g of fresh blueberry and black current juice in a controlled temperature at 23 °C, but in one of the samples a small amount of soil (a contaminant) was added.

Results and Interpretation

Both samples show low thermal powers, but the thermal power of the sample with a contaminant increases in an exponential fashion, while the sample without contaminant shows a constant thermal power.
In this experiment the 100 g samples were taken from a refrigerator and charged into the calorimeter, which is why they need to be supplied with significant amounts of heat to reach the temperature of the calorimeter. As a result, it took more than 10 hours before the calorimeter measures the correct signal. Alternatively, it would be possible to pre-heat the samples in a heating block. However, this note shows that even a measurement protocol without pre-heating yields perfectly relevant results that show the significant influence of the contaminant on the shelf life of the product.



Further experiments with different preservatives or conservation methods could easily be conducted to measure how they mitigate the effect of the contaminant and thereby identify the best method to optimize conservation.

Conclusion

Isothermal calorimeters such as BioCal 2000 are an effective and easy-to-use tool for shelf life studies. The method described in this Application Note can be used for all types of foodstuffs and for many different processes. Many processes responsible for spoilage, and particularly microbiological spoilage as in the present measurement, produce relatively high thermal powers and are easy to study with calorimeters like the BioCal 2000.

References

The following references discuss shelf life studies using isothermal calorimetry in food science.

1. Riva, M., D. Fessas, and A. Schiraldi, Isothermal calorimetry approach to evaluate shelf life of foods. Thermochim. Acta, 370 (2001) 73-81.

2. Alklint, C., L. Wadsö, and I. Sjöholm, Accelerated storage and isothermal microcalorimetry as methods of predicting carrot juice shelf-life. J. Sci. Food Agric., 85 (2005) 281-285.

3. Wadsö, L. and F. Gómez Galindo, Isothermal calorimetry for biological applications in food science and technology. Food Control, 20 (2009) 956-961.