Studies of food spoilage and processes to increase shelf life

Instruments to which this note applies: I-Cal Flex, Biocal 2000, Biocal 4000

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

Introduction

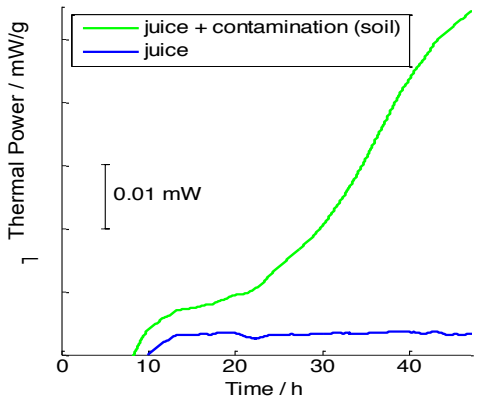
Spoilage refers to all types of processes that reduce the quality of a food product, either by its appearance or its suitability for human consumption. Spoilage often occurs through enzymatic activity, oxidation or microbial growth (bacteria, mold, yeast). While spoilage many times is associated with 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. Measurements take place without any intervention by a technician, and results can be conveniently retrieved with the click of a button and interpreted any time during or after completion of the experiment.
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 the Calmetrix Biocal, with 125 ml sample vials, 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 commercial lightly pasteurized fruit drink made from blueberries, containing blueberries, black currents, grapes and sugar

Test Protocol

Both sample vials were loaded 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 a contaminant was added.

Results and Interpretation

Both samples show relatively 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 over an extended period of time.
In this experiment the 100 g samples were taken from a refrigerator and then loaded into the calorimeter, which is why the initial part of the curve shows negative thermal power as the temperature in the sample stabilizes to the set temperature inside the calorimeter. Alternatively, it would be possible to pre-heat the samples in a heating block. However, as shown in this note, 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.



Calorimetry measurements such as these, on juices produced with different pasteurization procedures, preservatives and their concentrations, pH or other production variables can be used to easily identify the best method to extent shelf life.

Conclusion

Isothermal calorimeters such as Biocal 2000 and Biocal 4000 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 liquid or solid foodstuffs and for many different processes. Microbiological spoilage, as in the present measurement, produces relatively high thermal powers and is therefore easy to study with isothermal calorimetry.

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.