Study on Energy Metabolism of Food Microorganisms with an Isothermal Microcalorimeter

Keywords: metabolizable energy for growth; microorganism; food processing; toxicity evaluation

MC152

ABSTRACT

In recent years, there have been an increase in publications on food studies with microcalorimeters, including the separation and purification of natural products, optimization of food processing procedures, food additives, and food pollution and toxicity assessment. Since the instrument is highly sensitive and able to measure the metabolizable energy for growth of living organisms, there have been many studies on plant cells, animal cells or microorganisms (bacteria, fungi, viruses, etc.) published in a variety of fields. This app note introduces the application of the measurement of metabolizable energy for growth of living organisms in food processing.

EXPERIMENT

The purpose of food processing is to extend the storage life of food while maintaining its nutrition and taste. In the past, unscientific methods, such as experience rule or trial and error method, were commonly used, which was time-consuming and labor-intensive. With the advantages of high sensitivity and throughput, the microcalorimeter can effectively replace the previous methods. The figure below is an example of using the TAM isothermal microcalorimeter to evaluate the optimization of carrot juice processing (additives and heat treatment).

Figure 1 shows an example of food additives. Fresh carrot juice is compared to carrot juice with additives added. These additives were: 10% green tea, 40% orange juice, or 1% preservative. All samples were put in the microcalorimeter together. The time of thermal peak was observed to evaluate the effectiveness of the additives to extend the storage life of food. Not only the type but also the dosage of additive can be evaluated in this way. The result indicated that the 1% preservative was the most effective additive and it could extend the storage life to 48 hours compared to the untreated juice.

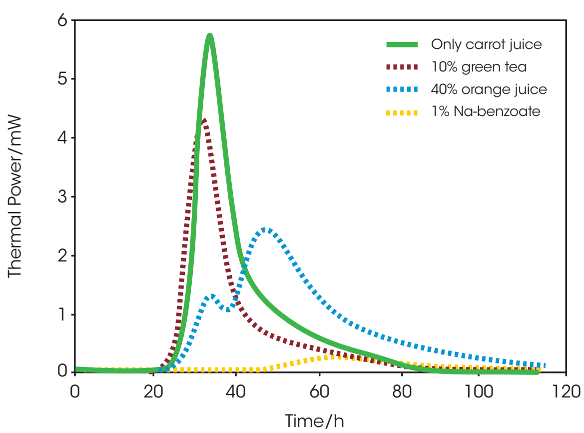

Figure 1. [4]

Figure 2 is the evaluation of the storage life of the carrot juices after the preheating treatment. The juices were heated for the same period of time but at different temperatures (50, 60, and 70 degrees), and the differences among their storage life were compared. As expected, the higher temperature of the heat treatment could better reduce microorganisms in the fresh carrot juice to extend its storage life. Similarly, along with the temperature of the heat treatment, its duration can also be quickly screened with a multichannel calorimeter.

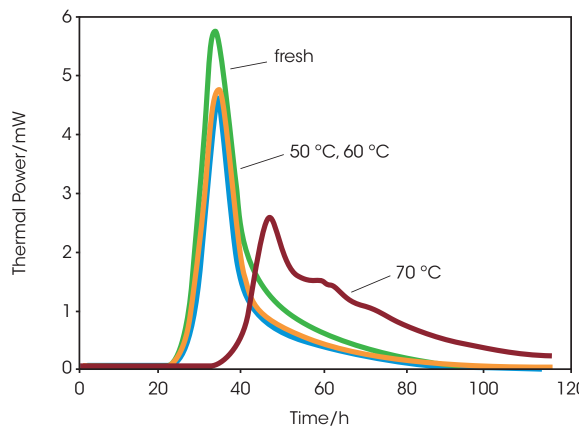

Figure 2. [4]

Figure 3 demonstrates that the measured energy signals mainly come from the activity of the microbes in the sample pool.

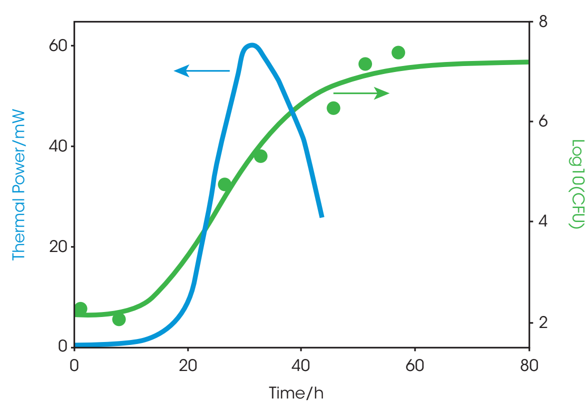

Figure 3. [4]

As mentioned previously, the same concept can be used in food fermentation research or toxicity assessment to further analyze the characteristics of heat peaks, such as peak type and peak time. This is particularly helpful in evaluating microbial activity. For detailed analysis methods, please refer to the reference.

REFERENCES

1. Gómez Galindo et al. (2005) “The potential of isothermal calorimetry in monitoring and predicting quality changes during processing and storage of minimally processes fruits and vegetables” Trends Food Sci. Technol. 16, 325-331.

2. Wadsö L, Li Y & Bjurman J. (2004) “Measurements on two mould fungi with a calorespirometric method” Thermochim Acta 422, 63–68.

3. Wadsö L et al. (2010) “Use of isothermal microcalorimetry to monitor microbial activities” FEMS Microbiology Letters 303, 1–8.

4. Wadsö L & Gomez Galindo F (2009) Isothermal calorimetry for biological applications in food science and technology. Food Sci Technol Food Control 20: 956–961.

5. Selva Roselin et al. (2010) “Recent trends and some applications of isothermal titration calorimetry in biotechnology” Biotechnol. J. 5, 85–98.

6. Chen Xiaojuan, Shen Yunfen, Liu Yi, et al, Advances on Isothermal Microcalorimetric Studies of Microbial Communities, Chemistry.

This note was previously published in Chinese as TACNANMC001V1.

For more information or to request a product quote, please visit www.tainstruments.com/ to locate your local sales office information.