Rapid Automated Bacterial Impedance Technique (RABIT)

Csilla Mohácsi-Farkas

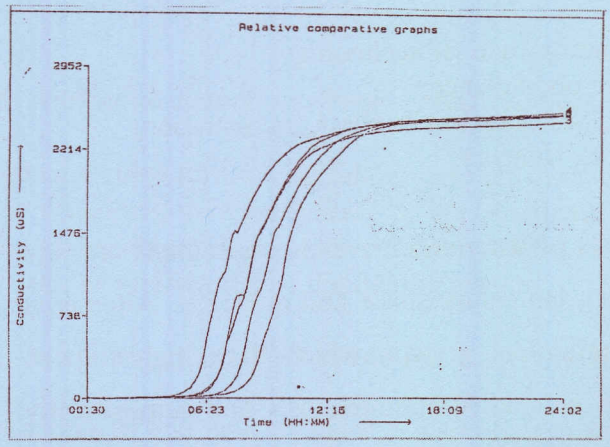
Department of Microbiology and Biotechnology,
Faculty of Food Science,
Budapest University of Economic Sciences and Public Administration,
Budapest, Hungary

Commonly used traditional methods of determining viable cell counts are time consuming and laborious, and require much laboratory space and materials. Alternative methods of data capture for following microbial growth, which have higher speed, especially, if they enable many samples to be studied simultenously and automatically, have great potential not only in quality control laboratories but also as research tools of predictive microbial modelling.

Due to microbial catabolism of large, uncharged or weekly charged organic molecules in nutrient media, smaller more highly charged products are formed which alter the electrical properties of a microbial culture. The observation that electrical conductance in the liquid microbial cultures as well as at the interface of electrodes increases with increasing population densities has led to the development of „impedimetric" or „conductimetric" instruments for analysis of microbial contamination and microbial growth. Conductance is the inverse of resistance, impedance is the AC equivalent of resistance. Impedance microbiology is the measurement of microbial growth by monitoring the movement of ions between two electrodes (conductance) or the storage of charge at the electrode surface (capacitance). Microbial growth by producing highly charged molecules creates an increase in both conductance and capacitance, causing a decrease in impedance (direct method).

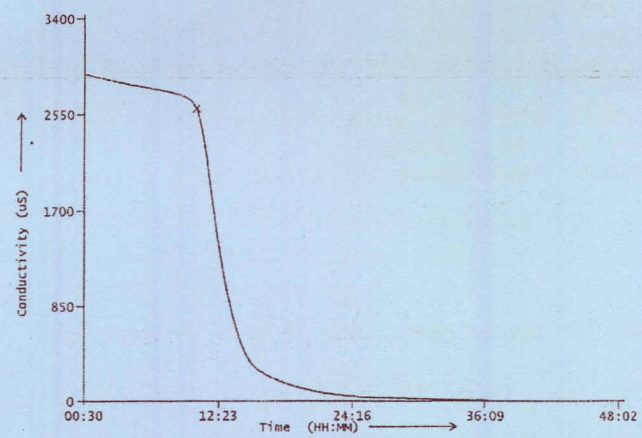
There is a detection time during which the conductance change due to microbial metabolism is not observable until the microorganisms reach a critical number (approx. 10^6-10^7/ml for bacteria, and approx. 10^5/ml for yeasts). According to Firstenberg-Eden and Eden (1984), there is a linear function between the logarithm of the initial population density and the detection time (DT). Their model assumes that a) the generation time is

constant, at least in the range of measurement, and b) a constant amount of ions produced by each cell in its lifetime.



Impedimetric curves of decimal dilutions of *E. coli* suspensions

Some microorganisms cannot be detected with direct impedimetry because their growth does not induce a sufficient conductance change (due, for instance, to the formation of unionised products) (Owens & Wacker-Viveros, 1986). The problem could be overcome by using an indirect impedimetric technique. Indirect measurements utilize changes of conductance in CO_2 traps produced by the microorganisms. In this case CO_2 evolving from the culture is absorbed by a potassium hydroxide solution which is in contact with the electrodes (Owens et al., 1989).



Indirect measurement of *Saccharomyces cerevisiae*

Utilizing the potential of conductance/impedance techniques for automation, several different types of commercial devices are available on the instrument market. Differences in the instruments can be found in the electrode material, placement, and number of sample holders as well as in the operating frequency. All instruments include some sort of precisely controlled incubators, the ability of monitoring changes in many samples simultaneously, and computer control data analysis. RABIT instrument (Don Whitley Co., U.K.) is one of those are able to perform both direct and indirect conductance measurements.

Impedance and conductance instruments are used to estimate microbial contamination of food (Rule, 1997), and to predict the potential shelf-life of specific products (Bishop et al., 1984). In our laboratory RABIT instrument was applied to estimate bacterial contamination and predict micorbiological shelf-life of pre-cut chilled vegetables (Mohácsi-Farkas et al., 1999/a) and chilled-irradiated meat products.

Impedance microbiology offers a potential to selective detection of food-borne pathogens (Madden et al., 1996). In the case of preservative testing, impedimetry can screen efficacy of antimicrobial additives (Mohácsi-Farkas et al., 1999/b). Conductance measurements can also be applied for data generation in predictive modelling (Borch and Wallentin, 1993, Szigeti and Farkas, 2000).

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