No more plating? Fast methods for microbial parameters and for screening of pathogens in drinking water analysis using flow cytometry

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Abstract

Throughout the world the hygienic quality of drinking water and recreational water is based on the analysis of two microbiological parameters: the heterotrophic plate count (HPC) and the search for the faecal indicator bacterium Escherichia coli [1]. Both methods were developed originally more than a hundred years ago and have so far served their purpose fairly well. Although these methods were improved over the years they still have the disadvantage of being slow (E. coli and HPC) and insensitive (HPC). Testing for specific pathogenic bacteria requires usually even more time and effort. Also the many recently developed molecular methods have a number of disadvantages [2]. Despite the multitude of analytical methods presently available there is an urgent need for methods that allow a fast, reliable and cheap assessment of the hygienic state of a water sample within 1-2 hours. Flow cytometry is a method that has the potential to fill this gap because it allows detecting cells quickly after staining with fluorescent dyes. We have investigated several possible applications of flow cytometry for the fast detection of total cells, their viability, as well as for the screening for specific pathogenic microbes after fast immuno-enrichment and immuno-staining [3-5]. Application of these basic flow cytometric methods in drinking water production, disinfection and distribution, as well as for basic research in microbial ecology of freshwater and drinking water will be illustrated in various examples. The FCM-based methods presented here will expand the range of easily accessible microbial parameters in drinking water analysis and may, on the long run, even replace some of the traditional methods. For example, the total cell counting proved to be robust and is used already in practice in some drinking water works in Switzerland and the Netherlands. Recently, on-line-flow cytometry for simple microbiological parameters such as the total bacterial cell number has been tested in our laboratory and it seems perfectly feasible for application in practice [6]. [1] WHO / OECD (2003) Assessing Microbial Safety of Drinking Water. OECD, Paris, France, WHO, Geneva, Switzerland. [2] K´oster W. et al. (2003) Analytical methods for microbiological water quality testing. In: Assessing Microbial Safety of Drinking Water, pp. 237-295. OECD, Paris, France, WHO, Geneva, Switzerland. [3] Hammes F., Egli T. (2010) Cytometric methods for measuring bacteria in water: advantages, pitfalls and applications. Anal. Bioanal. Chem. 397, 1083-1095. [4] Hammes F. et. al. (2008) Total bacterial cell counts as a descriptive microbiological parameter for drinking water treatment processes. Water Res. 42, 269-277. [5] Keserue H.-A. et al. (2010) Rapid detection and enumeration of Giardia lamblia cysts

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