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A chemiluminescence approach for the detection of morphine in urine samples

Sonu Gandhi
Amity University, India

A sensitive immunoassay for morphine was developed by chemiluminescent approach. The anti-MAM antibody was developed for Monoacetyl Morphine (MAM) and labeled with horseradish peroxidase (HRP) for the development of competitive assay. The method is based on the competition between labeled antibodies and free drug in spiked urine samples. A hapten (MAM) was functionalized with chloroacetic acid chemistry to generate hydroxyl moiety and conjugated with carrier protein (BSA). The biophysical characterization was done by various spectroscopic methods such as UV-Vis, fluorometer, CD, IR, MALDI-TOFF and was used as an immunogen for the generation of anti-MAM antibody. A binding assay was performed and high titer of antibody (1:64,0000) was obtained and the relative binding affinity constant (K_{aff}) of anti-MAM antibody was 3.1×107 l/mol. Under competitive conditions, the IC50 value for heroin, mono acetyl morphine (MAM), morphine and codeine were in the range of 0.01-0.08 ng/ml respectively. The developed chemiluminescence based competitive assay could detect heroin and its metabolites in standard and urine samples up to 0.01 ng/ml that indicates fairly good precision with linear range, reactivity and therefore could be implemented in illegal trafficking.

sonugandhi@gmail.com

Lumped-element approach for digital simulation of centrifugal microfluidic systems

Mahdi Mohammadi
Dublin City University, Ireland

Since the 1990s, centrifugal lab-on-a-disc (LoaD) systems have evolved into an exciting opportunity and mature technology platform. These centrifugal microfluidic systems have already entered a broad range of applications such as life-science research, biomedical point-of-care diagnostics, environmental monitoring, immunoassays analysis and nucleic acid testing. Over the last decade, simulation has a key role in developing new products, especially for a dynamic system. Simulation is a vital step for microfluidic design and analysis. The typical mesh-based simulation methods, i.e. FEA (Finite Element Analysis) are very time-consuming with convergence problems; however these methods are very accurate. To circumvent this limitation, lumped element simulation is proposed for centrifugal microfluidic network analysis based on the electric circuit which is quite fast and fit for parameter variations. In addition, this can simulate fluid flow and pressure distribution through multi elements serial and parallel architectural elements. The centrifugal flow control elements and their networking to complex microfluidic circuitry translate into equivalent, lumped element descriptors. Each lumped element will have certain free parameters, for instance, corresponding to resistances or capacitances. Over the recent years, Ducrée group in DCU has developed a special breed of microfluidic lab-on-a-chip (LoaC) systems based on centrifugal liquid handling for applications in biomedical point-of-care diagnostics and the life sciences. For the first time, they have introduced a form of logical flow control on these so-called lab-on-a-disc (LoaD) platforms which functions on the analogy of digital microelectronics. Based on this analogy, the lumped element simulations have been implemented for the centrifugal microfluidic network to obtain an efficient microfluidic design. Multiple laboratory unit operations (LUOs) such as sample take-up and liquid transport, metering, aliquoting, routing, mixing, valving and washing have been simulated using lumped element simulation for different application i.e. RNA extraction, centrifugal analyzer for liver assay, bioassays in whole blood, point-of-care applications, ELISA kit.

mehdi.mohammadi@dcu.ie