Generation of Stable Concentration Gradients in 2D and 3D Environments Using a Microfluidic Ladder Chamber

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BACKGROUND

In the chemical, biomedical, and pharmaceutical industries, it has become increasingly desirable to perform large numbers of chemical operations in a highly parallel fashion. For example, cell culture methods are a commonly used research techniques that allows the systematic manipulation of a growth condition of cells. In cell culture the culture media and substrate can be varied under controlled conditions. With well known culturing techniques the entire cell is exposed to the same conditions. However, for purposes of conducting experiments this is not always advantageous. Some cells can be asymmetrical and parts of the cell specialized. Accordingly, reproducible and efficient mechanisms for studying directed migration of different cells types are needed to study various cell differentiation and pathological processes. Accordingly, reproducible and cost-effective devices, systems and methods for forming temporal and spatial microfluidic concentration gradients in 2D and 3D environments are needed.

TECHNOLOGY DESCRIPTION

In our paper entitled 'Generation Of Stable Concentration Gradients In 2D And 3D Environments Using A Microfluidic Ladder Chamber' currently located at http://www.springerlink.com/content/u6212263241l0743/fulltext.pdf, we delineate a simple microfluidic device for generating stable concentration gradients in 2D and 3D environments. The device, termed the Ladder Chamber, uses a two-compartment diffusion system to generate steady state gradients across flow-free channels that connect the source and sink channels. To demonstrate the utility of the Ladder Chamber for cell migration, neutrophil chemotaxis was successfully observed in soluble chemoattractant (IL-8) gradient. The Ladder Chamber's simple design and experimental implementation make it an attractive approach for investigating cell migration and other biological experiments in well-defined gradients in 2D surfaces as well as in 3D gels.

A microfluidics-based method for generating stable concentration gradients with controlled profiles has been developed (Dertinger et al. 2001; Jeon et al. 2000). However, the microfluidic chemotaxis chamber has two main drawbacks. First, since the chamber depends on diffusion across laminar streams to establish gradients, the cells are exposed to constant shear flow, which can influence directional motility. In addition, most of the autocrine/paracrine factors that are secreted by the cells will be washed away. Second, as in most conventional chemotaxis assays, migration in the microfluidic chemotaxis chamber is limited to two-dimensional (2D) substrates. Two-dimensional cell migration assays do not address in-vivo processes that involve migration in a three-dimensional (3D) matrix, such as neutrophil chemotaxis after transmigration, and cancer cell invasion.

APPLICATIONS

Our microfluidic Ladder Chamber is capable of generating stable concentration gradients across 2D surfaces and 3D matrices. Neutrophil chemotaxis was successfully demonstrated in the Ladder Chamber. Compared to other assays, this chamber offers simplicity and improved stability of the gradients. In addition, the chamber provides a high-throughput approach for rapid characterization of chemotactic responses. The diffusion chamber also provides a straightforward method for generating concentration gradients in three-dimensional gels. This can be adapted to a variety of gels, allowing chemotaxis to be studied in different 3D environments. The simple nature of this approach, coupled with its versatility, will make it broadly applicable

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OTHER INFORMATION

CATEGORIZED AS

- » **Medical**
  - » Devices
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RELATED CASES

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in cell migration research.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	7,947,491	05/24/2011	2006-169

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