Abstract

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Journal of Biomedical Science and Applications

2021
Vol 5.S5

Microdevice based on centrifugal effect and bifurcation law for separation of plasma from on-line diluted whole blood

Kenia Chavez Ramos

Continuous-flow methods laboratory, Analytical Chemistry Department, Mexico

Abstract

In recent decades, scientific interest in the development of devices capable of performing routine clinical analyzes through the application of standardized traditional laboratory protocols in a miniaturized lab-on-a-chip device has increased. In the present work, an innovative microdevice for the on-line whole blood dilution with a phosphate buffer solution (PBS) and separation of plasma was designed, manufactured, and characterized. The microdevice was constructed with a rectangular cross-section and spiral-shaped microchannels by photolitography and soft litography. Also, the widths of the diluted plasma and the remaining blood outlet microchannels were different to create a difference in the outlet flowrates to facilitate and achieve the plasma separation based on the combination of centrifugal effect (Dean drag force) and bifurcation law (Zweifach-Fung effect). The separation purity (□) under the separation conditions (total flowrates between 25 and 100 µL/min, entrance flowrate ratio PBS/whole blood between 4 and 10, and hematocrit (% HCT) between 3 and 8) were around 100 % for fresh blood samples, while the separation efficiency (β) was between 8 and 13 %. The concentration in the separated diluted plasma was between 0.1 and 0.7 % (v/v) with plasma flowrates between 3 and 7 µL/min, respectively. The quality of the diluted and separated plasma from micordevice was corroborated from a blood sample from a patient diagnosed with rheumatoid arthritis through the quantification of anti-cyclic citrullinated peptides (anti-CCP) antibodies employing a microdevice immunoassay. The developed microdevice has a high potential to be coupled with the on-line detection of biomarkers.

Biography

Kenia Chávez graduated with honors from the BSc. Chemistry in 2014 at UNAM. In 2017, she has completed her master's degree at the School of Chemistry (UNAM) and began her PhD studies. Her current research includes a multidisciplinary project with the intention of developing microdevices focused on clinical diagnosis through the detection and quantification of antibodies present in blood plasma by means of an Enzyme-Linked Immunosorbent Assay (ELISA).

