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Organic Additives for the Enhancement of Laminar Flow in Brain-Vessels-Like Microchannel Assembly

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EXTENDED ABSTRACT

Flow enhancement which traditionally applicable in reducing the pressure drop in the core of the turbulent flow in pipes, ducts and conduits has extended its impact into medical field. A minute amount of flexible long chain polymers has been proven to be effective in enhancing and improve the blood flow which is normally in laminar regime. However, most of the investigated drag reducing additives (DRA) are artificial and carries properties including toxic and non-biodegradable thus raise the concern to be utilized in health applications. In this present work, organic polymers were extracted from okra, aloe vera and hibiscus leaves were used as DRA to enhance the laminar flow in custom-made microchannel that simulating the human brain vessels. The experiment was conducted using open-loop microfluidic system. Pressure measurements were used to evaluate the flow enhancement performance as the function of percentage of flow increment (%FI) of mucilage additives at different concentrations (100 to 1000 ppm). The results showed that the increasing of the okra mucilage concentration increased the drag reduction performance and reached to the maximum at 1000 ppm of okra solution. Both aloe vera and hibiscus mucilage showed greater drag reduction efficacy at lower additives concentration (100ppm, 300ppm and 500ppm). 14.03% of maximum flow enhancement was achieved by using 100 ppm of aloe vera mucilage at the operating pressure of 400 mbar. The results showed the potential of these organic polymers as DRA to enhance the blood flow thus could be a milestone in medical applications.

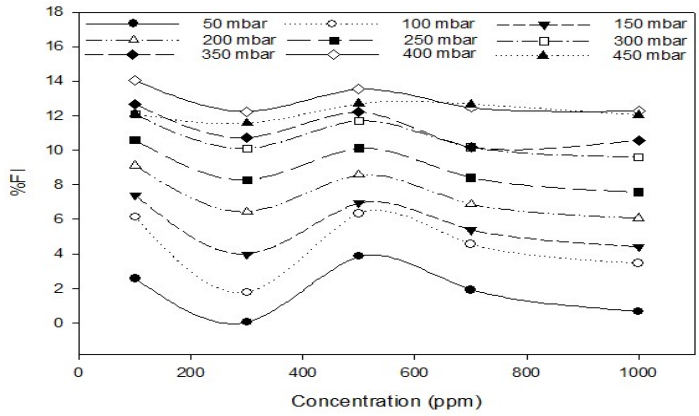

Fig. 1: %FI as the function of aloe vera mucilage concentrations varying the operating pressure

Keywords: Flow enhancement; Organic polymers; Microchannel; Brain-vessels-like

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