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Title

Effect of flow conditions on the swimming efficiency of Dunaliella Salina in microfluidic contraction devices

Abstract

The economic and ecological importance of microorganisms and their fundamental functions in different contexts is well-documented. They constitute the major part of the world's biomass, represent the lowest level of the food chain [1] and are utilised in a wide range of applications that encompass food and beverage preparation, genetic engineering and renewable energy. [2, 3] Some microorganisms can swim and propel themselves and are termed as microswimmers; the definition includes bacteria, spermatozoa, unicellular, colonial algae and protozoans. [1] This work focuses on the fluid dynamic behaviour of *Dunaliella Salina* (DS) (a type of halophile green micro-algae found in hypersaline environments) in microfluidic contraction-expansion geometries for varying flow conditions, in order to engineer the motion of the cells and enhance the efficiency of their applications. Experimental investigation is currently underway considering different microfluidic abrupt contraction-expansion geometries with different contraction ratios (CR = 2, 4 and 8), including the visualisation of the algae's motion using an inverted microscope, and tracking their motion using software, such as cellSens®, Matlab and ImageJ in order to understand the algae's behaviour and how their motion is influenced by the surrounding environment and flow conditions. We have been able to distinguish three regimes: one in which the mean flow velocity is relatively small compared to the algae swimming speed and DS cells swim randomly; a second t where the flow begins affecting the algae behaviour but the cells can still partially withstand the flow rate; and a third where the flow advection dominates over motility and algae trajectories tend to the fluid streamlines.

[1] Pedley T. J. *et al*. *Annu Rev Fluid Mech*,*24*(1), 313-358.
[2] Haw M. *et al. Phys World*, *25*(2), 39-43.
[3] Guasto J. S. *et al. Annu Rev Fluid Mech*, *44*, 373-400.