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Study of diffusion of fluorescent nanoparticles inside human cell cytoplasm

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Abstract

Living organisms are extremely complicated. We, as humanity, invest a great deal of time and money into the understanding of what makes us tick. Comprehension of human physiology cannot be achieved without a properly described function of the basic constituent of life – cell. Single cells function thanks to the organized action of many distinct systems. Inside of tiny cellular volume, hundreds of different processes take place. All of them need substrates and give products, often requiring a catalyst to function. Cells maintain the homeostasis – a state in which all life functions remain in a balance. Disruption of the homeostasis triggers dysfunction and disease. Great effort was put into elucidation how, why, and when things happen inside cells. All those questions were answered by the experiments made either on whole organism, or more conveniently in a test tube. Both of those approaches are not without flaw. We shifted our attention to systems that are the middle ground thanks to the rise of the cell cultures. Now, uniform characterisation of conditions inside cytosol is necessary. This thesis aims to provide a comprehensive description of viscosity – one of the physiological values of the key importance in the living cells. Viscosity impacts vast majority, if not all, of biochemical and biophysical processes.

The complexity of cellular structure and its physiology will be presented in introductory part of this work. Also, subjects of diffusion and viscosity will be discussed. Finally, fluorescence correlation spectroscopy will be thoroughly described. Following the introduction, meticulous description of experimental procedures will be presented. Then, in part devoted to presentation and discussion of results obtained, changes of viscosity depending on the size of particles moving inside the cytoplasm of model living cells will be described. This description will be extended into several cell types representing different cancerous and healthy tissues. Fluorescence correlation spectroscopy will prove to be efficient in the elucidation of the mechanism of oligomerization of dynamin-related protein 1. Finally, investigations concerning changes of viscosity of the cytoplasm of cells undergoing cell cycle is going to be presented. The work will end with a short summary.