Accepted Manuscript

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PII: S1359-0294(17)30138-3
DOI: https://doi.org/10.1016/j.cocis.2018.01.011
Reference: COCIS 1173

To appear in:

Received date: 15 November 2017
Revised date: 3 January 2018
Accepted date: 27 January 2018

Please cite this article as: Anna Trybala, Victor Starov , Kinetics of spreading wetting of blood over porous substrates. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Cocis(2017), https://doi.org/10.1016/j.cocis.2018.01.011

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Kinetics of spreading wetting of blood over porous substrates

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Abstract

Blood rheology and spreading of blood over porous substrates in the case of complete and partial wetting are reviewed. It is shown that the blood is well described by a model of non-Newtonian shear thinning power law liquid. In the case of complete wetting a theory is developed, which predicts a universal behaviour of radius of blood droplet, contact angle and wetted spot on time. The predicted theoretical behaviour is a good agreement with experimental observation. In the case of particle wetting the experimental data show also a universal behavior in the case of sufficiently big pore sizes but a new phenomenon was found in the case then red blood cells are bigger than the pore sizes: they accumulate on the membrane surface, which allow serration of plasma and red blood cells without damaging red blood cells.

Key words: porous substrates, blood, complete and partial wetting

Introduction

Dried blood spots (DBS) is a highly potential and advanced method of blood collection, transportation and storage which has been heavily investigated and used over the recent decade [1 6]. However, most studies of DBS are focused on the clinical aspect, such as, analytical method, analytic sensitivity and the application of new analytes etc. The effects and mechanism of spreading behaviour of DBS sampling on DBS applications are less investigated in both theoretical and experimental aspect. The basic procedure of DBS sampling is to dispose a small amount of blood droplet on a filter paper where the blood droplet will spread, penetrate into and slowly dry out; hence, the whole sampling process can be recognized as the spreading of blood, which is a non-Newtonian fluid, over porous medium.

Blood is a non-Newtonian liquid, which shows a shear-thinning behavior [23 26]. Different rheological models have been used based on curve fitting of experimental data for a

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