

Loughborough University
Institutional Repository

*Spreading of blood over
porous substrate: Dried
blood spots sampling
[Abstract]*

This item was submitted to Loughborough University's Institutional Repository by the/an author.

Citation: CHAO, T-C., DAS, D.B. and STAROV, V., 2015. Spreading of blood over porous substrate: Dried blood spots sampling. Presented at the 6th APS International PharmSci Conference 2015, Nottingham, 7-9th September.

Additional Information:

- This is an abstract of a conference paper.

Metadata Record: <https://dspace.lboro.ac.uk/2134/25737>

Version: Submitted for publication

Publisher: © the Authors. Published by Academy of Pharmaceutical Sciences of Great Britain

Rights: This work is made available according to the conditions of the Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International (CC BY-NC-ND 4.0) licence. Full details of this licence are available at: <https://creativecommons.org/licenses/by-nc-nd/4.0/>

Please cite the published version.

Spreading of blood over porous substrate: Dried blood spots sampling

TzuChieh Chao^a, Diganta B. Das^{*}, Victor Starov^b

*Department of Chemical Engineering Loughborough University, Loughborough
LE113TU, Leicestershire*

**Corresponding author (D.B.Das@lboro.ac.uk), ^a (T.Chao@lboro.ac.uk), ^b (v.m.starov@lboro.ac.uk)*

Dried blood spots (DBS) is a blood collecting and storage method, which has been widely applied for newborn screening, therapeutic drug monitoring (TDM), and others. The concept of DBS involves the use a porous filter paper as a sponge to absorb capillary blood drops and preserve as dried blood samples for further analysis. However, there are some disadvantages of the DBS process, such as, unequal distribution, haematocrit effects and analytes extraction, which have limited their applications for highly sensitive analysis.

To address these issues, the spreading/imbibition of blood during the DBS sampling process has been investigated from both experimental and theoretical point of view in this work. The sampling process of DBS is described as a spreading process of a non-Newtonian drop (blood) over porous substrates (filter paper). Porcine blood with different haematocrit levels spreading/penetrating over different porous substrates, such as, commercial DBS filter paper and nitrocellulose membrane, have been used for the investigation via our spreading experiment. The time evolution of spreading parameters of DBS sampling process, such as, contact angles, droplet base radius and wetted region radius, were recorded and analysed to describe the spreading/imbibition behaviour of DBS sampling. The experimental results have shown that the spreading parameters of DBS sampling on each porous substrate fall into a universal curve under the dimensionless scale. According to our observations, the spreading behaviour of blood can be described as complete wetting on the commercial DBS cards (Whatman 903) and partial wetting on the nitrocellulose membrane.

Simulating models have been developed to describe the spreading/imbibition behaviours of DBS sampling process over porous substrate in complete wetting case. In the case of complete wetting, a system of two differential equations is derived, which describes the time evolution of radius of both the drop base and the wetted region inside the porous medium. The results show a good agreement while validating the spreading parameter, known as, droplet base radius, wetted region radius and contact angle with experiment data. These models provide simple and accurate methods to describe the spreading behaviour of DBS sampling process.

In the consideration of the application of DBS analysis, the understanding of spreading/imbibition behaviour of DBS should allow us to better control the performance and outcome of pharmaceutical and analytical studies while using DBS samples. In order to improve the current theoretical studies in DBS application, further research is recommended.