Nanoparticles production from microfluidics: the elixir?

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


Additional Information:

• This is a poster presented at the Loughborough University Research Conference 2015.

Metadata Record: https://dspace.lboro.ac.uk/2134/19733

Version: Accepted for publication

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.
Nanoparticles production from microfluidics: The Elixir?

David Odetade*, Goran Vladisavljevic, Chris Rielly
Department of Chemical Engineering,
Loughborough University, LE11 3TU

INTRODUCTION

- Nanoparticles offer improved performance of active ingredients, stability, controlled delivery, increase comfort and reduce the overall drug content and cost.
- Nanoparticles are helpful in drug delivery in cases where drugs have poor water solubility.
- Drugs such as Hydrocortisone (HC) pose a problem, because the right amount of unchanged drug needs to reach the targeted cells.

AIM:
- Produce hydrocortisone nanoparticles using laboratory-fabricated microfluidic devices and investigate a variety of device parameters on nanoparticle properties.
- Study the effect of stabilisers and polymer on the produced nanoparticles.

EXPERIMENTAL SET UP

Experiments were carried out in fabricated glass capillary co-flow microfluidic devices, to synthesise hydrocortisone nanosuspensions. Figures 1 and 2 are the schematic diagrams of the co-flow microfluidic device and the experimental set-up of the synthesis of the hydrocortisone nanoparticles respectively while Figure 3 is the flow diagram of the steps taken in producing the nanoparticles.

CHARACTERISATION

DSC thermal profile of processed and unprocessed HC were analysed, to show the changes in the crystallinity of the drug. A sharp peak observed in Figure 7 corresponds to the melting point of the pure unpreserved sample. This peak shifted for the processed drug, which indicates the encapsulation of the drug in the polymer and stabilisers. This was corroborated by the XRPD analysis carried out on the processed and unprocessed samples (Figure 8A and 8B).

NANOPARTICLES FORMATION

EXPERIMENTAL RESULTS

It was observed that increase in flow rate ratio of the aqueous phase to dispersed phase led to decrease in the size of nanoparticles produced as shown in Figure 10. This was expected, as the precipitation formation, which is the main force of supersaturation of the solution, being induced by the shorter mixing time of the drug solution and antisolvent, as flow rates are increased thereby reducing the nucleation time. This can also be explained by the increasing Reynolds Number as a result of higher flow rates improving the mixing within the system.

CONCLUSION

- Nozzle diameter affects the size of nanoparticles produced.
- HPMC (and other stabilisers) has a major effect on the size and stability of nanoparticles produced.

FUTURE WORK

- Production and encapsulation of nanoparticles using counter-current devices and other types of nanoparticles and study of the release rates of drugs encapsulated.
- Synthesis of Liposomes and Niosomes using both Dispersion Cell and 3D-printed Microfluidic devices to encapsulate drugs.

References


Acknowledgement

- Loughborough Materials Characterisation Centre (LMCC) for SEM and XRPD images.
- Technical staff of Department of Chemical Engineering, Loughborough University.