Development of novel drug formulation using microfluidic device

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


Additional Information:

- This is a conference poster.

Metadata Record: https://dspace.lboro.ac.uk/2134/10084

Please cite the published version.
This item was submitted to Loughborough’s Institutional Repository (https://dspace.lboro.ac.uk/) by the author and is made available under the following Creative Commons Licence conditions.

For the full text of this licence, please go to: http://creativecommons.org/licenses/by-nc-nd/2.5/
1. Introduction

Biosorbable poly(lactic acid) (PLA) microspheres have been used for controlled drug release, as ultrasound contrast agents, for cell cultivation and for W/O/W emulsion. W/O particles are formed by evaporation of DCM. The resultant droplets are solidified by evaporation of solvent. Porous PLA particles can be produced via W/O/W emulsion route, where first, an inner water phase is dispersed in a mixture of PLA and DCM in the presence of oil-soluble surfactant to form a W/O emulsion. This emulsion is then dispersed drop-wise into an aqueous surfactant solution to form a W/O/W emulsion. W/O particles are formed by evaporation of DCM.

2. Emulsion Formulation

- **Single o/w emulsion method:**
  - Continuous phase: 5 wt.% poly(vinyl alcohol) in Milli-Q water
  - Dispersed phase: 0.5–3 wt.%, poly(di-lactic acid) + trace amounts of Nile red dye in organic solvent (dichloromethane, ethyl acetate, 1:2 chloroform/toluene)
- **Multiple w/o/w emulsion method:**
  - Outer aqueous phase (a): 5 wt.% poly(vinyl alcohol) in Milli-Q water
  - Oil phase (a): 10 wt.% PGPR + 1 wt.% PLA + Nile red in DCM
  - Inner aqueous phase (a): 20 wt.% Milli-Q water
  - Oil phase (b): 10 wt.% PGPR + 1 wt.% PLA + Nile red in 1:2 chloroform/toluene
  - Inner aqueous phase (b): 10 wt.% Milli-Q water

3. Glass Capillary Devices [1]

The dispersed and continuous phase were supplied from the two ends of the same square capillary in opposite directions and both liquids were collected through the inner circular capillary. The continuous phase moulds the interface into a cusp, which causes the dispersed phase to break into drops in the tapered section of the collection tube. Taper angle and aperture size of inner capillaries was finely tuned with a micropipette puller and microforge. Capillary tips were treated with a hydrophilic silane to hydrophilise the glass surface uniformly.

4. Drop Generation in Glass Capillaries

Results show linear relationship between particle and droplet size; gradient increases when PLA concentration is higher. Solid lines represent trend lines; dotted lines are lines corresponding to mass balance equations. Relationship between flow conditions and optimal drop size elucidated.

5. Experimental Results

<table>
<thead>
<tr>
<th>PLA Concentration</th>
<th>Particle Diameter / μm</th>
<th>Flow Rate Ratio (Qc/Qd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5 wt% PLA</td>
<td>粒子直径 / μm</td>
<td>流量比 (Qc/Qd)</td>
</tr>
<tr>
<td>3 wt% PLA</td>
<td>200 µm</td>
<td>15 ml·h⁻¹</td>
</tr>
<tr>
<td>1 wt% PLA</td>
<td>220 µm</td>
<td>2.5 ml·h⁻¹</td>
</tr>
<tr>
<td>0.5 wt% PLA</td>
<td>240 µm</td>
<td>10 ml·h⁻¹</td>
</tr>
<tr>
<td>3 wt% PLA</td>
<td>260 µm</td>
<td>1.5 ml·h⁻¹</td>
</tr>
<tr>
<td>1 wt% PLA</td>
<td>280 µm</td>
<td>5 ml·h⁻¹</td>
</tr>
</tbody>
</table>

6. Conclusions

- Monodispersed poly(lactic acid) (PLA) particles of 10 to 40 μm have been produced via flow focusing glass capillary devices.
- The sizes of PLA particles have been accurately controlled with a selection of PLA concentration in DCM (0.5–5 wt.%), orifice size of the injection capillary and fluid flow rates.
- Further work will investigate drug release profile for these particles.

7. Acknowledgement

This work was supported by EPSRC first grant No. EP/HO29923/1.