Quality assessment of 3D printed sildenafil and furosemide tablets for the pediatric population using an innovative extrusion-based technique

Materials and methods

Cartridges containing formulations with furosemide 2 mg or 10 mg per tablet, or sildenafil 4 mg per tablet, were slightly heated to a semi-solid consistency to allow printing.

3D printed tablets were analysed on quality requirements of the European Pharmacopoeia (EP) in triplicate. Linear regression analysis was performed to assess correlation between tablet mass and content.

Results

<table>
<thead>
<tr>
<th>Test</th>
<th>EP Requirement</th>
<th>Furosemide 2 mg</th>
<th>Furosemide 10 mg</th>
<th>Sildenafil 4 mg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content uniformity</td>
<td>Acceptance value of 15</td>
<td>4.2 – 10.6</td>
<td>4.8 – 8.9</td>
<td>6.6 – 9.2</td>
</tr>
<tr>
<td>Dissolution profile</td>
<td>&gt;80% dissolved content after 45 min</td>
<td>76.9% (95%-CI 73.6 – 80.2%)</td>
<td>86.3 – 88.8%</td>
<td>86.6 – 89.7%</td>
</tr>
</tbody>
</table>

The tablets met the weight distribution requirements only after adjusting the printing path to double row printing. The average weight was 141.1 mg with an RSD of 1.26%.

In addition to performed tests, the EP also describes quality tests to ensure microbiological stability (EP 5.4.1) and mechanical strength (EP 2.9.7 and EP 2.9.8).

All tablets showed linear correlation between tablet mass and tablet content.

Discussion point 1. Testing of mechanical strength
The EP describes friability (EP 2.9.7) and resistance to crushing (EP 2.9.8) to assess the mechanical strength of tablets. However, for 3D printed tablets, these tests may be too rigorous. A test designed to ensure layer adhesion may be more appropriate.

Discussion point 2. Appropriateness of tests for small batches
For small batch sizes it may not be practical to carry out all quality tests. In such cases, the EP allows for other suitable methods to ensure quality. It therefore can be argued that for 3D printed tablets, other methods should be investigated to assess suitability.

Acknowledgments

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