evaluation of the properties of HPMC capsules manufactured using different methods

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OBJECTIVES

Two-piece hard capsules are popular for pharmaceutical products with many active ingredients. Hypromellose (HPMC) capsules are regarded as the one of best choices because of their low moisture content, lack of brittleness and good chemical stability. HPMC capsules are commonly prepared by two different methods: cold gelling using a gelling agent and thermal gelling. The physicochemical properties of the capsules prepared by these methods could be different due to different thermal histories, additives and HPMC grades. In preparing capsule formulations, it is important for capsules to meet customer requirements such as robust processability, with no damaging mechanization, and fast dissolution with low variability irrespective of the test media pH.

In this study, the factors important for capsule performance, dissolution, brittleness and moisture content were evaluated on films and commercially available HPMC capsules manufactured by these 2 methods.

FILM PROPERTIES

**HPMC Capsules**

<table>
<thead>
<tr>
<th>Film properties</th>
<th>HPMC solution</th>
<th>Films with gelling agent</th>
<th>Films without gelling agent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thickness (µm)</td>
<td>81±3</td>
<td>82±4</td>
<td>90±6</td>
</tr>
<tr>
<td>Tensile strength [N]</td>
<td>105±5</td>
<td>102±6</td>
<td>93±14</td>
</tr>
<tr>
<td>Elongation at break [%]</td>
<td>26.5±8.0</td>
<td>21.5±8.5</td>
<td>9.5±3.0</td>
</tr>
</tbody>
</table>

HPMC films were prepared by adding the amount of gelling agent given below: (1) HPMC 2910, (2) HPMC 2906.

**Impact Test**

Impact test was performed on the holder of a 10 g gram weight dropped from 10 cm onto the table. The percentage of capsules that split at standard (A) or cold gelling (B) was recorded. A capsule is defined as broken if a piece larger than 0.1 cm² was formed.

**Tensile Test**

Tensile test for films was done using a Shimadzu UTS-100A (Stainless plate RT, 5M) at constant speed of separation (10 mm/min) until the capsule split. The percentage of capsules that split at standard (A) or cold gelling (B) was recorded. A capsule is defined as broken if a piece larger than 0.1 cm² was formed.

**DISCUSSION**

The ordered structure of HPMC molecules in solution is retained during the drying process. HPMC molecules in solution form a rigid thermal gel above the gelling temperature. In the thermal gel state, HPMC molecules are likely to aggregate in groups to form a gel structure.

In addition, it is possible that drying temperature affects the structure of the film. By using SEM, micro-probes and non-homogeneous lamellar-like structures were found in HPMC cast films dried at high temperatures (55%, 75%) (C. Perley et al 1988).

This was probably due to trapped water in the structure causing the formation of small holes owing to a faster drying rate of the surface than the rest of the film. It was demonstrated that the additivity of a gelling agent, Carrageenan, did not affect the mechanical properties of the film. It was found to work as a cold gelling promoter in HPMC films probably by getting into HPMC tight structures.

These results show that capsule A, which was prepared by cold-gelling using Carrageenan, had fast and pH-independent dissolution with good mechanical strength.

**CONCLUSIONS**

This study indicates that HPMC film shows excellent physical properties when prepared by the “cold gelling method” using a gelling agent. These capsules are less brittle and their rate of dissolution is faster than Capsule B manufactured by thermal gelling. It is suggested that Capsule A would be preferred for pharmaceutical products because of its mechanical and dissolution properties.