The development of solid dosage forms that can be chewed or easily dispersed in the mouth is particularly attractive for the paediatric and geriatric markets. A key challenge for the final patient’s acceptance is in the design of tablets having an appealing texture, as well as an acceptable taste and mouthfeel. The selection of excipients is critical in achieving a tablet’s disintegration in the oral cavity, a pleasant mouthfeel, and robust tablets that can withstand processing and transportation.

Our DC polyols range displays a palette of different textures as a result of their inherent physicochemical properties, such as enthalpy of dissolution and crystal shapes. For instance, Xylitol exhibits a cooling effect upon dissolution in the mouth and tablets containing maltitol provide a “crunchy” sensation when chewed. The purpose of this study was to propose different methodologies for assessing the feelings of brittleness, crunchiness and melting in the mouth upon chewing tablets formulated with polyols.

### Materials and Methods

#### Materials

The directly compressible polyols used in this study were maltitol (SweetPearl® P300 DC; Roquette Frères, France), xylitol (XYLISORB® DC; Roquette Frères, France) and sorbitol (NEOSORB® P300 DC; Roquette Frères, France), Magnesium stearate as a lubricant was purchased from Bärlocher (Germany).

#### Preparation of Tablets

The polyols and the lubricant were blended in a Turbula T2C blender (Willy A. Bachofen, France) for 5 min (Table 1). The tablets were prepared by direct compression using single punch tabletting press FETTE Exacta 21 (FETTE Compacting, Germany) equipped with 16-mm flat beveled-edge punches whilst applying increasing compression forces (10-30 kN). The press was set to achieve identical tablet weights (1200 mg).

#### Physical Properties of Tablets

The prepared tablets were evaluated for physical parameters, such as thickness — using a standard micrometer and hardness — using an ERWEKA TBH 30 GMD hardness tester (ERWEKA GmbH, Germany).

#### Development of an In Vitro Sensory Evaluation Test

The test was developed using a texture analyser that records applied forces through probes. Two tablet quarters were placed side by side in a specially designed cup. Then a 10-mm diameter probe on contact with the top of the tablet pieces went down at a constant rate. The resulting variation of the force was recorded along 3.5 mm of the displacement of the probe inside the tablet. The fragmentation process of the tablet upon collapsing appeared as multiple peaks (Figure 1). Each test was repeated four times. The overall quantity and frequency of the peaks would be a good indicator of the sensation of “crunchiness” during chewing of the tablet.

#### In Vivo Sensory Evaluation Test

A panel conducted sensory evaluations. The panel comprising 23 people was trained to perceive three sensory descriptors:

- Britteness — the breakdown of the tablet into two to four pieces after one bite.
- Crunchiness — the persistence of solid individual fragments after one bite.
- Melting of the crystals — the quick melting and disappearance of crystals in the mouth.

The perceived intensity of these three sensory attributes was rated by each individual on a scale of 0-7 (where 0 = not apparent and 7 = very apparent). The statistical analyses were performed with ANOVA Friedman and Wilcoxon tests.

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**Table 1**

<table>
<thead>
<tr>
<th>Polyol (qsp 100% w/w)</th>
<th>Magnesium stearate (%w/w)</th>
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</thead>
<tbody>
<tr>
<td>XYLISORB®</td>
<td>1.2</td>
</tr>
<tr>
<td>NEOSORB® P300 DC</td>
<td>0.8</td>
</tr>
<tr>
<td>SweetPearl® P300 DC</td>
<td>1.2</td>
</tr>
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</table>
Study of the Compression Settings on Tablet’s Properties
NEOSORB® P300 DC, SweetPearl® P300 DC and XYLISORB® DC were compacted at increasing compression forces of 10, 20 and 30 kN. The hardness of the tablets increased with the compression force until 20 kN. NEOSORB® P300 DC tablets exhibit the maximum hardness at 20 kN and gave higher hardness values than SweetPearl® P300 DC and XYLISORB® DC tablets for all compression forces (Table II).

The compression profiles for SweetPearl® P300 DC shows also the maximum hardness at the compression force of 20 kN above which there is a decrease of hardness. For the compression profile of XYLISORB® DC, it can be observed that the hardness is still increasing at 30 kN and this product could be compressed at a higher compression force than 30 kN. For texture evaluation, tablet hardness of 250 N and 100 N were selected.

In Vitro Sensory Evaluation
There is practically no fragmentation observed for NEOSORB® P300 DC tablets. The curves are flattened in comparison with tablets made of SweetPearl® P300 DC and XYLISORB® DC. This result was observed for both 100 N and 250 N tablets. Accordingly, the maximum force required to breakdown the tablet increased with the increase in tablet hardness (Table III).

When we consider the maximum force required for disruption of XYLISORB® DC tablets, this force is higher for both 100 N and 250 N tablets than for NEOSORB® P300 DC tablets. We observe also that the number of peaks is multiplied approximately 20-fold. These results highlight different behaviours for the two polyols and, therefore, would confirm differences in the perception of these two polyols upon chewing and dissolution in the mouth. The SweetPearl® P300 DC tablets exhibit an intermediate behaviour between NEOSORB® P300 DC and XYLISORB® DC tablets.

In Vivo Sensory Evaluation
In vivo, NEOSORB® P300 DC tablets are characterized mainly by a sensation of melting and practically no crunchiness. In comparison, XYLISORB® DC tablets exhibit both crunchiness

Table II: Physical properties of tablets (mean ± SD)

<table>
<thead>
<tr>
<th>Tablet hardness 100 N</th>
<th>Tablet hardness 250 N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum force (N)</td>
<td>Number of peaks</td>
</tr>
<tr>
<td>Maximum force (N)</td>
<td>Number of peaks</td>
</tr>
</tbody>
</table>

Table III: Maximum force applied and number of peaks recorded by the Instron Texturizer

Results and Discussion
and melting sensations (Figure 2). SweetPearl® P300 DC tablets are characterized by a dominant perception of crunchiness. There is no statistical difference in the perception of crunchiness between SweetPearl® P300 DC and XYLISORB® DC tablets. Conversely, XYLISORB® DC and SweetPearl® P300 DC tablets are significantly crunchier than NEOSORB® P300 DC tablets.

We observe similar profiles as for the 100 N tablets. For a tablet’s hardness of 250 N, however, XYLISORB® DC tablets are significantly crunchier than SweetPearl® P300 DC tablets (Figure 3).

### In Vivo Versus In Vitro Sensory Evaluation

When we compare both in vitro and in vivo sensory evaluation testing, we can correlate the difference in behaviour of the tablet during fragmentation under pressure with differences in the crunchiness and melting attributes. NEOSORB® P300 DC tablets are characterized by a predominance of melting sensation upon chewing probably as a result of the particular crystalline shape of the particles and high compressibility of the powder, which is in agreement with the rather flat fragmentation curve. SweetPearl® P300 DC tablets exhibit more crunchiness. XYLISORB® DC tablets combine both melting and crunchiness attributes. Both XYLISORB® DC and XYLISORB® DC have the crunchiness anticipated from their fragmentation curves.

The overall acceptance from a palatability point of view between these three polyols was evaluated. There is a clear preference for XYLISORB® DC tablets with approximately 70% of the entire panel (Figure 4).

### Conclusion

This study describes two different methodologies for sensory evaluation of two attributes — crunchiness and melting. The differences observed in both attributes can be directly linked to the compressibility behaviour and the crystal shape of the powder, and more specifically to the rearrangement and the brittleness of the different polyols under compression. The in vivo study has revealed that the evaluation of both crunchiness and melting is a good combination for predicting a good taste and mouthfeel.

### References