Texture Profile Analysis

What is Texture Profile Analysis?
Texture profile analysis is the measurement and description of the textural properties of food. Texture can be measured by a trained sensory panel (organoleptic) or using specialized equipment (http://servedbyadbutler.com/redirect_alink.spark?ALID=7827&ID=168182) (instrumental).²

Measurements are made by compressing an item to a set distance and analyzing the force it takes for the item to deform.

Origin
Dr. Alina Surmacka Szczesniak developed the original texture profile analysis parameters while working as a food scientist for General Foods in the early 1960s.¹ In order to create a common language to describe the texture of food, Szczesniak created a scale with readily available food items to provide an accurate example for each of the categories.²

<table>
<thead>
<tr>
<th>Panel Rating</th>
<th>Product</th>
<th>Brand or Type</th>
<th>Manufacturer</th>
<th>Sample Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cream Cheese</td>
<td>Philadelphia</td>
<td>Kraft Foods</td>
<td>½ inch</td>
</tr>
<tr>
<td>2</td>
<td>Egg White</td>
<td>hard cooked 5 mins.</td>
<td></td>
<td>½ tip</td>
</tr>
<tr>
<td>3</td>
<td>Frankfurters</td>
<td>Large, uncooked, skinless</td>
<td>Mogen David Kosher Meat Products Corp.</td>
<td>½ inch</td>
</tr>
<tr>
<td>4</td>
<td>Cheese</td>
<td>Yellow, American, pasteurized process</td>
<td>Kraft Foods</td>
<td>½ inch</td>
</tr>
<tr>
<td>Panel Rating</td>
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</tr>
<tr>
<td>5</td>
<td>Olives</td>
<td>Exquisite giant size, stuffed</td>
<td>Cresca Co.</td>
<td>1 olive</td>
</tr>
<tr>
<td>6</td>
<td>Peanuts</td>
<td>Cocktail type in vacuum tin</td>
<td>Planter's Peanuts</td>
<td>5 nuts</td>
</tr>
<tr>
<td>7</td>
<td>Carrots</td>
<td>Uncooked, fresh</td>
<td></td>
<td>½ inch</td>
</tr>
<tr>
<td>8</td>
<td>Peanut Brittle</td>
<td>Candy part</td>
<td>Kraft Foods</td>
<td>1 piece</td>
</tr>
<tr>
<td>9</td>
<td>Carrots</td>
<td></td>
<td>Dryden &amp; Palmer</td>
<td>1 piece</td>
</tr>
</tbody>
</table>

The original scales had 5 to 7 points. Today's scales commonly use a 15 point intensity ranking. Adaptations have been made to the original classifications to capture the language needed to describe specific products such as greasiness of potato chips. Textural profile analysis is an evolving tool used to accurately describe the textural characteristics of food or other products. Debate continues over use of a trained sensory panel (organoleptic) vs specialized equipment (instrumentation).

**Function**

A quantitative scale has been created for each textural attribute.¹

The primary categories for texture profile analysis are:

- *Hardness* – the initial force used to deform²
- *Cohesiveness* – how the item holds together²
- *Viscosity* – flow rate²
- *Elasticity* (Springiness) – the rate at which a deformed item reforms²
- *Adhesiveness* – rate at which item comes away from probe (instrumental) or roof of mouth/teeth (organoleptic)²

The primary categories can be further broken down into secondary categories:

- *Resilience* – measurement of how a sample recovers from deformation in relation to speed and forces derived.
- *Brittleness* (Fracturability) – the initial force needed for a material to fracture²
- *Chewiness* – energy required to chew a solid food until it is ready for swallowing²
- *Gumminess* – energy required to disintegrate a semisolid food until it is ready to swallow²

The primary and secondary categories may be further broken down as needed to define the characteristics in a specific food item.² For example, mouth coating and melt rate are used to describe ice cream much better than hardness or chewiness.
Using specialized equipment, a food sample is placed in the equipment and compressed. This action mimics chewing and creates the force deformation curve. The force of the first bite and the force of the second bite are measured against the amount of deformation of the food sample for analysis. All textural attributes are analyzed by the instrument software. The food samples must be prepared in exactly the same way to get consistent results. The test is usually repeated up to 15 times for statistical accuracy.

Application

Textural profile analysis testing is also known as the “Two Bite Test”. The test mimics the mouth’s biting activity allowing analysis of how food responds when chewed. The Two Bite testing method allows for multiple textures to be analyzed in one test. The test results are plotted on a graph as seen in figure 1.

TPA Force vs Time (Figure 1)

The force vs time graph (Figure 1) shows the force peak resulting from each compression cycle. This is a typical 2-cycle TPA curve obtained from any load bearing instrument. While the force vs distance graph (Figure 2) better displays the response of the sample to the application and removal of strain. The following are typical measurements obtained from a TPA curve:

- Hardness: $P_1$
- Springiness: $D_s / D_1$
- Resilience: $A_3 / A_1$
- Cohesiveness: $B_2 / A_1$
- Chewiness: $(B_2 / A_1) \times P_1 \times D_s$
- Gumminess: $P_1 \times B_2 / A_1$

Texture profile analysis is used to accurately describe the textural characteristics of food. This technique provides a universal language for food scientists, vendors, sales staff, and customers. Knowing the textural profile of a product can determine the attributes that increase consumer liking.
References


