# Texture Profile Analysis

Texture is a critical shelf-life indicator and an important organoleptic characteristic for baked goods' overall acceptance. A food product is not only soft or firm but has other attributes like springiness, resilience, adherence, tooth-packing and so on. As a complex organoleptic parameter, texture is commonly determined by sensorial evaluation with trained panelists.[1]

However, these types of analysis are time consuming and expensive. The elevated costs in both production and execution of sensory tests led to the development of instrumental techniques which reduce both time and long term cost of food texture analysis.[1]

In the 1960s Dr. Alina Surmacka Szcześniak developed the original Texture Profile Analysis (TPA) method to understand the behavior and impact of several food products' texture on consumer acceptance. At the same time a group of colleagues at General Food were developing an instrument capable of quantifying texture parameters in an objective manner.[2]

# What is Texture Profile Analysis?

Texture Profile Analysis (TPA) or the "two bite test" is an instrumental technique developed to measure several textural parameters to describe food texture. Commonly used in the food industry, TPA is also used in other industries such as pharmaceuticals and cosmetics. The test consists in two consecutives compressions of the sample by a probe to simulate the chewing process at established settings for each product. Then, the results are plotted into graphs to analyze the results.[2]

TPA is use for the evaluation of several food products, such as:[2]

- Baked goods (bread, pound cake, muffins, rolls, etc.)
- Dairy products (hard and soft cheese)
- Meat products (hot dogs, hamburger)
- Confectionery (jelly beans, candies, chocolate bars, etc.)

TPA is commonly used in the food industry to:[1,2]

- Improve sensory properties of novel or competitive products
- Compare existing products
- Characterize textural properties of food products in case of production or ingredient changes (e.g. change of flour supplier or formula ratios)
- Analyze quality properties of food products
- Model shelf-life data
- Characterize textural changes during storage or under different storage conditions

Products succeed in the marketplace in part because their "textural characteristics" are pleasing to customers. Knowing the tactile properties of your baked goods can add value to quality control programs, product development, and R&D.

# Measuring Quality

***The TPA measures a wide variety of textural parameters. Its primary categories are:*** [2,3]

### Hardness

Maximum force applied during the first compression.

### Cohesiveness

Capacity of the product to withstand a second deformation relative to the first compression.

### Elasticity (springiness)

Capacity of the product to spring back after the deformation of the first compression.

### Adhesiveness

Rate at which item comes away from probe (instrumental) or roof of mouth/teeth.

***The primary categories can be further broken down into secondary categories:*** [2,3]

### Resilience

Measurement of how a sample recovers from deformation in relation to speed and applied forces.

### Chewiness

Energy required to chew a solid food until it is ready for swallowing.

### Brittleness (fracturability)

The force at the first peak when fractured, it only applies to the products that fracture.

### Gumminess

Energy required to disintegrate a semisolid food until it is ready to swallow.

### NOTE

The primary and secondary categories may be further broken down as needed to define the characteristics in a specific food item.

# HOW TPA WORKS

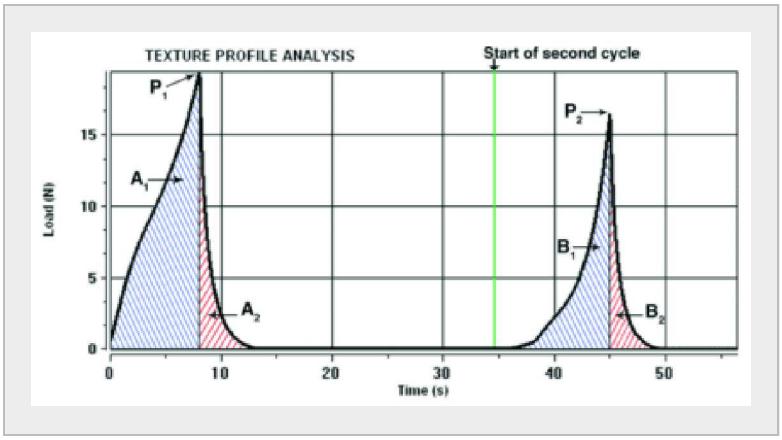
The TPA consists of a double compression test carried out by a machine called Texture Analyzer. The equipment is coupled to a computer and has several testing probes depending on the type of product to be analyzed. Initially the lab technician or researcher must undertake a literature research to select the appropriate test settings for the product. TPA instruments commonly come with pre-charged settings for commonly tested products.[2]

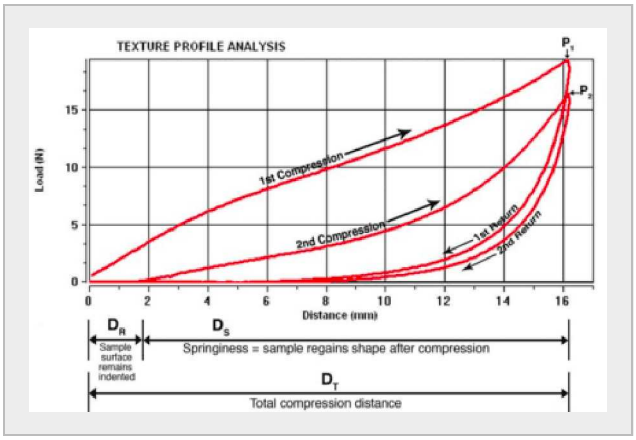
A typical TPA test consists of a probe that descends at a set pre-test speed. The Texture Analyzer starts recording data as soon as the automatic trigger is achieved at the set force. The sample is then compressed by the probe with the specified force or test-speed up until the target distance or percentage strain is reached.

After the target distance or percentage strain is achieved the probe ascends back to the original position at the test- speed. After this point, the probe descends back to the second compression after the target time is reached. Finally, the probe retrieves back to the original trigger position.[2]

It is important to note that the target time between compression can influence the recovery of the sample, and thus may influence the springiness of the product in comparison to the results obtained with a sensory panel.[2]

## Typical TPA Graphs:[1]



# 5 Top Tips for Texture Profile Analysis[2]

1

**SELECTION OF THE PROBE**

Use flat probes or compression plates that are larger than the sample to be tested. Consider that some values may not be truly representative of the calculated parameters due to the use of an inappropriate probe for analysis. Avoid using penetrating probes like conical probes, and do not use knife blades or Kramer Shear Cell for TPA tests.

2

**COMPRESSION DISTANCES OR PERCENT STRAINS**

Applied different compression strains from around 66 - 80% to simulate the breaking of the food to swallow. An excessive amount of strain (above 70%) may cause the destruction of the sample, especially with brittle products. It is important to consider the type of product and test premise when selecting test percent strain. Commonly used values of percent strain for a wide variety of food products are between 25 - 50%.

3

**COHESION CALCULATOR**

Determine cohesion by simplified TPA project that calculates this parameter by considering the downstroke energy from both compressions cycles.

4

**SELECT APPROPRIATE TPA PARAMETER**

Consider what data will be relevant to your tests, and then focus on the correct settings to amplify that parameter. Some product may break after the first compression and thus resulting parameters for the second compression will be meaningless.

5

**WAIT BETWEEN CYCLES**

Select the appropriate wait time between compressions considering the actual product to be consumed and how this will behave in a normal setting. Prolong wait times may cause a complete spring back to the original height, while short wait times may not show the realistic springiness of the product.

## How many samples of my product should I test to obtain reproducible results?

Ideally five samples or more should be tested to obtain reproducible results to allow for statistical calculations. Especially for sample products that may not be homogenous enough to provide reproducible results.[6]

## What is the difference in TPA between resilience and springiness?

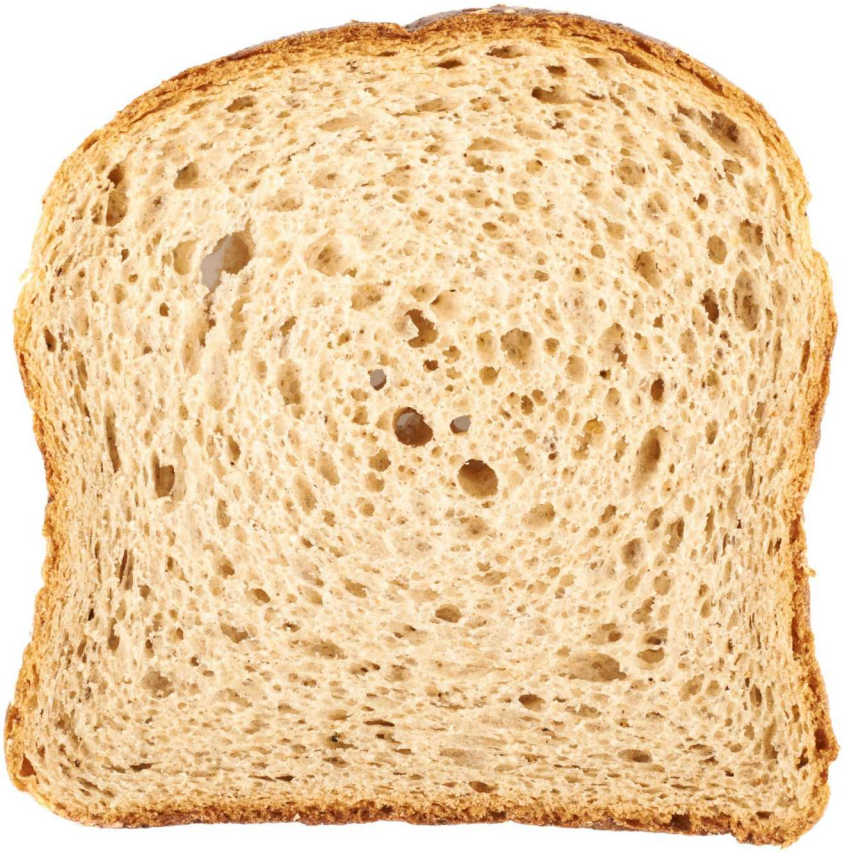
In TPA readings, resilience is associated with the energy required to compress a product and how much it "fights to regain its original height". Resilience can be determined during the first compression, while the compression and withdrawal speed are the same. Springiness is related to the height difference perceived during the first and second compression, and is associated with how well a product springs back to its original height once it has been compressed. It is determined by the height difference between the first and second compression.[2]

## Is there an ideal firmness texture value for bread?

An established ideal firmness doesn't exist. However several publications show a typical firmness for white pan bread in the range of 135 - 290 grams of force at the first day after baking; these values are usually determined as the control sample for comparison of novel formulations. Bread firmness increases significantly as storage time increases, and in consequence its sensory acceptability decreases, thus values above the mentioned range are undesirable for sensorial reasons.[7]

# How many bread slices should be tested for good statistical values?

According to the AIB Standard Method for white pan bread loaves firmness, at least two loaves are tested with two slices stacked on top of each other at a time. At least six measurements are taken per loaves. The recommendation per variable is two loaves, and thus twelve readings per variable should be taken into account. The typical procedure establishes testing on the first, third and seventh day after baking.[8]



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