PHYSICAL PROPERTIES OF FOOD

TEXTURE OF FOODS

Texture is one of the most important quality characteristics of foods. Foods have different textural properties. These differences are caused by inherent differences due to the variety difference, differences due to maturity, and differences caused by processing methods.

Sensory & Instrumental Methods

Food texture can be evaluated by sensory or instrumental methods. Sensory methods need a taste panel containing trained panelists. It is hard to repeat the results. Instrumental methods are less expensive and less time consuming as compared to sensory methods. There are various instrumental methods to determine the texture of foods.

1. Compression

Compression (deformation) test measures the distance that a food is compressed under a standard compression force or the force required to compress a food a standard distance. This test can be compared to the squeezing of bread by the consumers to be sure that bread is fresh. The sensory description of this test is softness or firmness. According to the AACC method, bread firmness can be determined by using compression principle (AACC, 1988). This test can also be used for other baked products.

2. Snapping/Bending

This test measures the force required to bend or snap brittle foods such as biscuits or crackers. The sample is laid across two vertical rails that support it in horizontal position. A third bar mounted above the sample and equidistant between the supporting rails is lowered until the sample breaks and the force is measured. The force required to snap the sample depends on the strength and the dimensions of the sample. The three-point bending test is the most commonly used snapping-bending test. This test is used for biscuit and chocolate bars that are homogeneous and long compared to their thickness and width. Samples should have a length to thickness ratio of at least 10 for this test.

3. Cutting Shear

The Pea Tenderometer, which was introduced in 1937, works via the principle of cutting shear. It consists of a grid of blades rotated at constant speed through a second grid of blades. As the peas are cut by the blades, the maximum force is measured. This instrument is still used to determine the maturity of peas at harvest. The Kramer Shear press was also developed to determine the texture of peas. It is widely used to determine the texture of fruits and vegetables. A typical system contains 10 shear blades that are 3.2 mm thick and separated by a distance equal to thickness. The sample holder is filled with the food. Shear blades are forced through the material until they pass through the bars in the bottom of the sample container. Force on the ram holding the blades is measured over time and correlated to the firmness of the product.

4. Puncture

Puncture test measures the force required to push the probe into the food and expressed as firmness or hardness of the product. It is used mostly for fruits, gels, vegetables, and some dairy or meat products. The puncture test is not widely used on cereal products since hard baked

products are susceptible to fracture when subjected to this test. Puncture force is proportional both area and perimeter of the probe and compression and shear properties of food.

5. Penetration

Penetrometers were originally designed to measure the distance that a cone or a needle sinks into a food such as margarine or mayonnaise under the force of gravity for a standard time. This is a simple and relatively inexpensive apparatus used for determination of spreadability of butter. The penetration depth depends on weight, cone angle, falling height, and properties of test materials. The cone will first deform the material and at large deformation the material may yield or fracture.

6. Texture Profile Analysis

Texture Profile Analysis (TPA) compresses a bite-sized piece of food (usually 1 cm cube) twice to simulate the chewing action of the teeth. Compression is usually 80% of the original length of sample. As a result of TPA, sensory properties such as gumminess, cohesiveness, and so forth can be determined objectively. Texture analyzers are used to obtain texture profile analysis.

The force curve generated as a function of time is known as a texture profile. Since the instrument compresses the sample twice, two positive and two negative curves are obtained Peak forces and areas under the curves are used to determine various properties of foods like fracturability, hardness, cohesiveness, adhesiveness, springiness, gumminess, and chewiness.

Fracturability (brittleness) is defined as the force at the first significant break in the first positive bite area.

Hardness is defined as the peak force during the first compression cycle.

Cohesiveness is defined as the ratio of the second positive bite area to the first positive bite area.

Adhesiveness is defined as the negative force area for the first bite representing the work required to pull the plunger away from the food.

Springiness (elasticity) is defined as the height to which the food recovers during the time that elapses between the end of the first bite and start of the second bite (distance or length of the compression cycle during the second bite).

Gumminess is the product of hardness and cohesiveness. In sensory terms, it is the energy required to disintegrate a semisolid food so that it is ready for swallowing.

Chewiness is the product of gumminess and springiness. In sensory terms, it is known as energy required for chewing a solid food until it is ready for swallowing.

Color of Food

Color is one of the important quality attributes in foods. Although it does not necessarily reflect nutritional, flavor, or functional values, it determines the acceptability of a product by consumers. Sometimes, instead of chemical analysis, color measurement may be used if a correlation is present between the presence of the colored component and the chemical in the food since color measurement is simpler and quicker than chemical analysis. For example, total carotenoid content of squash can be determined from color measurements without performing a chemical analysis because there is a correlation between total carotenoid content and color for