Physicochemical Properties of Food
Proximate and Ultimate Analysis

The physiochemical properties of foods (rheological, optical, stability, flavor) ultimately determine their perceived quality, sensory attributes and behavior during production, storage and consumption.

- The *optical properties* of foods are determined by the way that they interact with electromagnetic radiation in the visible region of the spectrum, *e.g.,* absorption, scattering, transmission and reflection of light.
- For example, full fat milk has a whiter appearance than skim milk because a greater fraction of the light incident upon the surface of full fat milk is scattered due to the presence of the fat droplets.
- The *rheological properties* of foods are determined by the way that the shape of the food changes, or the way that the food flows, in response to some applied force.
- For example, margarine should be spreadable when it comes out of a refrigerator, but it must not be so soft that it collapses under its own weight when it is left on a table.

- The *stability* of a food is a measure of its ability to resist changes in its properties over time.
- These changes may be chemical, physical or biological in origin.
- *Chemical stability* refers to the change in the type of molecules present in a food with time due to chemical or biochemical reactions, *e.g.,* fat rancidity or non-enzymatic browning.
- *Physical stability* refers to the change in the spatial distribution of the molecules present in a food with time due to movement of molecules from one location to another, *e.g.,* droplet creaming in milk.
- *Biological stability* refers to the change in the number of microorganisms present in a food with time, *e.g.,* bacterial or fungal growth.
- The *flavor* of a food is determined by the way that certain molecules in the food interact with receptors in the mouth (taste) and nose (smell) of human beings.
- The perceived flavor of a food product depends on the type and concentration of flavor constituents within it, the nature of the food matrix, as well as how quickly the flavor molecules can move from the food to the sensors in the mouth and nose.
- Analytically, the flavor of a food is often characterized by measuring the concentration, type and release of flavor molecules within a food or in the headspace above the food.
- Foods must therefore be carefully designed so that they have the required physicochemical properties over the range of environmental conditions that they will experience during processing, storage and consumption, *e.g.,* variations in temperature or mechanical stress.
- Consequently, analytical techniques are needed to test foods to ensure that they have the appropriate physicochemical properties.

What is Proximate Analysis?

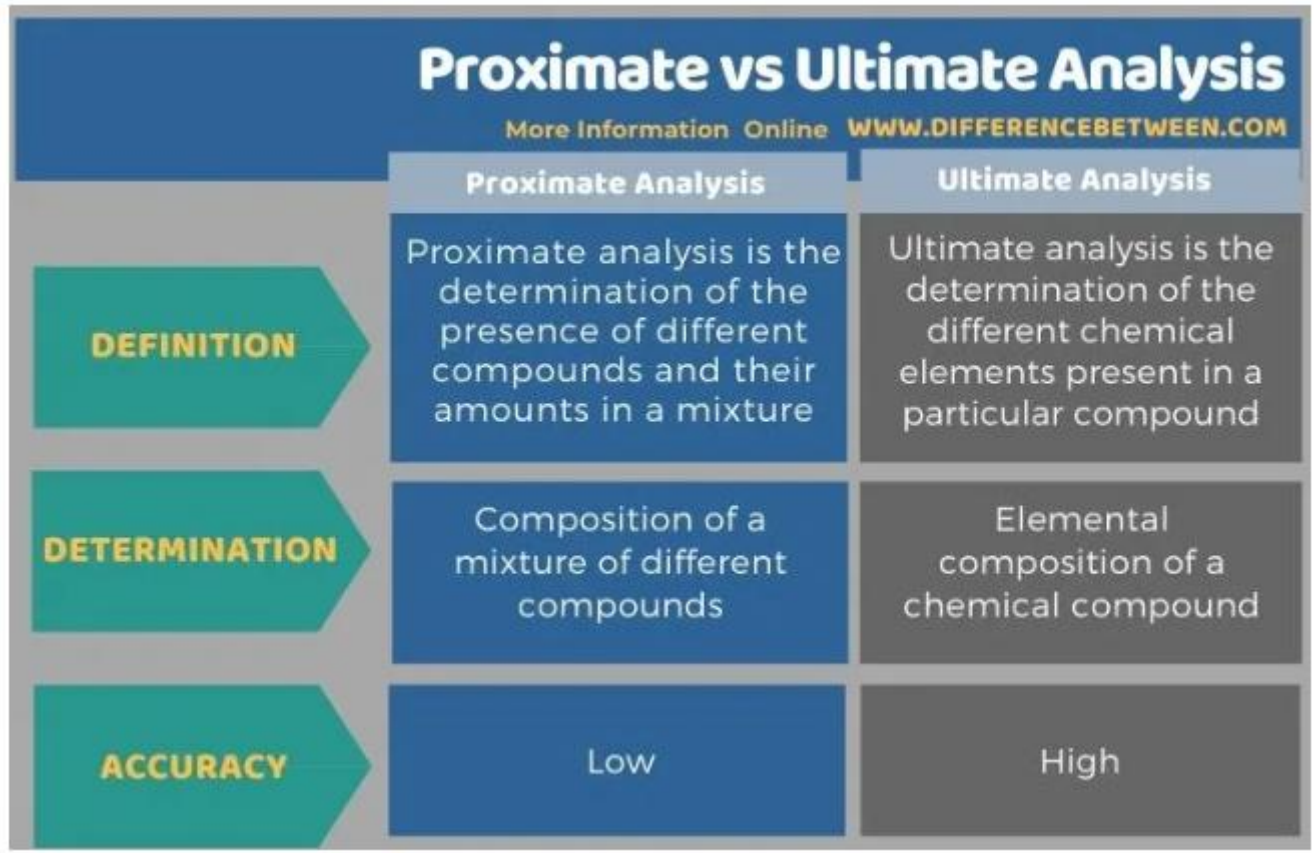
- Proximate analysis is the process of determination of the presence of different compounds and their amounts in a mixture.
- This concept of proximate analysis was developed by Henneberg and Stohmann (German scientists) in 1860.
- The method of proximate analysis involves the partitioning of compounds into different categories depending on the chemical properties of these compounds.
- Mainly, there are six categories of compounds as moisture, ash, crude protein, crude lipid, crude fiber, and nitrogen-free extracts.
- Proximate analysis techniques are mainly used in analyzing biological materials.
- E.g. decomposition of human consumable good into the constituents from which the goods are made of.
- It gives us a good approximation about the contents in the package and allows us to sell the goods cost-effectively.
- Also, it helps to verify the nutrient content in the package.
- Although it does not give the entire nutritional value of food, it gives an inexpensive way to determine the quality of food.

What is Ultimate Analysis?

- Ultimate analysis is the process of determination of the different chemical elements present in a particular compound.
- This technique gives more comprehensive results compared to the proximate analysis process.
- The ultimate analysis tests moisture, ash, carbon, hydrogen, nitrogen, sulfur and oxygen content of the sample to determine the elemental composition of the sample.
- Each and every chemical element in the sample is analyzed through chemical routes, and the contents are expressed as percentages with respect to the total mass of the sample.
- This technique is often used in the coal and coke industry.

What is the Difference Between Proximate and Ultimate Analysis?

- Proximate analysis involves the determination of the different compounds present in a mixture.
- Meanwhile, the ultimate analysis involves the determination of the number and types of different chemical elements present in a particular compound.
- Therefore, the key difference between proximate and ultimate analysis is that proximate analysis is the technique used to analyze the compounds in a mixture whereas ultimate analysis is the technique used to analyze the elements present in a compound.
- Generally, ultimate analysis gives more comprehensive results compared to proximate analysis.


Proximate vs Ultimate Analysis
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Proximate Analysis
Ultimate Analysis
DEFINITION
Proximate analysis is the determination of the presence of different compounds and their amounts in a mixture
Ultimate analysis is the determination of the different chemical elements present in a particular compound
DETERMINATION
Composition of a mixture of different compounds
Elemental composition of a chemical compound
ACCURACY
Low
High