

Food Chemistry

Food chemistry is the study of chemical processes and interactions of all biological and non-biological components of foods. The biological substances include such items as meat, poultry, lettuce, beer, and milk as examples. It is similar to biochemistry in its main components such as carbohydrates, lipids, and protein, but it also includes areas such as water, vitamins, minerals, enzymes, food additives, flavors, and colors. This discipline also encompasses how products change under certain food processing techniques and ways either to enhance or to prevent them from happening. An example of enhancing a process would be to encourage fermentation of dairy products with microorganisms that convert lactose to lactic acid; an example of preventing a process would be stopping the browning on the surface of freshly cut Red Delicious apples using lemon juice or other acidulated water.

1. Water

A major component of food is water, which can encompass anywhere from 50% in meat products to 95% in lettuce, cabbage, and tomato products. It is also an excellent place for bacterial growth and food spoilage if it is not properly processed. One way this is measured in food is by water activity which is very important in the shelf life of many foods during processing. One of the keys to food preservation in most instances is reduce the amount of water or alter the water's characteristics to enhance shelflife. Such methods include dehydration, freezing, and refrigeration.

2. Carbohydrates

Comprising 75% of the biological world and 80% of all food intake for human consumption, the most common known human carbohydrate is Sucrose. The simplest version of a carbohydrate is a monosaccharide which possesses the properties of carbon, hydrogen, and oxygen in a 1:2:1 ratio under a general formula of CH_2O where n is a minimum of 3. Glucose is an example of a monosaccharide as is fructose.

A chain of monosaccharides form to make a polysaccharide. Such polysaccharides include pectin, dextran, agar, and xanthan. Sugar content is commonly measured in degrees brix.

3. Lipids

The term lipid comprises a diverse range of molecules and to some extent is a catchall for relatively water insoluble or nonpolar compounds of biological origin, including waxes, fatty acids (including essential fatty acids), fatty-acid derived phospholipids, sphingolipids, glycolipids and terpenoids, such as retinoids and steroids. Some lipids are linear aliphatic molecules, while others have ring structures. Some are aromatic, while others are not.

Some are flexible, while others are rigid. Most lipids have some polar character in addition to being largely nonpolar. Generally, the bulk of their structure is nonpolar or hydrophobic (“water-fearing”), meaning that it does not interact well with polar solvents like water. Another part of their structure is polar or hydrophilic (“water-loving”) and will tend to associate with polar solvents like water. This makes them amphiphilic molecules (having both hydrophobic and hydrophilic portions). In the case of cholesterol, the polar group is a mere –OH (hydroxyl or alcohol). Lipids in food include the oils of such grains as corn, soybean, from animal fats, and are parts of many foods such as milk, cheese, and meat. They also act as vitamin carriers as well.

4. Food proteins

Proteins compose over 50% of the dry weight of an average living cell and are very complex macromolecules. They also play a fundamental role in the structure and function of cells. Consisting mainly of carbon, nitrogen, hydrogen, oxygen, and some sulfur, they also may contain iron, copper, phosphorus, or zinc. In food, proteins are essential for growth and survival and vary depending upon a person’s age and physiology (e.g., pregnancy). Protein is commonly obtained from animal sources: eggs, milk, and meat. Nuts, grains and legumes provide vegetable sources of protein, and protein combining of vegetable sources is used to achieve complete protein nutritional quotas from vegetables.

Protein sensitivity as food allergy is detected with the ELISA test.

5. Enzymes

Enzymes are biochemical catalysts used in converting processes from one substance to another. They are also involved in reducing the amount of time and energy required to complete a chemical process. Many aspects of the food industry use catalysts, including baking, brewing, dairy, and fruit juices, to make cheese, beer, and bread.

6. Vitamins

Vitamins are nutrients required in small amounts for essential metabolic reactions in the body. These are broken down in nutrition as either water soluble (Vitamin C) or fat soluble (Vitamin E). An adequate supply of vitamins can prevent diseases such as beriberi, anemia, and scurvy while an overdose of vitamins can produce nausea and vomiting or even death.

7. Minerals

Dietary minerals in foods are large and diverse with many required to function while other trace elements can be hazardous if consumed in excessive amounts. Bulk minerals with a Reference Daily Intake (RDI, formerly Recommended Daily Allowance (RDA)) of more than 200 mg/day are calcium, magnesium, and potassium while important trace minerals (RDI less than 200 mg/day) are copper, iron, and zinc. These are found in many foods, but can also be taken in dietary supplements.

8. Color

Food coloring is added to change the color of any food substance. It is mainly for sensory analysis purposes. It can be used to simulate the natural color of a product as perceived by the customer, such as red dye like FD&C Red No.40 Allura Red AC to ketchup or to add unnatural colors to a product like Kellogg company Kellogg's Froot Loops. Caramel is a natural food dye; the industrial form, caramel coloring, is the most widely used food coloring and is found in foods from soft drinks to soy sauce, bread, and Pickling|pickles.

9. Flavors

Flavor in food is important in how food smells and tastes to the consumer, especially in sensory analysis. Some of these products occur naturally like salt and sugar, but flavor chemists (called a "flavorist") develop many of these flavors for food products. Such artificial flavors include methyl salicylate which creates the wintergreen odor and lactic acid which gives milk a tart taste.

10. Food additives

Food additives are substances added to food for preserving flavors, or improving taste or appearance. The processes are as old as adding vinegar for pickling or as an emulsifier for emulsion mixtures like mayonnaise. These are generally listed by "E number" in the European Union or GRAS ("generally recognized as safe") by the United States Food and Drug Administration.