Food chemistry

"Food Chemistry" redirects here. For the journal, see Food Chemistry (journal).

Food chemistry is the study of chemical processes and interactions of all biological and non-biological components of foods.[1][2] 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 History of food chemistry

The scientific approach to food and nutrition arose with attention to agricultural chemistry in the works of J. G. Wallerius, Humphry Davy, and others. For example, Davy published *Elements of Agricultural Chemistry, in a Course of Lectures for the Board of Agriculture* (1813) in the United Kingdom which would serve as a foundation for the profession worldwide, going into a fifth edition. Earlier work included that by Carl Wilhelm Scheele who isolated malic acid from apples in 1785.

In 1874 the Society of Public Analysts was formed, with the aim of applying analytical methods to the benefit of the public.[3] Its early experiments were based on bread, milk and wine.

It was also out of concern for the quality of the food supply, mainly food adulteration and contamination issues that would first stem from intentional contamination to later with chemical food additives by the 1950s. The development of colleges and universities worldwide, most notably in the United States, would expand food chemistry as well with research of the dietary substances, most notably the Single-grain experiment during 1907-11. Additional research by Harvey W. Wiley at the United States Department of Agriculture during the late 19th century would play a key factor in the creation of the United States Food and Drug Administration in 1906. The American Chemical Society would establish their Agricultural and Food Chemistry Division in 1908 while the Institute of Food Technologists would establish their Food Chemistry Division in 1995.

Food chemistry concepts are often drawn from rheology, theories of transport phenomena, physical and chemical thermodynamics, chemical bonds and interaction forces, quantum mechanics and reaction kinetics, biopolymer science, colloidal interactions, nucleation, glass transitions and freezing/disordered or noncrystalline solids, and thus has Food Physical Chemistry as a foundation area.[4][5]

2 Water in food systems

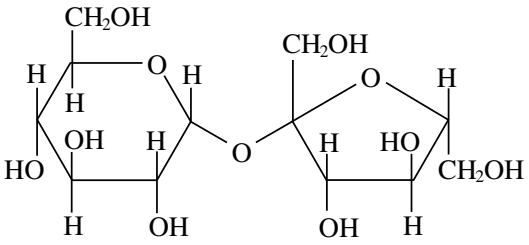
Main article: Water

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 shelf-life. Such methods include dehydration, freezing, and refrigeration[6][7][8][9] This field encompasses the *"physiochemical principles of the reactions and conversions that occur during the manufacture, handling, and storage of foods"*[10] .

3 Carbohydrates

Main article: Carbohydrate

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 $C_nH_{2n}O_n$ where n is a minimum of 3. Glucose is an example of a monosaccharide as is fructose. Combine them in the picture shown to the right and you have sucrose, one of the more common sugar products around.



Sucrose: ordinary table sugar and probably the most familiar carbohydrate.

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.

4 Lipids

Main article: Lipid

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.

5 Food proteins

Main article: Protein (nutrient)

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.

6 Enzymes

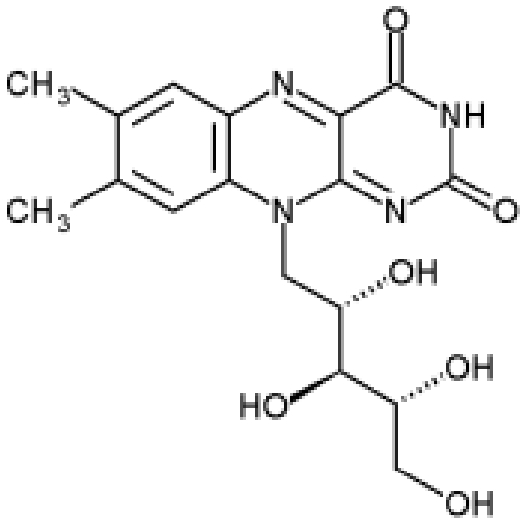
Main article: Enzyme

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.

7 Vitamins

Main article: Vitamin

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



Riboflavin (Vitamin B_2), water soluble.

while an overdose of vitamins can produce nausea and vomiting or even death.

8 Minerals

Main article: Dietary mineral

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.

9 Color

main|Food coloring

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.

10 Flavors

Main article: Flavor

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.

11 Food additives

Main article: Food additive

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.

12 See also

- Food physical chemistry
- Dietary supplement
- Food and Bioprocess Technology (journal)
- Food Chemistry (journal)
- Food composition
- Food engineering
- Food fortification
- Food microbiology
- Food packaging
- Food preservation
- Food rheology
- Food safety
- Food science
- Food storage
- Food supplements
- Food technology
- Nutraceutical
- Nutrification (also called food enrichment or fortification)

Food chemist also help extract color from food, which is one of many jobs they have.

13 References

[1] John M. de Man.1999. *Principles of Food Chemistry* (Food Science Text Series), Springer Science, Third Edition

[2] John M. de Man. 2009. Food process engineering and technology, Academic Press, Elsevier: London and New York, 1st edn.

[3] Proc. Soc. Analyt. Chem p. 234

[4] Pieter Walstra. 2003. *Physical Chemistry Of Foods*. Marcel Dekker, Inc.: New York, 873 pages

[5] *Physical Chemistry Of Food Processes: Fundamental Aspects.*1992.van Nostrand-Reinhold vol.1., 1st Edition,

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[7] *Physical Chemistry Of Food Processes: Fundamental Aspects*.1992.van Nostrand-Reinhold vol.1., 1st Edition,

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[9] *Physical Chemistry of Food Processes, Advanced Techniques, Structures and Applications*.1994. van Nostrand-Reinhold vols.1-2., 1st Edition, 998 pages; 3rd edn. Minuteman Press, 2010; vols. 2-3, fifth edition (*in press*)

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15 External links

- American Chemical Society Agricultural and Food Chemistry Division website.
- Institute of Food Technologists Food Chemistry Division website.
- Association of Public Analysts
- The Penn State University,Food Chemistry,USA
- Wageningen University, Laboratory of Food Chemistry, The Netherlands
- / Mexican Food Recipe

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