Definition: **food technology** from *Hawley's Condensed Chemical Dictionary*

Practice of the techniques used in the preparation of foods for large-scale human use. Among others these include harvesting, postharvest treatment, all forms of cooking, tenderizing, preservation by chemicals, heating, dehydration, drying and freezing, distillation and solvent extraction, milling, refining, hydrogenation, emulsification, packaging materials and storage, labeling, and transportation. Other aspects of food technology are bacteriology, sanitation, quality control, and formulation of ingredients for a wide variety of end products. A recent development of importance is the growth of convenience and quick-service foods.

Summary Article: **food technology**

The application of science to the commercial processing of foodstuffs. Food is processed to make it more palatable or digestible, for which the traditional methods include boiling, frying, flour-milling, bread-, yogurt-, and cheese-making, and brewing; to prevent the growth of bacteria, moulds, yeasts, and other microorganisms; or to preserve it from spoilage caused by the action of enzymes within the food that change its chemical composition, resulting in changes in flavour, odour, colour, and texture. These changes are not always harmful or undesirable; examples of desirable changes are the ripening of cream in butter manufacture, flavour development of cheese, and the hanging of meat to tenderize the muscle fibres. Fatty or oily foods suffer oxidation of the fats, which makes them rancid.

Preservation enables foods that are seasonally produced to be available all the year. Traditional forms of **food preservation** include salting, smoking, pickling, drying, bottling, and preserving in sugar. Modern food technology also uses many novel processes and additives, which allow a wider range of foodstuffs to be preserved. All foods undergo some changes in quality and nutritional value when subjected to preservation processes. No preserved food is identical in quality to its fresh counterpart, therefore only food of the highest quality should be preserved.

In order to grow, bacteria, yeasts, and moulds need moisture, oxygen, a suitable temperature, and food. The various methods of food preservation aim to destroy the micro-organisms within the food, to remove one or more of the conditions essential for their growth, or to make the foods unsuitable for their growth. Adding large amounts of salt or sugar reduces the amount of water available to micro-organisms, because the water tied up by these solutes cannot be used for microbial growth. This is the principle in salting meat and fish, and in the manufacture of jams and jellies. These conditions also inhibit the enzyme activity in food. Preservatives may also be developed in the food by the controlled growth of micro-organisms to produce fermentation that may make alcohol, or ethanoic (acetic) or lactic acid. Examples of food preserved in this way are vinegar, sour milk, yogurt, sauerkraut, and alcoholic beverages.
Refrigeration below 5°C/41°F (or below 3°C/37°F for cooked foods) slows the processes of spoilage, but is less effective for foods with a high water content. This process cannot kill micro-organisms, nor stop their growth completely, and a failure to realize its limitations causes many cases of food poisoning. Refrigerator temperatures should be checked as the efficiency of the machinery (see refrigeration) can decline with age, and higher temperatures are dangerous.

Deep freezing (preserving foods at very low temperatures – −18°C/−1°F for domestic freezers and from −18°C/−1°F to −29°C/−20°F for commercial freezers) stops almost all spoilage processes, except residual enzyme activity in uncooked vegetables and most fruits, which are blanched (dipped in hot water to destroy the enzymes) before freezing. Preservation by freezing works by rendering the water in foodstuffs unavailable to micro-organisms by converting it to ice. Micro-organisms cannot grow or divide while frozen, but most remain alive and can resume activity once defrosted. Some foods are damaged by freezing, notably soft fruits and salad vegetables, the cells of which are punctured by ice crystals, leading to loss of crispness. Foods must be frozen very quickly so that small ice crystals form in the cells and no damage is caused to the structure of the food. A slow freezing process allows large uneven ice crystals to form that will later rupture the cells and cause the flavour, texture, and nutritional value to change when the food is thawed. Fatty foods such as cows’ milk and cream tend to separate. Freezing has little effect on the nutritive value of foods, though a little vitamin C may be lost in the blanching process for fruit and vegetables. Various processes are used for deep-freezing foods commercially.

Pasteurization, a method of heat treatment, is used mainly for milk. By holding the milk at 72°C/162°F for 15 seconds, then cooling it rapidly to 10°C/50°F, all disease-causing bacteria (pathogens) can be destroyed. Less harmful bacteria survive, so the milk will still go sour within a few days.

Ultra-heat treatment is used to produce UHT milk. This process uses higher temperatures than pasteurization, and kills all bacteria present, giving the milk a long shelf life but altering the flavour. Milk is heated to 130–40°C/265–85°F for 1–5 seconds. The advantages of this process over the traditional sterilization process is that there is little colour change, only a slight change in taste, and very little loss of nutrient content. UHT milk is sold in airtight cartons and will keep for up to six months.

Drying is effective because both micro-organisms and enzymes need water to be active. This is one of the oldest, simplest, and most effective ways of preserving foods. In addition, drying concentrates the soluble ingredients in foods, and this high concentration prevents the growth of bacteria, yeasts, and moulds. Dried food will deteriorate rapidly if allowed to become moist, but provided they are suitably packaged, products will have a long shelf life. Traditionally, foods were dried in the sun and wind, but commercially today, products such as dried milk and instant coffee are made by spraying the liquid into a rising column of dry, heated air; solid foods, such as fruit, are spread in layers on a heated surface.

Accelerated Freeze-Drying (AFD) is carried out under vacuum. This is the most modern method of commercial drying. It produces a dried product of excellent quality. It is less damaging to food than straight dehydration in the sense that foods reconstitute better, and it is used for quality instant coffee and dried vegetables. The food is frozen and then the temperature is increased, to vaporize the ice that turns to steam as it dries out the food. The colour, texture, and most of the flavour are kept, the nutritional profile is retained, the food does not shrink as much as with other methods, and...
the food is preserved for longer than with other drying methods. The foods lose much of their weight, but retain the original size and shape. They have a spongelike texture, and rapidly reabsorb liquid when reconstituted. Refrigeration is unnecessary during storage; the shelf-life is similar to dried foods, provided the product is not allowed to become moist. The success of the method is dependent on a fast rate of freezing, and rapid conversion of the ice to vapour. Therefore, the most acceptable results are obtained with thin pieces of food, and the method is not recommended for pieces thicker than 3 cm/1 in. Fruit, vegetables, meat, and fish have proved satisfactory. This method of preservation is commercially used but the products are most often used as constituents of composite dishes, such as packet meals. The process is, however, a more costly method of drying, and AFD foods need to be handled with care as they crumble easily.

**Canning** relies on high temperatures to destroy micro-organisms and enzymes. The food is sealed in a can to prevent recontamination. The effect of heat processing on the nutritive value of food is variable. For instance, the vitamin-C content of green vegetables is much reduced, but, owing to greater acidity, in fruit juices vitamin C is quite well retained. There is also a loss of 25–50% of water-soluble vitamins if the liquor is not used. Vitamin B (thiamine) is easily destroyed by heat treatment, particularly in alkaline conditions. Acid products retain thiamine well, because they require only minimum heat during sterilization. The sterilization process seems to have little effect on retention of vitamins A and B₂. During storage of canned foods, the proportion of vitamins B and C decreases gradually. Drinks may be canned to preserve the carbon dioxide that makes them fizzy.

**Pickling** utilizes the effect of ethanoic (acetic) acid, found in vinegar, in stopping the growth of moulds. In sauerkraut, lactic acid, produced by bacteria, has the same effect. Similar types of non-harmful, acid-generating bacteria are used to make yogurt and cheese.

**Curing of meat** involves soaking in salt (sodium chloride) solution, with saltpetre (sodium nitrate) added to give the meat its pink colour and characteristic taste. Bacteria convert the nitrates in cured meats to nitrites and nitrosamines, which are potentially carcinogenic to humans.

**Irradiation** is a method of preserving food by subjecting it to low-level radiation (see food irradiation).

**Puffing** is a method of processing cereal grains. They are subjected to high pressures, then suddenly ejected into a normal atmospheric pressure, causing the grain to expand sharply. This is used to make puffed wheat cereals and puffed rice cakes.

**Chemical treatments** are widely used, for example in margarine manufacture, in which hydrogen is bubbled through vegetable oils in the presence of a catalyst to produce a more solid, spreadable fat. The catalyst is later removed. Chemicals introduced in processing that remain in the food are known as food additives and include flavourings, preservatives, anti-oxidants, emulsifiers, and colourings.