Food Technology past and present

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Evolution of food habits in man

Man evolved from tree-dwelling apes who lived on a diet of fruits and seeds. Later, with a drastic change of climate, apes are believed to have climbed down to the ground where they began to supplement diets with bark, young shoots, edible roots and small animals like ants, termites, frogs and insect grubs. In other words, they changed their diets from a herbivorous nature to an omnivorous style. Gradually our ancestors changed their food habits and consequently began to hunt larger animals. Later, man used more effective methods to attract animals towards their settlements by providing a bait for the animals so that they could hunt them in the vicinity of the settlement. As the next step, ancestors trained domesticated dogs to help them in hunting. Subsequently, they domesticated animals like sheep, goats and pigs. Domestication enabled man to access a wider range of plants and animals. Hence, about 10,000 years ago man started changing his way of life from foraging to farming. In order to survive the ancient man had to harness nature. In frozen climates he used ice to freeze meat. In tropical climates, instead of freezing he dried foods in the sun. Our indigenous people "Veddhas" preserve meat in bees honey.

Grain, bread, ***Thalapa*** and/or porridge were the basis of food consumed by our ancestors. For example, in ancient time, Egyptians roasted grains of barley, wheat or millet to prepare bread. Later, they found strains of wheat from which they were able to prepare dough directly from raw flour. They also found the way of producing beer and later applied the knowledge in bread-making as well. The knowledge in food science widens fast as food technology advances. For example, in the canning process, food is heated to kill all microorganisms and then the food is sealed to cut off the supply of oxygen and thereby prevent the entry of new microbes. Another example is the knowledge of commercial growers who ship fruit over long distances without many losses. They pick the fruit while it is still unripe and treat it with ethylene gas to ripen but not spoiled when it reaches the market. Consumers who buy fruit that is still unripe may speed up the process of ripening by enclosing the fruit in a small bag. This traps the ethylene that is given off by the ripening fruit.

Today, there is a wide range of methods available to maintain and enhance the shelf life, appearance and taste of food. Consumers with busy life-styles who cannot afford much time on food preparation and cooking can buy ready to eat type of food products which require

only a little time for preparation and cooking. Rational combination of these methods with modern distribution networks makes seasonal crops available year-round in supermarkets and grocery stores all over the country, region and the world at large. Food processing operations involved in the food industry can be grouped into four categories; preparative operations, conversion operations, preservation operations and ancillary operations

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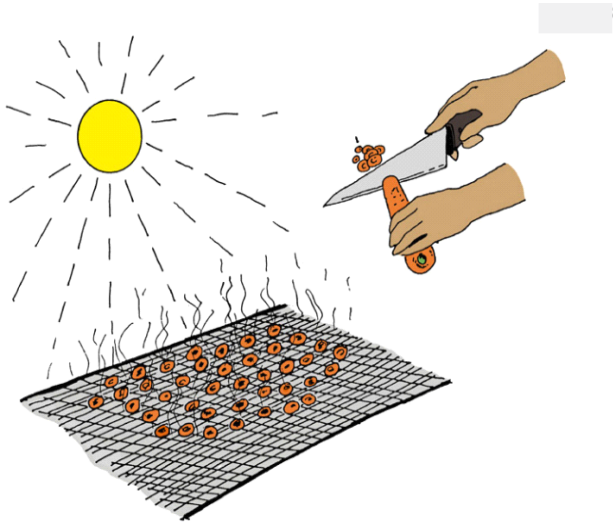
Food processing operations

Preparative operations employed in the food industry include a wide range of operations which include operations like cleaning, sorting and grading. For example, in a vegetable farm processing may involve only picking, sorting and washing fruits and vegetables before they are sent to the market. **Conversion operations** practised in the food industry consist of size reduction and screening of solids, mixing, emulsification, filtration, membrane separation, centrifugation, extraction and crystallization. Some processing methods convert raw materials into a different form or change the nature of the product. For example, in the manufacture of sugar from sugar beets or in the manufacture of cheese, conversion operations modify the raw materials into different products. **Preservation operations** are intended to keep foods without any spoilage. Food spoilage is any change that makes food unfit for consumption and includes chemical and physical changes; e.g. bruising and browning; infestation by insects or other pests; or growth of microorganisms like bacteria, yeast, and moulds. Foods before consumption may have made a long journey from the farm or processor to consumer. This journey may extend beyond national boundaries, oceans or continents taking days to months. Therefore irrespective of the processing or preservation method used **ancillary operations** like proper packaging of food is very essential to make sure that food remains wholesome.

Some food preservation techniques destroy enzymes and proteins present in raw foods, which are responsible for chemical and physical changes that take place naturally after harvesting. Food preservation techniques also help to overcome the moisture or temperature conditions which favour the growth of microorganisms. As microorganisms multiply and grow, they break down food constituents producing unpleasant changes in taste, texture and appearance, and may cause food-borne illness at large. The changes we can observe or recognise are considered as spoilage. Now let us try to understand about some preservation techniques which are commonly used worldwide.

Traditional techniques in food preservation



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Each civilization or community would have its own specific methods to dry fish, wild game, domestic animals, vegetables and fruits. A fire was used to create the heat needed to dry foods and in some cases smoking them as well. Drying is the oldest method of preserving food and it is quite simple when compared with other methods.

Food can be dried in several ways including sun drying and oven drying. For a good-quality product vegetables and fruits must be prepared for drying as soon as possible after harvesting. They should be blanched, cooled and laid out to dry without delay. Foods should be dried rapidly, but not too fast that the outer areas becomes hard before the moisture inside has a chance to evaporate.

Sun drying is a traditional method where foods are dried naturally under the sun. Solar drying is cheap, but is not so easily controlled as in the case of dehydration with sophisticated means. Drying by direct exposure to the sun has a number of disadvantages like exposing the produce to dust and atmospheric contamination, insect infestation etc. Therefore, cleanliness and sanitation are essential conditions to be maintained when foods are dried.

Almost all kinds of fruits need some treatment before drying. When fruits like apples, pears, banana or other light-coloured fruits are cut and exposed to the air, the flesh turns brown rapidly due to oxidation. If oxidation is not stopped, it will harm the texture, flavour, aroma and appearance of the fruit. Therefore, fruits of this type need to be treated with an antioxidant in order to prevent browning reactions. Sprinkling the fruit pieces with an ascorbic acid solution can be very helpful to stop browning. Sulphuring is the best antioxidant treatment for preserving colour. Sulphuring also helps to prevent loss of vitamins A and C. Sulphur itself is not a preservative but it discourages insects and microbes which can cause spoilage. Blanching is used to destroy enzymatic activities which otherwise cause undesirable changes in vegetables and some fruits prior to further processing. Almost all vegetables need to be blanched (scalded in boiling water for a short time before drying). A few vegetables like mushrooms, okra and onions need no blanching before drying. Most fruits do not need to be peeled before drying. But some fruits with tough and waxy skins need to be cracked first. Fruit should be cut into uniform pieces or slices so that it will dry more evenly and thin pieces dry faster than thick counterparts.

Advanced drying technologies

In some countries including Sri Lanka, heat generated by burning fire wood or agricultural waste is used for drying commodities like copra and root crops. In this connection, oven drying is the most practical and cheep way to succeed with dehydration. It protects foods from insects and dust and does not depend on the weather. Foods dried in this manner are more susceptible to scorching at the end of the drying period. Oven-dried foods usually are darker, more brittle and less flavourful than foods dried by a dehydrator. On the other hand, foods can be dried on trays in an electric dehydrator which is operated with an electrical heat source and ventilation system. Electric dehydrators are used to dry foods indoors. Electric dehydrators maintain low temperatures and use less energy than an oven and the quality of the product is better than with any other method of drying.

Freeze-drying

In freeze-drying, frozen food is placed in a special vacuum cabinet. There, water escapes from the food by sublimation, a process in which ice changes from a solid directly to a vapour bypassing the liquid status. Freeze-dried foods retain their original flavour, texture and nutrients upon rehydration but must be packaged in moisture-proof, hermetically sealed containers. Freeze-drying is an expensive process used for such products as instant coffee, dried soup mixes, strawberries, mushrooms and shrimp.

Osmotic dehydration - a tool for improving food product quality

Osmotic dehydration (or dewatering impregnation soaking) is another way of removing water from commodities. It is a useful technique for concentration of fruit and vegetables. It gives rise to at least two major simultaneous counter-current flows; a significant water

flow out of the food into the solution and a transfer of solute from the solution into the food. Osmotic dehydration is achieved by placing the solid food, whole or in pieces, in aqueous solutions of sugars or salts of high osmotic pressure. It is used in various traditional preserving methods including salting of meat and fish and candying of fruit. In modern food industry, osmotic dehydration is used not as a preserving method but as a tool for obtaining intermediate and end-products of improved quality.

Other methods of processing and preservation of food

Fermenting

Fermentation was not invented, but rather discovered. Some microorganisms, yeasts in particular, are capable of utilizing fermentable sugars as their respiratory substrate and convert them into alcohols. Likewise some other microorganisms can produce lactic acids. Wine, toddy, beer, yoghurt, curd, sauerkraut, kefir, ***Jaddi*** and native medicines like ***Arishta*** are examples of fermented products. Fermentation was a valuable food preservation method. It cannot only preserve foods, but also create more nutritious foods, and was used to produce more palatable foods from less desirable ingredients. Some anthropologists believe that mankind settled down and transformed from nomadic wanderers into farmers to grow barley to make beer around 10,000 BC.

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Pickling

Pickling is the process of preserving food by anaerobic fermentation in brine (a solution of salt in water), to produce lactic acid. Pickling also can be achieved by marinating and storing food in an acid solution usually vinegar (or even diluted artificial acetic acid). The resulting food is called a pickle. This procedure gives the food a sour taste. Pickling began as a way to preserve food for out-of-season use, and for use in long journeys, especially by sea. Vinegar is produced naturally from starches or sugars which are first fermented to alcohol by yeasts and the alcohol is then oxidized by certain bacteria to acetic acid. For example, wines, toddy and ciders are all routinely transformed into vinegars. Pickling of foods is a very popular preservation technique because the sour taste of the food in it is appealing. Containers had to be made of stoneware or glass, since the vinegar would dissolve the metal from pots and make the food toxic.

Pickle products can also be subject to spoilage from microorganisms, particularly yeasts and moulds, as well as enzymes that may affect flavour, colour and texture. Processing the pickles in a boiling-water can will prevent both of these problems.

Curing

The earliest curing was intentionally done for dehydration purpose. Early cultures used salt to desiccate foods. Curing by salting and drying has been the oldest, simplest, cheapest and most widely practised method of preservation of fish throughout the world. Salting was common and even culinary by choosing raw salts from different sources (rock salt, sea salt, spiced salt, etc.). In the 1800's it was discovered that certain sources of salt gave meat a red colour instead of the usual unappetizing grey. Consumers preferred the red coloured meat. Curing involves adding some combination of salt, sugar, spices, vinegar or sodium nitrite to animal foods. It was also found that nitrites are capable of inhibiting growth of microbes like *Clostridium botulinum*. Curing is used to preserve meat and fish, yielding common products such as bacon, ham, frankfurters and corned beef. Smoking, a

flavouring and preservation technique is another ancient technique that is commonly used along with curing. Smoking involves cooking meat or fish very slowly over a low wood fire. Curing and smoking preserve food by binding or removing water so that it is not available for the growth of microorganisms. There are several other curing methods used to process fish; Colombo curing, pit curing and mono curing.

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Canning

Canning is comparatively a newer method of food preservation pioneered in the 1790s when Nicolas Appert, a French confectioner discovered that the application of heat to food in sealed glass bottles preserved the food from deterioration. Based on Appert's methods Englishman Peter Durand, used tin cans in 1810. Canning is the process in which foods are placed in jars or cans and heated to a temperature that destroys microorganisms and inactivates enzymes. This heating and later cooling forms a vacuum seal. The vacuum seal prevents other microorganisms from re-contaminating the food within the jar or can.

Today canning is used to preserve a wide variety of foods, including soups, sauces, fruits, vegetables, juices, meats, fish and some dairy products. Canning preserves food by heating it in airtight, vacuum-sealed containers. The can is filled with food and air is pumped out of the space remaining at the top of the can to form a vacuum. The container is then sealed, heated in a cooker called a retort, and finally cooled to prevent overcooking of the food inside the container.

Advanced food preservation techniques

Microwaving

Microwave energy is a natural phenomenon that occurs when an electric current flows through a conductor. Microwaves are a form of electromagnetic radiations that are very similar to sunlight and radio waves. The microwave oven was discovered as a spin-off from another technology. In 1946 Dr Percy Spencer, a self-taught engineer, discovered that the candy bar in his pocket had melted when he was testing a new vacuum tube called a magnetron. Later when he placed some popcorn kernels near the tube he observed the popcorn sputtering, cracking and getting thrown out all over the lab.

A microwave oven uses **microwaves** to heat food. Microwaves are radio waves. In the case of microwave ovens, the commonly used radio wave frequency is roughly 2,500 megahertz (2.5 gigahertz with a wavelength of 12.24 cm). Radio waves in this frequency range have an interesting property; they are absorbed by water, fats and sugars. Water, fat, and other substances in the food absorb energy from the microwaves in a process called dielectric heating. When they are absorbed they are converted directly into atomic motion — heat. Microwave heating is most efficient on liquid water, and much less so on fats and sugars (which have less molecular dipole moment), and frozen water (where the molecules are not free to rotate). Microwaves in this frequency

range have another interesting property; they are not absorbed by most plastics, glass or ceramics. Metals reflect microwaves, and is why metal pans do not work well in a microwave oven. In a microwave oven, the air in the oven is at room temperature, so there is no way to form a crust.

The cooking chamber itself is capable of preventing microwaves from escaping into the environment. The oven door is usually a glass panel for easy viewing, but has a layer of conductive mesh to maintain the shielding. Moreover, the radiation produced in a microwave oven is non-ionizing. As such, it does not have the specific cancer risks associated with ionizing radiations such as X-rays, ultraviolet light and high-energy particles.

Food irradiation

Food irradiation is sometimes referred to as **cold pasteurization** or **electronic pasteurization.** Food irradiation is a processing technique where the food is exposed to doses of ionising energy or radiation either from ã-rays or an electron beam. At low doses, irradiation extends the shelf life of the product concerned. At higher doses, this process kills insects, moulds, bacteria and other potentially harmful microorganisms. According to literature, research findings of over five decades have shown that food irradiation is a safe and effective form of processing. Food irradiation has been approved in 40 countries including the United States, China, France and Holland.

There is a common misconception that irradiated food is radioactive. The radiation used to process foods is very different from the radioactive fallout that occurs after a nuclear accident. In food processing, the radioactive source never comes into contact with the food and the doses are so low that the level of radioactivity is generally undetectable. Exposure to ã-rays does not make food radioactive while electron beams are formed from electricity, and hence do not need radioactive material to work. In both cases organisms that are responsible for spoiling foods like insects, moulds and bacteria are killed. However, food irradiation cannot kill viruses.

Likewise, there are so many other novel food processing technologies like super critical fluid extraction, nanoencapsulation, use of probiotics, single cell protein based food production, high pressure food processing, genetically modified foods etc. Food packaging also plays a major role in current food industry. Packaging technologies involve a wide range of techniques and materials. Packaging not only protects the food product extending the shelf life, but also helps in displaying items for sale in an attractive manner.

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A food is a source of protein if,

No label or advertisement relating to any food shall state or indicate thereon that such food is a course of protein unless:

√ *The quantity that would reasonably be expected to be consumed in one day contributes at least 12 grams of proteins*

√ *At least 20 percent, (20%) of the energy value of the food is provided by protein; and*

√ *The label states the protein content in grams per 100g or 100 ml of the food*