Contemporary food technology and its impact on cuisine

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This article contains a general review of current food technologies and their effect on the quality and safety of foods. The uses of these technologies in the context of current and projected world population, urbanization prevention of food losses, preservation and trade of foods, domestically and internationally are briefly reviewed. Technologies discussed are related to food storage, refrigeration, frozen foods, milling and baking, canning, pickling, extrusion processes, fermentation, and to foods and food ingredients such as fruits and vegetables, animal products, fat and oils, canned products, and food additives.

Key Words: food technology, urbanization, food storage, frozen and chilled foods, refrigeration, milling, canning, fermentation, food additives

Introduction

Archeology shows that humans have been alive and active in many parts of the world for several hundreds of thousands of years. Food supplies moved gradually over many centuries from hunter-gatherer and nomad status to the domestication and selection of plants and animals, allowing populations to become more fixed, and to establish permanent villages, towns, and eventually cities. Food habits were developed based on the foods available in different parts of the world, the use of fire, fermentation and other food treatments to make many plant and animal derived foods more palatable and more easily digested, on genetic variations among different population groups. Cultural developments were often based on different beliefs, nature observations, and political structures.

Local and world population also played an important role in the development of food supplies, trade in food, and cuisine. Population growth estimates show that the world population 2000 years ago was about 30,000,000; 1000 years ago, it was 31,000,000; and 100 years ago 1,650,000,000. In 2000 it was estimated that the world population was 6,060,000,000 people. This exponential growth of world population over the past 100 years, along with improved economies, better information technology, and increased travel between different parts of the world, have had a dramatic effect on agricultural resources, on food supplies, and on food habits, local cuisine, and on the spread of different cuisines around the world.

As the world population has grown, many people have moved from rural areas to larger towns and cities, and better economic, health and education possibilities in urban areas have also contributed to urban population growth. Urban growth has also had a dramatic effect on how foods are produced, stored, processed and marketed since most city people are involved in activities other than raising food. Transportation systems for food, wholesale and retail markets, restaurants, canteens for workers and school feeding programmes all have had an effect on how food is produced and utilized.

As world population grew, and particularly in the past two centuries, migration of people occurred from one part of the world to other areas as manufacturing industries grew, new areas of land were developed for agriculture, mining, etc, all requiring larger work forces. As people moved from one area to another for work purposes, they brought along with them the culture, food habits and cuisine from the regions of their origin. Many of these food habits and culinary systems were adopted in other countries, so that at present foods and food service systems in many parts of the world have a very wide choice of different foods and menus available. Different menus and foods from Europe, Africa, the Middle East, Asia and the Americas can be found in many other countries and areas. Current availability of information about different foods and cultures, advertising, and more adventurous food choices by consumers has also added to the variety of foods and cuisines available.

All countries produce foods, but virtually no country is completely self-sufficient in agriculture so that it can produce all of the food items that are used in local diets, or are used in animal feed for producing cattle, poultry and fish. Most countries have seasonal production of different foods, and in many cases temporary surpluses of different food crops or products, requiring storage that will prevent post-harvest food losses, and enabling trade in surplus foods or food products in domestic markets, or between countries.

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With the growth of urban areas and a shift from older systems of local trading, and the lengthening of food supply lines from short, local distances to thousands of kilometers in many instances, preservation or proper storage of foods has become more important, and protecting and preserving the quality and safety of foods has become very important. Local, national, and international standards, laws and rules for foods have been widely developed, along with government and food industry systems to assure compliance with these rules. Consumers of foods and food products, whether at home or outside the home are faced with the challenge of accepting foods that may have a number of quality or safety problems that can not be detected by visual inspection. Excess water in foods, short weight, contamination with pathogenic microorganisms, excessive pesticide residues, mycotoxins and other contaminants can not usually be detected by consumers, but must be controlled by governments and industry.

How contemporary food technologies influence cuisine

Food technologies encompass a very wide spectrum of activities related to foods from basic production techniques, through harvest, transportation, storage, processing and marketing, including wholesale marketing, retail marketing to consumers, or the production and provision of foods in restaurants and other food service establishments.

With the growth of world population, the formation of large towns and many very large cities with populations of more than 1,000,000, providing adequate amounts of affordable and good quality and safe foods and food products that meet local demand is a constantly changing and expanding challenge. Consumer food selections based on taste, texture, convenience and other factors such as possible food safety problems and dietary advice about better nutrition and health protection have also led to changes in foods and food systems. Some traditional foods such as yogurts, tofu and various herbs and spices have become more popular with a wider range of consumers, and newer technologies such as pasteurization, irradiation and mechanical refrigeration, have created new products such as tofu ice cream, to meet new consumer demands and desires. Other more traditional systems for food preservation such as fermentation and pickling of vegetables and meats, salting of fish, meats and meat products, smoking of meats and fish, have all been altered to reduce salt content, increase desirable traits such as "mouth feel", crunchiness of preserved vegetables, and reduce nitrates and nitrates in animal products. Usually these changes are accompanied by different systems of food storage such as refrigeration to prevent bacterial growth, and preserve quality and safety.

The following is a brief description of other food technologies that have an influence of foods, their availability, nutritive value, quality and safety.

Fruit, vegetable, cereal and animal production

Technologies to enable farmers, and providers of fish to produce enough and varied foods to adequately feed over 6,000,000,000 people every day include production of better seeds, provision of organic and inorganic fertilizers, tillage systems to preserve topsoil and properly use scarce water resources, judicious and legal use of pesticides and animal drugs, and the use of new development of plants and animals using biotechnology. There is a tremendous need for training of people involved in food production so that they are familiar with and can use the best food production methods available to maximize yields and assure efficient and sustainable production that provide foods that markets desire. As food habits change locally and internationally the challenge to adapt production processes to meet new and changing demand is a constant challenge. The work of the farmers, fish providers and the food transformation industry is often not fully appreciated by the public or policy makers, but without well-informed and efficient food producers, we would all starve.

Food storage

Foods are susceptible to spoilage due to a wide range of factors (including improper moisture content or being dampened with water for dried foods) such as moulds, rots, bacteria and other spoilage microorganisms, rodents, birds, insects, and improper temperature control (too hot, too cold). Over the past centuries more durable products such as cereals that are basic and staple foods for most of the world's population could be dried and stored in grain storage bins, or roots and tubers could be stored in cool places such as cellars and caves to extend the period of usefulness as food, or as seed for coming planting seasons, throughout the year.

With new food demands and food systems, there is a need for food markets in most parts of the world to have a wide range of foods available throughout the year, even during periods when these foods were not usually available some years ago. As noted above, most food products have been usually available during harvest periods, particularly fruits and vegetables. However consumers in many countries have grown to expect a good supplies of all foods throughout the year, and this requires new techniques of food storage to preserve products so that they do not deteriorate or spoil, and also the development of production areas in other countries or hemispheres where production periods are longer, or harvest seasons vary due to climate and seasonal differences.

Producing and preserving the amount of grains, other cereals, roots and tubers that provide the basic carbohydrates and some of the proteins needed as staple foods in all diets is a monumental task, given the growth in world population, and projected growth to over 8,000,000,000 by the year 2050. Cereals such as rice, wheat, maize, sorghums, can be stored in silos or other forms of secure storage for many months if the moisture content of the grains is low enough to prevent mould growth. Cereal storage facilities must be rodent proof, be designed to control insects, and kept dry so that moulds cannot grow. There has been a dramatic change in the technology used for grain storage over the past 50 years, helping to prevent post-harvest losses of grains that did range up to 40% of total crops in many countries in earlier years, or at present in some developing countries. In addition to use as human foods, there is a

great and growing demand for cereals as the basis for animal feed for beef cattle, swine and poultry, and in this area losses of grains must also be controlled. The newer types of grain storage systems have greatly improved the basic quality of grains used in food products such as pasta, noodles, bread, and of rice. This is also true of other dried products such as lentils and beans that provide basic energy and proteins to diets.

Tubers such as potatoes and root crops such as turnips, carrots, beets, rutabagas can be stored for relatively long periods in cold storage so that they are available as foods during winter months in colder climates. Cold storage for these crops can be natural, such as cold cellars or caves, or artificially cooled. Changes do occur in the moisture content and freshness of these crops during long storage periods, and these potential changes have to be controlled to assure good eating quality. Rots and moulds are potential problems, especially in naturally cool storage places such as cellars and caves where control of temperature and moisture can be a problem.

Storage of meat and other animal products, milk and milk products, cheeses, fish, and many fruits and vegetables require special refrigerated storage spaces. Most of these products require cool, but not freezing, temperatures. Some retain basic quality better under special atmospheric conditions to retard aging of the products. Given the amount of products that are harvested in certain periods of the year, and the demand for these products throughout the year, storage capacities must be huge, and shipping done under temperature-controlled circumstances as well.

Frozen foods

Many foods and food products can also be frozen, such as meats, or fruits and vegetables, after some minimal processing (blanching) to stop enzymatic processes than would cause deterioration or storage problems. Frozen products must be carefully packaged to avoid loss of moisture and "freezer burn" while in the frozen state. Cooked products that were previously frozen do not always have the same taste or texture as products cooked immediately after harvest, but freezing technology has been improved so that these products are often much closer to fresh foods in taste and texture, after heating or cooking, than canned products.

Dried foods

Many food products can be dried to preserve food value and greatly extend shelf life. Dried milk is a very good example, and is widely used in feeding programs, and as an ingredient in many processed foods. Spices, beans and lentils, fish, tree fruits such as dates, nuts, and many other foods can be dried. The drying process can change the taste of all foods, when consumed dried, or when mixed with water to produce liquid products such reconstituted dried milk. The contribution of dried food products and cuisine can be quite different from these foods when consumed as fresh products.

Milling

Although cereals are staple foods, and have been for many centuries, humans have digestive difficulties in consuming wheat, rice, corn, millet, or other cereals. The reason for this is the hard husk that covers these cereals and protects them in the field from insects and other pests. The fibre in the husk is not digestible. In addition, the seed germ is quite fatty, and can cause rancidity in ground cereals. Grinding the cereals, and processing them to remove the outer husk and the fatty germ, results in more pure starch and protein, which are integral parts of all cereals, but are more digestible than whole grains, providing essential energy and protein to people. The husk (bran) removed from cereals can be used in animal feed, and the germ can be used in feed, or in many cases, as a source of oil for cooking or as a food ingredient, such as corn oil. Milling cereals to remove the husk also reduces the amounts of micronutrients such as B vitamins in the finished ground product, and in many countries flours are enriched by adding back to them the vitamins and minerals that are removed in the milling process.

Cereals and cereal products have been an essential part of the cuisine in all parts of the world for centuries. Milled rice is the most consumed carbohydrate in the world. Wheat and corn flours are staple foods in Africa, the Middle East, Europe and the Americas. The technological changes to milling processes over the past 75 years have enabled the extraction of more or less pure starch and protein from cereals, and the retention of some of the micronutrients by parboiling in the case of rice, before milling. As mentioned above, enrichment of cereal products is an important technology to assure that these staple foods not only provide needed energy, but also contain essential vitamins and minerals that might otherwise not be present in sufficient amounts in cereal-based diets to prevent micronutrient deficiency diseases.

Baking/oven heating

Many food products are baked prior to their being marketed or consumed. The use of ovens to bake breads, and roast meats and vegetables is a very old technology. Bread making in ovens dates from about 3,000 A.D. on the basis of ovens and records from Egypt. Roasting of meats and other foods is also a very old technology. During these ancient times people developed methods for changing the taste, smell and texture of raw foods and food mixtures by baking or otherwise exposing these products to heat for controlled periods of time. The browning and drying that accompanies the heating of foods is highly desired by most consumers, and the recipes used in most cuisines require use of heat for many aspects of overall cuisine preparation.

Newer technologies involved in heating foods include better systems for broiling foods, and the use of microwave technology to quickly cook, thaw, or reheat many foods. The contribution of these technologies to cuisine development has been widespread, and very useful. In most cases the finished foods produced using these

techniques are not easily distinguishable to other more time and energy consuming methods of heating foods.

Canning

About 150 years ago the process of heating foods in hermetically sealed containers was developed in France. This was quickly recognized as a convenient way to preserve foods that otherwise might not be available at times other that harvest periods. Canning in metal or glass containers spread rapidly to many countries and has been used to preserve meats, other animal products and fruits and vegetables. Heating of the filled containers can be done on a batch basis in large steam heated autoclaves, or for products of high acidity such as tomatoes, in continuous cookers. For all canned products, care must be taken to assure adequate temperature to kill all pathogenic bacteria such as Clostridium botulinum, or spoilage bacteria that have high heat resistance.

While canned foods are used in a variety of cuisine selections, the changed taste and texture of the canned products must be taken into account in using them in food preparation. Unless consumers are used to the taste of the canned product, they may reject the product containing canned ingredients if they are normally used to the use of fresh products. On the other hand, some canned products are so widely used, such as canned tomatoes in pasta, that dishes made with fresh tomatoes are often not well appreciated. Thus in this case, technology has caused a change in consumer acceptance so that older technologies have fallen into disuse.

Canned drinks

A special area of canning involves canned drinks. These can be fruit juices, vegetable juices, soft drinks that can be carbonated or still (non-carbonated), and alcoholic beverages such as beer. All of these products have to be heat treated or otherwise preserved so that micro-organisms cannot grow in them. Additives such as benzoate can be used in preserving soft drinks, and carbonation also helps in preserving cola-based drinks. Soft drinks can be sweetened with sugar or high fructose syrups, or with non-nutritive sweeteners such as cyclamates, saccharin or aspartame. Canned drinks are used in many diets and in between meals in many parts of the world, and can be an important source of calories and safe water in areas where the public water supply is not safe to drink. The growth in the marketing and consumption of these drinks over the past 50 years has been phenomenal and they have had an impact on the fluids content of many cuisines.

Preserves and pickling

Preserves of fruits and vegetables, and some meat and fish products have been prepared for several centuries. Boiling fruits in a sugar solution to remove some of the water from the fruit, and the increase in the viscosity of the resulting mixture so that the fruit remains firm, but growth of microorganisms is inhibited by increased osmotic pressure of the mixture. Fruit preserves can still support mould growth on their surface, so it is necessary to keep these products chilled after opening the jar or tin in which they are normally sold to avoid mould growth.

Preserved meat and fish products, plus pickled vegetables usually utilize brine solutions or vinegar as preservatives, after some processing to remove excess water, fermentation for some pickles and cabbage, and mixing with spices or other products. The technologies used in making preserves and pickled products have not changed dramatically over many years.

Fats and oils and frying

In older technologies, fats and oils were mainly extracted from animal products. Tallow, lard and other animal fats, including fat from milk were used in cooking, in making bread and other baked products and in other food products. Olive oil was pressed from ripe olives for many centuries. Relatively crude edible oils were extracted from coconut and oil palm.

Using newer technologies, most other commonly available fats and oils such as oil from peanuts, soy, cottonseed, safflower, corn and other processed cereals are relatively recent additions to the overall supply of available fats and oils. The technology used in preparing most vegetable and cereal derived oils is complex, and requires isolation of the fat containing portion of plants. Fats are obtained by cooking the entire seed or fat-containing parts of it, and using solvents or presses to remove the oil from other parts of the plant. Vegetable oils are often further processed using steam to remove odours from the oils, and excess acidity is countered by use of alkali, and unwanted fatty acid components are removed to be used in making soap, while edible oils are separated into fats for human consumption, or for use in animal feed. The residue of vegetable matter from which oil is pressed is usually of a high protein content, and can be used in both human food and animal feed.

Frying of foods in oil is an old technology, and has been used for many centuries. Fats can be heated to higher temperatures that water (for boiling) and used in cooking many products, including starchy foods, vegetables and meats or fish to give a desirable taste, smell and texture. Deep-frying involves immersing foods entirely into highly heated oils and helps to rapidly cook foods and seal in flavours. References to frying of foods can be found in literature for more than 2,000 years.

Extrusion technology

Foods such as corn, peanut meal and many cereals can be made into mixtures of starch and protein fractions, with sugar or food additives included, and put through a heating and pressure system using screw mills to produce high levels of temperature and pressure in the mixtures. The screw mills push the mixture forward under constantly higher pressure until the mixture exits the mill through a die that extrudes the product in a distinctive form. The high levels of pressure and temperature break down starch globules in the mixtures so that they are more plastic, and the sudden release of pressure on extrusion from the mill allows the formation of steam bubble that quickly expand and dry the extruded product. Many commonly consumed products such as corn chips, and many puffed products used as snacks or as meal components are produced through extrusion technology.

These products represent the use of a relatively new technological process that has added to many cuisines.

Additives

Food additives have been used for many centuries in the form of vinegar or oil to preserve foods. In the 20th century advances in chemistry, and a better understanding of food chemistry led to the development of many different chemicals used as additives in foods to help in preservation of the foods, to retain or add color to foods, to emulsify food ingredients, or serve many other food preservation and process food improvement functions. Most processed foods contain some food additives, and pre-market safety clearance procedure systems are required for additives in most countries so that they will not cause any food safety problems. The newer food and chemical technologies used in producing and using additives are essential to the current day food supply in most parts of the world.

Fermentation

Fermentation has been used for centuries to improve the nutritional quality of foods, to preserve foods or some desirable parts of foods, and to generally change the taste and texture of foods. Fermentation can involve the use of yeasts or bacteria, with different results. Fermentation of carbohydrates and sugars using yeasts to produce alcohol in beers, wines and related alcoholic beverages is a very old technology. Beer production has been somewhat expanded over centuries from opaque beers that include the residues of the main carbohydrates to clarified beers such as lager beers and ale. Similar fermentations of fruits and some vegetables result in alcoholic beverages such as hard cider from apples, and when distilled, fruit flavoured liqueurs such as kirsch from cherries, plum brandy, etc. Further fermentation technologies can be used to turn alcohol containing products into vinegar.

Fermentation with certain bacteria can promote the coagulation of proteins in products such as yogurt, and use of bacteria or moulds can produce lactic acid in products such as pickled vegetables, notably cucumbers. Yogurt, many cheeses and pickled vegetables have been produced using fermentation for many centuries.

In Asia, and in China in particular, fermentation of roasted soy meal using first Aspergillus mold, followed by brining and fermentation with Lactobacilli bacteria and yeasts has been used for centuries to produce soy sauce, a very popular addition to the basic cuisine of many Asian cultures. Other, but similar fermentation techniques are used on protein and carbohydrate sources to produce popular sauces and other products. In China recently there have been trials to use soy sauce containing bio-available iron (as Iron-EDTA) as a vehicle to combat problems of anemia III.

Conclusions

This paper has examined the influence of food technologies on cuisine. It is clear that developments in food handling, production, processing, and in food service over many centuries, has had a profound influence on how foods are prepared and consumed. Many different types of food systems and different cuisines have evolved in different parts of the world due to available food supplies, traditional or new ways of preparing foods, and the spread of dietary habits and cuisine from one part of the world to another. Humans are able to adapt to many different foods and food habits, and at present in urban areas in many countries many different types of cuisines are commonly consumed, in the home, and outside the home. Food technologies of many different kinds help in assuring the availability throughout the year of adequate supplies of a wide range of good quality and safe foods.

References

Due to the broad nature of this paper, most of its content has been drawn from the experience of the author. There are several thousand references that could be cited, but this would be counter-productive to the broad review nature or the paper. A few references that were consulted in preparing this paper, and will help in further exploring the topics covered are:

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传统和当代食品技术对烹饪的影响

Contemporary food technology and its impact on cuisine

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本文总结回顾了目前所使用的食品加工技术及其对食品质量和安全性的影响。同时也阐述了这些食品加工技术对世界人口规划、国家和国际范围内预防城市食品短缺、食品保藏和食品贸易等方面的影响。所论述的这些食品技术是关于食品储藏、冷冻、冷藏以及研磨、培烤、罐藏、腌制、挤压和发酵等技术，另外也包括各类食品以及各种食品组分，如水果、蔬菜、动物制品、脂肪、油脂以及罐藏食品和食品添加剂等方面的技术。

This article contains a general review of current food technologies and their effect on the quality and safety of foods. The uses of these technologies in the context of current and projected world population, urbanization prevention of food losses, preservation and trade of foods, domestically and internationally are briefly reviewed. Technologies discussed are related to food storage, refrigeration, frozen foods, milling and baking, canning, pickling, extrusion processes, fermentation, and to foods and food ingredients such as fruits and vegetables, animal products, fat and oils, canned products, and food additives.

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