THE FOOD INDUSTRY is the world’s largest industry. In the United States alone, more than $1 trillion is spent annually on food. That is roughly 10 percent of the gross domestic product (GDP). In addition, the industry employs more than 16.5 million people.

**Objective:**

- Give an overview of the food industry.

**Key Terms:**

- agricultural production
- blanching
- dehydration
- distribution
- emulsion
- evaporation
- extrusion
- food chemistry
- food microbiology
- food physics
- food processing
- food safety
- freezing
- frying
- homogenization
- hurdle
- irradiation
- marketing
- microwaving
- pasteurization
- refrigeration
- regulation
- sterilization

**An Overview of the Food Industry**

The food industry is a large, complex collection of businesses and institutions that provide food for the world’s population.

**COMPONENTS OF THE FOOD INDUSTRY**

Components of the food industry include agricultural production, food processing, research and technology, marketing, distribution, regulation, financial services, and manufacturing.
**Agricultural Production**

*Agricultural production*, or farming, is the use of land and other resources to grow crops and raise animals.

**Food Processing**

*Food processing* is the transformation of crops, animals, and other ingredients into food. Crops are harvested and animals butchered. Mechanical procedures, such as mixing, grinding, chopping, and emulsifying, are used to process food. Various food preservation methods, cooking procedures, and cooking techniques may also be involved. Spices and other additives may be added during the processes.

Food processing has many benefits. Toxins are removed; foods are preserved, making marketing and distribution tasks simpler; and greater food consistency results.

Processing can have an adverse effect on food nutrition. For instance, heat applied during canning reduces the vitamin C content of fruits and vegetables.

**Research and Technology**

Research and technology are important to the food industry. Applied technologies, such as GPS and genetic engineering, increase agricultural production. Computers have improved the efficiency of all aspects of the food industry.

**Marketing**

*Marketing* is the activities or processes that create, communicate, deliver, and exchange products and services of value for customers. The marketing industry includes research, advertising, distribution, and sales. It is very complex.

**Distribution**

*Distribution* is all the activities associated with the transport of food products to where they can be used.

**Regulation**

*Regulation* is the implementation of local, regional, national, and international rules for food production and sale. Food quality and food safety are primary concerns behind regulation.
Financial Services

Financial services are those services related to banking, insurance, and other monetary matters associated with the food industry.

Manufacturing

Manufacturing involves the production of materials and equipment used to produce, process, and distribute food. Examples of such materials and equipment are fertilizers and pesticides; tractors; food processing equipment, such as fermentation vats and mixers; and equipment used to transport food.

PRINCIPLES OF SCIENCE APPLIED TO FOODS

Many scientific principles are applied in the food products and processing industry. Three significant fields of science are chemistry, physics, and microbiology.

Food Chemistry

Food chemistry is the study of the substances of which food is made. Elements, or building blocks, combine to form compounds. Table salt, or NaCl, is a simple compound. Other food compounds are much more complex. The major compounds that make up food are water, lipids (fats), proteins, and carbohydrates. Vitamins and minerals are other essential compounds found in smaller amounts. Food additives, such as colors, thickeners, and preservatives, have certain chemical properties as well.

Water is a universal solvent and is essential for life.

Lipids (fats) are made of fatty acids. Fats play an essential role in the diet. They maintain the cellular membranes of all cells in the body. Fat is an efficient energy storage unit. Fat stored under the skin provides insulation.
Proteins are complex molecules made of amino acids. Proteins are used by the body for maintenance, growth, reproduction, and other functions.

Carbohydrates are compounds made of simple sugar molecules. The energy stored in carbohydrates fuels most biochemical activities in the body.

Vitamins are complex substances needed in very small amounts.

Minerals are inorganic substances essential for human growth.

**Food Physics**

*Food physics* is the study of food ingredients and heat or kinetic energy. Foods are heated, and foods are cooled.

**Food Microbiology**

*Food microbiology* is the study of microorganisms and their effect on food. Some microorganisms are undesirable—for example, molds, yeasts, bacteria, and viruses that can cause spoilage of foods. Other microorganisms are useful—for example, yeast used to make bread rise or bacteria used in cheese making.

**SELECTING AND PROCESSING FOOD PRODUCTS**

Harvested food is selected and processed before storage, transportation, and consumption.

---

**ON THE JOB...**

**CAREER CONNECTION: Product Development Food Scientist**

Product development food scientists study food. They analyze the nutritional content of food and research ways to make processed food safe and healthy. They apply findings from research to develop new or better ways of selecting, preserving, processing, packaging, and distributing food.

Product development food scientists design, develop, and test food processing methods and food processing equipment. They monitor production processes. When a process is not working as expected, they identify the cause and correct the problem.

Product development food scientists need at least a bachelor’s degree from an accredited postsecondary institution in food science, nutrition, or food engineering. Many get a master’s or doctoral degree.

These food scientists are vacuum sealing hotdogs for irradiation. (Courtesy, Agricultural Research Service, USDA)
**Food Selection**

The selection process includes the assessment of the raw material. Foods such as meat and produce are given quality and yield grades. With the help of industry, the United States Department of Agriculture (USDA) has established quality and yield grades for meat.

According to the USDA, quality grades are determined by marbling and overall maturity. They predict the palatability of the lean. There are eight quality grade designations: Prime, Choice, Select, Standard, Commercial, Utility, Cutter, and Canner.

USDA yield grades are an indication of cutability, or yield of boneless, closely trimmed retail cuts. The yield grade of a carcass is determined by (1) external fat, (2) kidney, heart, and pelvic fat, (3) rib-eye area, and (4) hot carcass weight. Yield grades measure the combination of fat and muscle, not just fat.

U.S. Grade Standards provide the produce industry with a uniform language for describing the quality and condition of commodities in the marketplace.

**Processing Methods**

Two primary methods of processing food are chemical and physical.

**Chemical Processing Methods**

Chemical processing methods involve intermediate moisture foods, water activity, addition of chemicals, and pH control.

Intermediate moisture foods are foods that have undergone a process that involves binding the water present in the foods for the purpose of preservation. Examples are cookies, bread, and cakes.

Water activity is a measure of the availability of water in a food that affects microbial, enzymatic, or chemical activity. Control of water availability determines the shelf life of foods.

Chemicals may be added to food to inhibit microbial growth. These include preservatives, as well as salt, sugars, wood smoke, and some spices that inhibit the growth of microorganisms.

The pH, or acidity, of the food can be altered to limit the growth of microorganisms.

**Physical Processing Methods**

A number of physical methods are used for processing foods, including blanching, dehydration, emulsion, evaporation, extrusion, freezing, frying, homogenization, hurdle, irradiation, microwaving, pasteurization, refrigeration, and sterilization.

**Blanching** is a slight heat treatment. Typically, hot water or steam is applied to vegetables before canning or freezing them.

**Dehydration** is the nearly complete removal of water from solid foods. Examples of dehydrated foods are dried soup mixes, dried fruit, powdered milk, and spices.

**Emulsion** is a process in which two liquid phases that do not mix are combined by dispersing one throughout the other in the form of very small droplets. An example of oil-in-water emulsion is salad dressing. An example of water-in-oil emulsion is butter.
Evaporation is the partial removal of water from liquid foods by boiling. Examples are evaporated milk, tomato paste, and juice concentrates.

Extrusion is the process in which a food is compressed and worked to form a semisolid mass. The mass is then forced through a restricted opening to create a desired texture or shape. Licorice, puffed wheat, and cornflakes are products of extrusion.

Freezing is the solidification of moisture in food through chilling. Freezing greatly slows the growth of most microorganisms.

Frying is the cooking of food with hot oil. The cooking is completed in a relatively short period.

Homogenization is a process to stabilize an emulsion. Milk is homogenized to improve its stability, and most caramel fillings are homogenized to increase their smoothness.

Hurdle, or combination processing, is a process that involves a variety of mild preservation techniques used in combinations to eliminate the growth of microorganisms. The aim is to provide more natural, freshlike foods.

Irradiation is the application of low doses of gamma radiation to food products.

Microwaving is the use of electromagnetic radiation to excite and heat water molecules in food. Microwaving is used with small food quantities.

Pasteurization is the process of heating a food to or below its boiling point for a defined period to destroy all pathogens, reduce the number of bacteria, inactivate enzymes, and extend the shelf life of a food product. This process usually involves a liquid, such as milk or spaghetti sauce.

Refrigeration is the cooling of food usually to between 1°C and 4°C to slow the growth of microorganisms. Refrigeration reduces spoilage, increases the holding period between harvesting and processing, and extends the storage life of commercially processed foods.

Sterilization is a processing method that involves heating to destroy all pathogenic and spoilage microorganisms in foods and to inactivate enzymes. Canned foods are sterilized.

FOOD SAFETY

Food safety is a scientific discipline pertaining to the handling, preparation, and storage of food in ways that prevent foodborne illness. Food safety is the responsibility of many people. Producers, shippers, processors, distributors, handlers, and numerous others play important parts in seeing that food is safe to eat.

Food hazards are biological, physical, or chemical properties that may cause food to be unsafe for human consumption. The goal of food safety is to limit these hazards.
Animals and plants raised for food may contain microscopic organisms. Under the right conditions and in the right numbers, some of these organisms can cause illness. Raw meat, poultry, fish, shellfish, and eggs often carry bacteria, viruses, or parasites that can be harmful to humans.

Food can be transported great distances and be handled many times before it reaches the consumer. During that period, it may be exposed to microorganisms or become contaminated by toxic chemicals. Physical objects or substances, such as metal fragments or soil, may also contaminate food.

**Federal Agencies**

Four major federal agencies are involved in food regulation and safety.

The USDA is the oldest federal agency that monitors the food supply in the United States. The mission of the USDA is to ensure people a safe, affordable, nutritious, and accessible food supply.

The Food and Drug Administration (FDA), within the United States Department of Health and Human Services (DHHS), is responsible for safeguarding all ingredients used in food products, approving new food additives, monitoring ingredients and foods to see that they are contaminant free, and monitoring dietary supplements, infant formulas, and medical foods for safety. It also oversees food labeling and requires that food product labels be informative, truthful, and useful to the consumer.

The Centers for Disease Control and Prevention (CDC), under DHHS, works with state agencies, private organizations, and other federal agencies to provide reliable health information, primarily in the area of disease prevention. CDC’s Food Safety Initiative Activity focuses on the prevention of foodborne illness through improved systems for disease surveillance and outbreak response, as well as through research, training, and education.

The Environmental Protection Agency (EPA) regulates pesticide usage and oversees water quality standards.

**Summary:**

The food industry is a large, complex collection of businesses and institutions. Components of the food industry include agricultural production, food processing, research and technology, marketing, distribution, regulation, financial services, and manufacturing.
Three significant fields of science associated with the food products and processing industry are chemistry, physics, and microbiology.

Harvested food is selected and processed before storage, transportation, and consumption.

Two primary methods of processing food are chemical and physical. Chemical processing methods involve intermediate moisture foods, water activity, addition of chemicals, and pH control. Physical methods include blanching, dehydration, emulsion, evaporation, extrusion, freezing, frying, homogenization, hurdle, irradiation, microwaving, pasteurization, refrigeration, and sterilization.

Food safety is a scientific discipline pertaining to the handling, preparation, and storage of food in ways that prevent foodborne illness. Four major federal agencies involved in food regulation and safety are the USDA, the Food and Drug Administration (FDA), the Centers for Disease Control and Prevention (CDC), and the Environmental Protection Agency (EPA).

Checking Your Knowledge:

1. What are the major components of the food industry?
2. How is science involved in food processing?
3. Why are foods selected and graded?
4. What are methods of processing foods?
5. What is the role of government in food safety?

Expanding Your Knowledge:

Select a food you really enjoy, such as milk, McDonald’s® French fries, or fresh strawberries. Conduct research on the food, and trace its path from production through processing, marketing, and distribution.

Web Links:

- Introduction to the Food Industry

- Foods for Trade

- The U.S. Food Safety System
  [http://usgovinfo.about.com/od/consumerawareness/a/The-Us-Food-Safety-System.htm](http://usgovinfo.about.com/od/consumerawareness/a/The-Us-Food-Safety-System.htm)