Part 1A

From raw materials to consumer: chemical, microbiological and technological aspects of food

chapter one

Introduction to the raw materials of food

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1.1 Introduction

Food is of fundamental importance to life. It is necessary for development and functioning, including maintenance and reproduction. On average, man consumes 30 tons of food during his lifetime; this is consumed in many basic dietary versions, varying at local, national, and international levels. Also, diet is related to social class. It is easy to see the difference in character between french fries and stew on one end of the scale and delicacies such as pâté de foie gras, filet steak, and quail eggs at the other. However, digestion splits all these foods into the same basic nutrients. The differences lie in quality, shape, and flavor only.

Basically, food is a mixture of chemicals. Usually, food components are distinguished in four categories: nutrients, toxins of natural origin, contaminants, and additives. The nutritients account for more than 99.9% of the food. The main classes of nutrients are carbohydrates, proteins, fats, vitamins, and minerals, and all of them may pose toxicological risks to the consumer.

In the course of evolution, through trial and error, man has learned to handle those foods that would cause acute adverse effects. Further, he has developed processing methods to eliminate or reduce toxicity in a number of cases. Cooking and other common means of food preparation effectively destroy many of the major toxic components, particularly those found in important plant foods.

Most of the food is treated in some way to improve its shelf life, texture, palatability or appearance. It would be difficult to change this situation. So, it is important to know what happens to the various food components on the way from raw material to consumer. The food industry is a large, continuously expanding industry. Although there are people who would like to do without industrially processed food and go back to nature, this is not possible on a large scale from a socio-economical point of view. The majority of the population depend on the food manufacturing industry for their daily food supply.

1.1.1 History of food manufacturing

Since the time when man settled in one place and became dependent on cultivated crops and animal husbandry for their food, the need for storage and preservation was evident. Grain and root crops could be kept reasonably well during winter, but products of vegetable, fruit, or animal origin could not be stored for long. Through experience, man learned to preserve perishables by drying, smoking, pickling, candying, and fermenting. Gradually, food manufacturing became a craft with the emphasis still on preservation. People began to specialize in food manufacturing for other people, without understanding the (bio)chemical and microbiological mechanisms underlying the processes involved. How to bake bread, to cure ham, or to make cheese has been known since ancient times, but it was not until 1857 that Pasteur could clarify the metabolism of the microorganisms involved. In 1912, Maillard first published on the browning reaction between sugars and amino acids, now known as the Maillard reaction.

In the 19th century, industrialization set in, and society changed with it. The population began to grow and large industrial areas developed. People became separated from the sites of growth, manufacturing and preservation of their food. This development was possible because new food preservation and production methods were developed, and old and new methods were made suitable for application on a large industrial scale. For instance, in 1809 Nicolas Appert discovered that food can be preserved by heat treatment. At first, the food was heated in glass vessels. About 50 years later tins were introduced in the U.S., while in that same period, Nestlé started the production of condensed milk and powdered milk by concentrating milk through evaporation. The development of methods for the extraction of sugar from sugar beets and the production of a butter substitute from vegetable oils and cheap animal fats, i.e., margarine, also took place in the 19th century.

Initially, these industrial processes were rather unsophisticated and poorly manageable. The sensoric quality of the products was often unsatisfactory, as they lost some of their color, flavor, and texture. New insights in organic and analytical chemistry, as well as in biochemistry, the nutritional sciences, microbiology, toxicology, and technology have been applied to industrial food processing since its first steps. The modern food industry is capable of manufacturing a wide variety of safe food products of high nutritional value and good quality, with great efficiency.

1.1.2 From raw materials to consumer

Food processing can be regarded as the conversion of raw agricultural material into a form suitable for eating. The first step is collecting or harvesting the raw material. This is primarily carried out by the producer. The time of harvesting is influenced by the ultimate purpose of the raw material; quality and ripeness are important for the efficiency and result of food processing. The raw material is transported as rapidly as possible to the site of manufacturing or to the shop so that there is as little deterioration as possible.

The next step is often separating the actual foodstuff from the bulky and indigestible material. The extraction of fats and oils, sugar, flour and starch, vitamins or natural colors and flavors are examples of this step. These refining processes are carried out almost exclusively on an industrial scale.

In the next step from raw materials to consumer, the raw materials and purified components are converted to palatable food products. A diet of fruit, milk, eggs, vegetables, grains, and meat in their raw state can meet all our physiological needs, but they

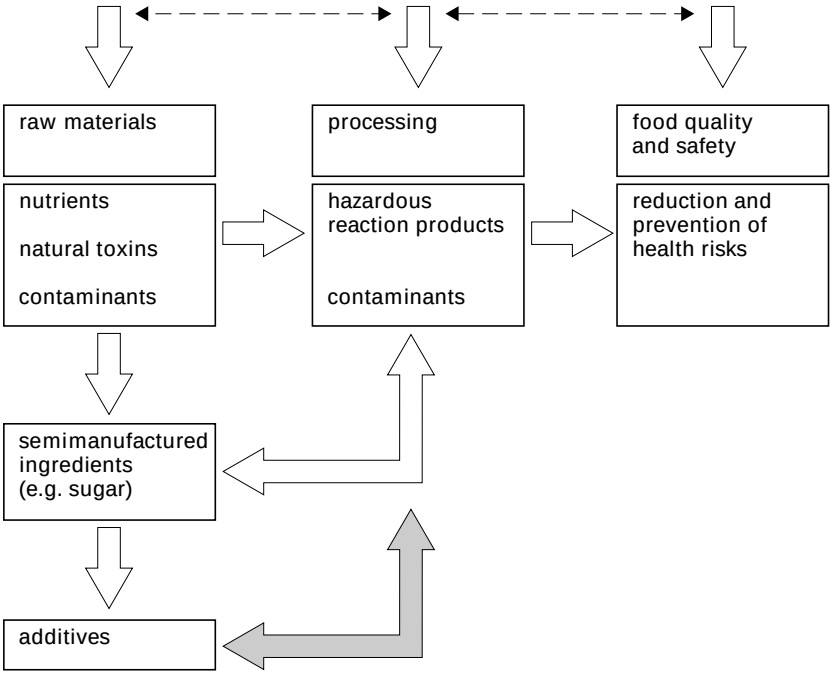

Figure 1.1 Food: from raw material to consumer.

can also be made into a wide range of tasteful and appetizing food products, which make eating them a much greater pleasure.

Traditionally, most of the food is prepared at home. The majority of modern consumers prefer to buy pretreated food which is easily stored and prepared at home. Changes in society, such as more women working away from home, falling birth rate, aging of the population, in combination with familiarity with foreign cultures, influence the modern food supply. Recently, food products with special characteristics, desirable from a nutritional or social point of view, have been developed. These include products containing less saturated and more unsaturated fat, fewer calories, less cholesterol, and more dietary fiber. In general, the food processing industry appears to be willing to gratify the consumer's wishes.

The pathway from raw material to consumer is summarized in Figure 1.1. It shows the various processing techniques that are applied, the reactions that take place, and the quality characteristics that are important.

Part 1A deals with the effects of origin, processing, manufacturing, storage, transport, and preparation of food on the toxicological risks associated with the intake of food, including the formation of hazardous products and the adverse interactions with nutrients.

Since substances of natural origin are not always harmless and the toxicological risks associated with the use of man-made products such as additives have been estimated to be minimal, the four categories of food components are discussed in the following order: natural toxins (including microbial toxins, Chapter 2) and naturally occurring antinutritives (Chapter 3), contaminants (Chapter 4), food additives and the rationale for their use (Chapter 5), and nutrients (Chapter 6). The latter are discussed with the emphasis on the effects of processing on their nature and contents.

Reference and reading list

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