CHAPTER II

THE COMPOSITION AND FUNCTIONS OF FOOD

Those now in charge of the feeding of a nation are thinking of food not only as part of a meal, but as so much protein, fat, carbohydrate, mineral matter, and water and as a source of the necessary vitamins. Exports are frequently spoken of in terms of tons of protein or millions of calories. The private citizen is no less interested in the constituents of food and the food needs of the body. Such knowledge is the first essential of intelligent economy and conservation.

The brief general survey of the composition of food in this chapter is given as a preliminary to more detailed study in later chapters. Students who have studied foods will probably be able to omit this chapter.

Many foods contain most of the food constituents mentioned above. Some few, such as sugar or oil, contain only one. Students in connection with this work should look up the composition of numerous foods, raw and cooked and group them according to the predominating constituent.

I. Carbohydrates — the most important constituents of our food in point of bulk.

A. The important kinds.

1. Starch. This is eaten chiefly in grain products — in flours and meals made from wheat,
I. Carbohydrates (*continued*).

Corn, barley, and the other cereals. They all contain from 60% to 70% starch. Bread is about one-half starch and potatoes and sweet potatoes are approximately one-fifth starch. Some other vegetables and green fruit contain small quantities.

2. Sugars. Several of them are found in food—the ordinary sugar from cane or beet (chapter IX), glucose made from corn starch, and the sugar (lactose) in milk, all of which are similar but not identical. Fruits and many vegetables contain considerable amounts of the various kinds of sugar; e.g., a large orange or one-fourth cup of raisins may contain as much as two tablespoons of sugar.

3. Cellulose or crude fiber. This carbohydrate occurs in foods in much smaller quantities than starch or sugar. It is found in most vegetables and fruits and in such flours and other cereal products as contain bran.

B. Elements in carbohydrates.

Carbon, hydrogen, and oxygen. When carbohydrates, therefore, burn inside or outside of the body the products are carbon dioxide and water.

C. Fate of starch and sugar in the body.

1. Digestion:—Both are practically completely digested especially if the starch is cooked. If raw starch is eaten, however, such as that in
I. Carbohydrates (continued).

uncooked green bananas, some of the starch may escape digestion and utilization.

a. Starch is acted on by the saliva in the mouth, the action is continued for a time in the stomach, and the process is completed in the small intestines. The large starch molecule is broken up until the simple sugar, glucose, is obtained as the end-product.

b. Sugars are digested mostly in the intestines, giving glucose or similar simple sugars. Thus starch and sugars are ultimately changed to practically the same products in the body.

2. The products of digestion are absorbed into the blood. They are carried to the muscles or elsewhere and burned as fuel to maintain body temperature and to give energy for the body's movements. That which is not needed for fuel may be changed to fat and stored in the body.

D. The function of cellulose.

Cellulose is scarcely changed at all in going through the body. It serves as the indigestible residue or "roughage" of the food. A certain amount is desirable, as a diet which would be completely digested would be apt to cause constipation.
II. Fats.
   A. Source in the diet.
      They are obtained from isolated fats like butter, oleomargarine, and oils, and from foods containing fat like fat meats, cheese, milk, fried foods, rich cakes, and pastries. (See chapter VIII.)
   B. Composition.
      They contain the same elements as the carbohydrates — carbon, hydrogen, and oxygen, but in different proportions. The composition of all fats is very similar, whether liquid or solid, highly flavored or "bland."
   C. Fate in the body.
      They are digested and absorbed in the intestines. They may be stored in the body or burned to carbon dioxide and water.

III. Protein (see chapter V).
   A. Examples of nearly pure proteins. No food is composed only of protein, but some contain only water and mineral matter beside the protein.
      1. Cottage cheese made from skim milk is protein plus a fairly large amount of water and some mineral salts (21% protein and 74% water).
      2. Egg white is also almost entirely protein and water (12.5% protein and 87.1% water).
   B. Other protein-rich foods.
      Among the more important of such foods are lean meat, poultry, fish, legumes (peas, beans,
III. Protein (continued).

peanuts), and cheese. Cereals, while containing somewhat less protein than these foods, are a very important source of supply because of their large quantity in the diet.

C. Elements in proteins.

Nitrogen is the element of the proteins which gives them their value as distinct from other food constituents. Proteins also contain carbon, hydrogen, oxygen, sulphur, sometimes phosphorus and a few other elements, including iron.

D. Fate in the body.

1. They are digested in the stomach and intestines to small units (called amino acids).

2. The digestion products are absorbed into the blood and used for —

a. Growth or repair of all parts of the body. During the entire life of the body its constituent cells multiply to provide for growth and to replace the cells which degenerate and die. Proteins are important constituents of cells and must be supplied to them by the food.

b. Manufacture of the various body secretions.

c. Fuel.

d. Proteins, therefore, have a double function — they are fuel foods like the carbohydrates and fats and they are necessary for the body’s repair and growth.
IV. Mineral constituents or the ash of foods.

A. The inorganic elements in food.

These are calcium, sodium, potassium, iron, magnesium, sulphur, iodine, phosphorus, and chlorine. Compounds of them are left as ash when the food is burned.

B. Source in the diet.

1. They are present in all foods in the natural state, but sometimes are removed during processes of refinement, such as sugar and the oils undergo.

2. The quantities in food are small, but they are none the less important. The vegetables and fruits are among the most important sources, the content being highest in the leafy vegetables like spinach and cabbage. Milk is also important especially as a source of calcium. Egg yolks, meat, whole cereals, and many vegetables are high in iron. (See chapter XIII.)

C. Function.

1. They are essential for growth as a necessary constituent of the cell structure; e.g., of bones, teeth, nails, etc.

2. They must be present in proper amounts in the body fluids.

V. The "vitamines."

These are recently discovered and little known substances. They are as necessary for
V. The "vitamines" (continued).

health and growth as the other better known constituents of foods.

A. It is believed that there are two, both of which are present in various foods in minute quantities.

1. The fat-soluble A, so called because it is soluble in fats, is present in milk, in butter, in beef fat, especially in the fat within the organs, in egg yolk, cod liver oil, and in the leaf vegetables.

2. The water-soluble B is found in many products, milk, vegetables, fruits, meat, and whole cereals, but is absent from fats, sugar, and cereal products like white flour from which the outer parts of the grain have been removed.

B. A diet limited in either of these may cause a generally unsatisfactory nutritive condition, stunting of growth, disease, and even death. This is discussed further in connection with milk (chapter XII).

C. The ordinary mixed diet of the American people, provided it contains milk or butter and vegetables, is not likely to be low in these vitamines.

VI. Water.

A. The largest part of the majority of foods is water. It varies from about 90% in such vegetables and fruits as cucumbers, lettuce, apples,
VI. Water (continued).

etc., to about 10% in dry crackers and cookies and practically none in sugar and oils.

B. Water helps maintain the proper dilution of the body fluids and the cells. It assists in the elimination of body excretions. The drinking of considerable water is desirable. The old idea that drinking water with meals is harmful has been proved incorrect.

VII. A very useful and simple way to teach the proximate composition and use of foods is to divide them into five groups which emphasize similarities in composition and function (compare chapter XIV). Some overlapping is, of course, unavoidable.

A. Vegetables and fruits. Useful chiefly for mineral matter and the vitamins, and therefore for the growth, repair, and regulation of the body.

B. Meat and other protein-rich foods including milk. Their main function is as body-building foods.

C. Cereals. Primarily fuel foods.

D. Sweets. Eaten for flavor as well as fuel.

E. Fats. Fuel foods.

VIII. The digestibility of food.

The above brief statement of the constituents and digestion of foods does not take into consideration the completeness of the digestive process. Most foods are almost, but not entirely quite digested. A small, varying quantity is lost.

A. The coefficient of digestibility is the percentage of the food eaten which is actually lost.
VIII. The digestibility of food (continued).

B. Digestibility in this scientific sense must not be confused with ease of digestion, which depends to a large extent on the rapidity with which food passes through the digestive tract, especially the stomach, on the amount of food eaten, and on slight irregularities causing discomforts, such as the formation of gases. Ease or difficulty of digestion may have no relation to the amount ultimately digested, although it may have an importance of its own.

C. To determine the coefficient of digestibility of a food, — e.g., butter — a weighed amount of it is fed in conjunction with a mixed diet in which it forms the only source of fat, and the amount of fat in the feces is determined. Coefficients for carbohydrate and protein in food are obtained similarly, by comparing the amount of the food fed with the amount in the feces. Coefficients for all three constituents of a food may be determined simultaneously.

D. The values for the coefficients of digestibility.

1. For a general summary for proteins, fats, and carbohydrates from animal and vegetable sources, see table in Sherman’s Chemistry of Food and Nutrition, p. 76. Note especially that —
   a. There is very little loss in digestion of the common foods, less than is popularly supposed.
   b. Healthy individuals differ very little in their power to utilize foods.
   c. The animal foods, especially the animal proteins, are digested somewhat more completely than the vegetable — an average of 95% of the animal protein and 78% to 85% of the vegetable protein.

2. Coefficients for individual foods.
   a. Look up the digestibility of various foods — as given, for example, in Sherman’s Food Products — milk, meat, cheese, cereals, potatoes, beans, etc.
   b. Note the similarity of different kinds of fat — e.g., butter and oleomargarine — except the few fats of
VIII. The digestibility of food (continued).

high melting point, and also the similarity of wheat flour and its substitutes.

c. Read, if possible, accounts of some of the most recent work on digestibility. (See References.)

REFERENCES


