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What is food?

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OBJECTIVES

- To discuss the complex cultural, economic and physiological interactions that determine the acceptability of certain items as food
- To briefly explore the medical aspects of food
- To briefly explore the chemical complexity of food
- To briefly explore the biological complexity of food

FOOD AND ITS FUNCTIONS

Nutritional aspects

Humans need food to live. Our basic need for food is based on the body's requirement for the nutrients found in food. Nutrients provide energy, promote the growth and repair of tissues, and regulate body processes. The biological and health significance of a particular food depends on several factors, including the chemical composition of its components, its physical form, and the amount consumed. Information about the nutrient content of food is important for assessing the nutrient adequacy of human diets. The nutrient content of a food varies according to the plant species, animal breed, the level of maturity of the plant or animal, the soil and fertiliser used to grow the food or the animal fodder and the processing used to prepare the food. Information on most nutrients is available in tables of food composition. Because of the many factors which influence the composition of food, nutrient values listed in food composition tables are representative of particular types of foods and the values given may vary significantly from the actual composition of a particular food (see Chapter 9). Information about the role of diet in health and disease has been obtained from

studying human populations and from laboratory investigations. Some of these studies have identified particular foods and food components as important factors in disease prevention and causation. In recent years, a great deal of scientific research has been directed at evaluating the effect on health of food components which, in the conventional sense, do not appear to have a nutritive function but nevertheless may have important biological and health effects. The possible role of these substances in maintaining health and preventing disease is discussed in Chapters 14 and 24.

Social and emotional aspects

Food, however, is more than a collection of nutrients and a means of satisfying hunger. In addition to meeting the body's physiological demands, it must also satisfy certain emotional and social needs. Food is an integral part of many religious practices, cultural heritage and societal symbolism. It affects our well-being, not only because of its chemical composition, but because of its psychological impact on our state of mind. Preference for a particular food depends on a complex interaction of factors such as cultural and social background, aesthetic appeal, taste preference, nutritional value, convenience and economics. Food must meet far more than just our nutritional requirements.

A medical view

Most cultures have viewed food and eating both as ways of maintaining health (and preventing illness or disease) and as therapy (Wahlqvist, 1988). The separation of the nutritional from the medical roles of foods, however, has probably been greatest in recent Western thought and most developed in legal systems in the English-speaking world, as evidenced by food, as opposed to drug (and therapeutic goods), legislation. The medical constructs of food have variously been animistic in terms of life forces, religious (as in ancient Egypt where food was 'the gift of Osiris'), humoral (as with 'hot and cold' food beliefs throughout Asia) and, most recently, scientific (based on measurement and experiment and principles of inductive and deductive reasoning) (Darby et al., 1976 & 1977). It has become apparent that the complexity of food and its interactions with human biology continue to defy complete description, although information science is making rapid inroads into this area. But still the ways in which food may affect health through its production (and related environmental and human demands), and its role in socialisation and community affairs are rarely considered. Some people express concern about the potential for the 'medicalisation' of food, by which they usually mean the setting aside of the non-medical pleasures, values and benefits it has. The medical and non-medical views can be usefully complementary, however. Perhaps the clearest indication of a growing medical interest in food comes from the appreciation of its physico-chemical properties, non-nutrient components (mostly phytochemicals, see Chapter 13) and microbiology, with preventive medicine and therapeutic potential. With the newer food technologies a range of new food products with health claims is emerging, generally known as 'functional foods' (see Chapters 4 and 55). These are appearing for the following reasons (Wahlqvist, 1996):

1. the manufacturer wants it to be known, or the consumer wants to know, that a food may perform a biological function of health interest
2. food legislators and nutrition scientists wish to monitor and evaluate the impact of new products following their introduction
3. food retailers (who are renters of shelf space for food sales) want guidance as to how to direct consumers to their wares
4. a higher level of risk associated with a given benefit is acceptable when a food is positioned and selected as exceptional compared with a traditional food; this can be achieved by creating a functional food designation.
5. the pace of discovery in nutrition science and development in food technology is such that new products are fast emerging which some manufacturers and consumers will wish to evaluate without undue delay. They will need to understand that there may be longer-term unforeseen outcomes, both beneficial and detrimental in such areas as:
   (a) athletic performance
   (b) antioxidants and disease prevention
   (c) vitamin and mineral fortification of foods for disease prevention
   (d) multifunction phytochemical compounds from food
   (e) foods with pre- and probiotics

The introduction of functional foods will require the following.

1 There should be sufficient scientific evidence of effect or efficacy to satisfy a 'functional foods panel' including biomedical science, food technology, legal and consumer expertise.
2 It must be possible to monitor the health indicator or endpoint in the exposed group.
3 The food label should draw attention to the distinction between functional food and other food.
4 There should be national limits as to the extent to which the food supply should be 'functional' as opposed to traditional. It must be possible for sufficient variety of basic food commodities to be obtained and regularly included in a dietary pattern (e.g not less than 30 biologically distinct foods per week) and this will be deduced from regular national nutrition surveys. The realm of food choice, once dictated by traditional beliefs and knowledge, transmitted through families and communities from generation to generation, now has more and more scientifically based medical inputs. These inputs need to be tempered with a wholistic socio-cultural approach.

THE CHEMICAL COMPLEXITY OF FOOD

Food is a chemically complex mixture of a wide variety of different substances. In addition to the nutritionally important components such as protein, fat, carbohydrate, water, vitamins, minerals and dietary fibre, food also contains other substances such as colours, flavours, food additives, contaminants, and

Table 5.1 Schematic diagram showing the chemical complexity of food

FOOD	nutrients	macronutrients	carbohydrate
			protein
			fat
			dietary fibre
			water
			unidentified macronutrients?
		micronutrients	vitamins
			minerals
			unidentified micronutrients?
	non-nutrients	food additives	synthetic additives
			nature-identical additives
			natural additives
		contaminants	industrial pollutants
			production and processing contaminants
			natural contaminants
			unknown contaminants
		processing artefacts	colours
			flavours
			other identified components
			unidentified artefactual components
		naturally occurring non-nutrients	colours
			flavours
			other identified components
			unidentified natural components

many other products of plant and animal metabolism. This is represented schematically in Table 5.1. In contrast to nutrients, the non-nutrient constituents of food are usually far more numerous. Often they are present in only minute amounts. For example, water and carbohydrate comprise approximately 97.5% by weight of a cabbage. The remaining 2.5% contains almost 200 components, most of them associated with the colour and flavour of the cabbage (see Table 5.2).

- Nutrients are chemical substances required by an organism to maintain life and reproduce. The requirements for specific nutrients vary from organism to organism.
- Essential nutrients are those which must be obtained by the organism from the external environment. For example, plants obtain essential nutrients from the soil; humans obtain essential nutrients from food and water.
- Non-essential nutrients are those produced in sufficient amounts by the organism. They do not have to be obtained from the external environment provided that any substance necessary for their formation is available in sufficient amounts from the environment.
- Both essential and non-essential nutrients are required for life and health.
- Nutrients required by humans are a highly complex mixture of chemical substances and include carbohydrates, proteins, fats, vitamins, minerals, water.

Table 5.2 Components identified in cabbage

alanine
allyl cyanide
allyl glucosinolate
allyl isothiocyanate
aluminium
anthoxanthins
arginine
arsenic
ascorbic acid
aspartic acid
barium
benzylamine
benzyl glucosinolate
benzyl isothiocyanate
3-butenyl glucosinolate
3-butenyl isothiocyanate
butyl glucosinolate
cadmium
caffeic-acid
caffeic-acid-4-O-β-glucoside
4-caffoylquinic-acid
calcium
carbohydrate
β-carotene
carvone
chlorogenic acid
chromium
citric acid
cobalt
copper
p-coumaric acid
p-coumaric acid-O-β-D-glucoside
1-O-*p*-coumaroyl-β-D-glucose–3-O-(6-O-(*trans*-*p*-coumaroyl)–2-O-β-D-glucopyranosyl-(β-D-glucopyranosyl)–5-O-β-D-glucopyranosyl)-cyanidin
4-*p*-coumaroylquinic-acid
5-*p*-coumaroylquinic-acid
crocetin
cyanidin–3-(*p*-coumaroyl)-sophoroside–5-glucoside
cyanidin–3-(di-*p*-coumaroyl)-sophoroside–5-glucoside
cyanidin–3,5-diglucoside
cyanidin–3-(diferulyl)-sophoroside–5-glucoside
cyanidin–3-(disinapyl)-sophoroside–5-glucoside
cyanidin–3-feruloyl-sophoroside–5-glucoside
cyanidin–3-malonyl-sophoroside–5-glucoside
cyanidin–3-sinapyl-sophoroside–5-glucoside
cyanidin–3-sophoroside–5-glucoside
1-cyano–3,4-epithiobutane
1-cyano–3,4-epithiopentane
1-cyano–2,3-epithiopropane
1-cyano–2-hydroxy–3-butene
1-cyano–4-methyl-sulfinyl-butane
1-cyano–3-methylsulfinylpropane
1-cyano–4-methylthiobutane
1-cyano–3-methylthiopropane
dehydroascorbic acid
dietary fibre
diindolylmethane
dimethylamine
erythro–1-cyano–2-hydroxy–3,4-epithiobutane
ethylamine
ethylmethylamine
fat
ferulic acid

Table 5.2 (cont.)

ferulic acid-β-D-glucoside
L-O-feruloyl-β-D-glucose
3-O-(6-O-*trans*-ferulyl)–2-O-β-D-glucopyranosyl)-(β-D-glucopyranosyl)–5-O-β-D-glucopyranosyl)-cyanidin
5-feruloylquinic acid
fluorine
folates
fumaric acid
glucobrassicin
gluconapin
3-O-(2-O-β-D-glucopyranosyl)–6-O-(4-O-β-D-D-glucopyranosyl)–5-O-β-D-glucopyranosyl)-cyanidin
3-O-(2-O-β-D-glucopyranosyl)–6-O-(4-O-β-D-glucopyranosyl)*trans-p*-coumaryl)-β-D-glucopyranosyl)–5-O-β-D-glucopyranosyl-cyanidin
3-O-(2-O-β-D-glucopyranosyl)–6-O-(4-O-β-D-glucopyranosyl)trans-ferulyl)-O-β-D-glucopyranosyl)–5-O-β-D-glucopyranosyl-cyanidin
3-O-(2-O-β-D-glucopyranosyl)–6–O-(4-O-[β-D-glucopyranosyl]–5-O-β-D-glucopyranosyl)–5-O-β-D-glucopyranosyl-cyanidin
3-O-(6-O-[*trans*-sinapyl]–2–O-(β-D-glucopyranosyl)-β-D-glucopyranosyl–5-O-(β-D-glucopyranosyl)-cyanidin
glucoraphanin
glutamic acid
glycine
goitrin
histidine
2-hydroxy–3-butenyl glucosinolate
2-hydroxy–i-cyano-but–3-ene
4-hydroxyglucobrassicin
4-hydroxy–indo-3-yl-methyl-glucosinolate
4-hydroxy-indoyl-3-yl-methyl-glucosinolate
indole–3-acetonitrile
indole–3-carbinol
indole 3-carboxaldehyde
indoyl–3,3'-dimethane
3-Indoylmethyl glucosinolate
iron
iso-leucine
iso-menthol
jasmonic acid
kaempferol
kaempferol–3-feruloyl-sophoroside
kaempferol–7-glucoside
kaempferol–3-sinapoyl-sophoroside
kaempferol–3-sophoroside
kaempferol–3-sophoroside–7-glucoside
lanthanum
lead
leucine
linoleic acid
α-linolenic acid
lithium
lutein
lysine
magnesium
malic acid
manganese
menthol
methionine
4-methoxybrassicin
1-methoxyglucobrassicin
1-methoxy–3-Indoyl-methylbrassicin
2-methoxyphenol
methylamine
S-methylcysteine sulfoxide
N-methylphenethylamine
N-methyl-β-phenethylamine
4-methyl-sulfinyl-butyl glucosinolate
4-methyl-sulfinyl-butyl *iso*-thiocyanate
3-methyl-sulfinyl-propyl-glucosinolate
3-methyl-sulfinyl-propyl-*iso*-thiocyanate
4-methyl-thiobutyl-glucosinolate
4-methyl-thio-butyl-isothiocyanate
2-methyl-thiopropyl-glucosinolate
3-ethyl-thio-propyl-isothiocyanate
mevalonic acid
molybdenum
narcotine
neo-chlorogenic acid
neo-glucobrassicin
neo-menthol
niacin
nickel
n-nonacosane
nonacosan–15-one
oleic acid
oxalic acid
palmitic acid
pantothenic acid
4-pentenyl-isothiocyanate
N-pentylamine
phenethylamine
phenethylcyanide
phenylethyl-isothiocyanate
phenylalanine
2-phenylethyl-glucosinolate
pheophytin
2-propenyl-glucosinolate
propyl-glucosinolate
phosphorus
potassium
progoitrin
proline
prop–2-enyl-isothiocyanate
protein
protocatechuic acid
quercetin
quercetin–3-glucoside
quercetin–3-sinapoyl-sophoroside
quercetin–3-sophoroside
quercetin–3-sophoroside–7-glucoside
quinic acid
riboflavin
rubidium
sec-butyl-isothiocyanate
selenium
serine
silicon
silver
sinapic acid
1-O-sinapoyl-β-D-glucose

Table 5.2 (cont.)

3-O-(6-O-[*trans*-sinapoyl]–2-O-(β-D-glucopyranosyl)-β-D-glucopyranosyl–5-O-(β-D-glucopyranosyl)-cyanidin	titanium
sinigrin	α-tocopherol
β-sitosterol	tryptophan
sodium	tyrosine
spirobrassicin	valine
stearic acid	vanadium
strontium	5-vinyloxazolidine–2-thione
succinic acid	violaxanthin
sulfur	vitamin B6
thiamin	water
threo–1-cyano–2-hydroxy–3-epi-thiobutane	zinc
threonine	zirconium

Source: adapted from Duke, 1992

SUMMARY

- This chapter looks at the complex cultural, economic and physiological interactions that determine the acceptability of certain items as food.
- It briefly explores the medicalisation of food.
- It briefly explores the chemical complexity of food.
- It relates the chemical and physical makeup of food to its biological activity and links this to other chapters which examine in greater detail the role of food in preventing certain diseases and maintaining good health and wellbeing.

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