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# What is food?

*David R. Briggs & Mark L. Wahlqvist*

## 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**

<b>FOOD</b>	<b>nutrients</b>	<b>macronutrients</b>	carbohydrate	
			protein	
			fat	
			dietary fibre	
			water	
		unidentified macronutrients?		
		<b>micronutrients</b>	vitamins	
			minerals	
			unidentified micronutrients?	
			<b>non-nutrients</b>	<b>food additives</b>
	nature-identical additives			
	natural additives			
	<b>contaminants</b>	industrial pollutants		
		production and processing contaminants		
		natural contaminants		
		unknown contaminants		
	<b>processing artefacts</b>	colours		
		flavours		
		other identified components		
		unidentified artefactual components		
<b>naturally occurring non-nutrients</b>		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	1- <i>O</i> - <i>p</i> -coumaroyl- $\beta$ -D-glucose-3- <i>O</i> -(6- <i>O</i> -( <i>trans-p</i> -coumaroyl)-2- <i>O</i> - $\beta$ -D-glucopyranosyl-( $\beta$ -D-glucopyranosyl)-5- <i>O</i> - $\beta$ -D-glucopyranosyl)-cyanidin
allyl cyanide	
allyl glucosinolate	
allyl isothiocyanate	
aluminium	
anthoxanthins	
arginine	
arsenic	
ascorbic acid	4- <i>p</i> -coumaroylquinic-acid
aspartic acid	5- <i>p</i> -coumaroylquinic-acid
barium	crocetin
benzylamine	cyanidin-3-( <i>p</i> -coumaroyl)-sophoroside-5-glucoside
benzyl glucosinolate	cyanidin-3-(di- <i>p</i> -coumaroyl)-sophoroside-5-glucoside
benzyl isothiocyanate	cyanidin-3,5-diglucoside
3-butenyl glucosinolate	cyanidin-3-(diferulyl)-sophoroside-5-glucoside
3-butenyl isothiocyanate	cyanidin-3-(disinapyl)-sophoroside-5-glucoside
butyl glucosinolate	cyanidin-3-feruloyl-sophoroside-5-glucoside
cadmium	cyanidin-3-malonyl-sophoroside-5-glucoside
caffeic-acid	cyanidin-3-sinapyl-sophoroside-5-glucoside
caffeic-acid-4- <i>O</i> - $\beta$ -glucoside	cyanidin-3-sophoroside-5-glucoside
4-caffoylquinic-acid	1-cyano-3,4-epithiobutane
calcium	1-cyano-3,4-epithiopentane
carbohydrate	1-cyano-2,3-epithiopropane
$\beta$ -carotene	1-cyano-2-hydroxy-3-butene
carvone	1-cyano-4-methyl-sulfinyl-butane
chlorogenic acid	1-cyano-3-methylsulfinylpropane
chromium	1-cyano-4-methylthiobutane
citric acid	1-cyano-3-methylthiopropane
cobalt	dehydroascorbic acid
copper	dietary fibre
<i>p</i> -coumaric acid	diindolylmethane
<i>p</i> -coumaric acid- <i>O</i> - $\beta$ -D-glucoside	dimethylamine
	<i>erythro</i> -1-cyano-2-hydroxy-3,4-epithiobutane
	ethylamine
	ethylmethylamine
	fat
	ferulic acid

**Table 5.2 (cont.)**

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

**Table 5.2 (cont.)**

3-O-(6-O-[ <i>trans</i> -sinapoyl]-2-O-( $\beta$ -D-glucopyranosyl)- $\beta$ -D-glucopyranosyl)-5-O-( $\beta$ -D-glucopyranosyl)-cyanidin	titanium
sinigrin	$\alpha$ -tocopherol
$\beta$ -sitosterol	tryptophan
sodium	tyrosine
spirobrassicin	valine
stearic acid	vanadium
strontium	5-vinyloxazolidine-2-thione
succinic acid	violaxanthin
sulfur	vitamin B6
thiamin	water
<i>threo</i> -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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# FOOD AND NUTRITION

Australasia, Asia and the Pacific

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