

PLANTS AS FOOD

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Summary

The grass family (Poaceae) is the fifth largest family of flowering plants but the most important for humans. Three grass species (wheat, rice, and maize) provide 3/5 of all human calories. These three species combined with another 17 cultivars produce 85% of the world's calories. Species of Araceae, Brassicaceae, Dioscoreaceae, Euphorbiaceae, Fabaceae, Musaceae, Rosaceae, and Solanaceae also are important staples for many cultures.

Although plant foods are excellent sources of nutrients and energy, humans consume plants for other reasons as well. Food crops have symbolic and ritualistic value in virtually all cultures. Many food species also have medicinal value, due to the plethora of allelochemical compounds they possess. Not all of these compounds are beneficial. Humans employ physiological, behavioral, and technological means of detoxifying plant foods before they are consumed.

1. Introduction

Plants are irreplaceable food resources for humans. Synthetic chemicals and petroleum derivatives can replace many plant-derived medicines, fibers, and dyes; metal, brick, and concrete can replace wood; but there is no substitute for plant-derived foods. Almost all human foods are plants or organisms that eat plants. Saprophytic fungi contribute relatively little to the average caloric intake of most people. The first humans gathered wild species.

Modern cultures rely on high-yielding cultivars, giving them greater control over food supplies. While food scarcity and famine remain threats in some parts of the world (e.g., sub Saharan Africa and the Indian subcontinent), more than 90% of the world has a predictable and sufficient source of food.

Many anthropologists argue that the increase control of the food supply has been the most important factor in evolution of human society. Recent genetic modification of cultivars has increased productivity, palatability, and in some cases, the nutritive value of food crops. Nonetheless, all of the world's food plants were developed by traditional farmers beginning 9,000 to 10,000 years ago. This chapter describes the major food crops and reasons for consuming plant foods and provides a brief overview of the toxicity of foods.

2. Major Food Crops

Humans obtain 85% of their calories from 20 plant species and 60% from just three grasses – wheat (*Triticum aestivum*), rice (*Oryza sativa*), and maize (*Zea mays*). Only about 1% of the world's vascular plants have been important food sources and only a few hundred have been domesticated. Remarkably, none of these twenty fundamental foods trace their origin to modern agronomy.

All were developed by traditional farmers 2,000 to 9,000 years ago. Foraging for wild plant and animal resources was the first subsistence strategy used by *Homo sapiens*. While a few foraging or pastoralist cultures are extant, most of the world's population relies on cultivated species for their daily caloric needs.

The four most widely cultivated species in the world (Table 1) are members of the grass family (Poaceae). More sugar cane (*Saccharum officinarum*) is produced than any of the other cultivated grasses, but little is consumed directly. Sugar cane is the major source of table sugar and also is used in ethanol production. Sugar beets (*Beta vulgaris* subsp. *vulgaris*, Amaranthaceae), which rank sixth in annual production, are used similarly. Maize (or corn) production has increased in the past few years due to increasing demand for ethanol.

Potatoes (*Solanum tuberosum*, Solanaceae) are the most commonly cultivated tuber. Other important tubers include cassava (*Manihot esculenta*, Euphorbiaceae), sweet potatoes (*Ipomoea batatas*, Convolvulaceae), and yams (*Dioscorea* spp., Dioscoreaceae). The latter three are especially important food sources in the tropics. Soy beans (*Glycine max*, Fabaceae) and barley (*Hordeum vulgare*, Poaceae) also rank in the top ten but most soy is grown as an oil seed or source of vegetable protein. Similarly, barley is more important as a source of alcohol than as a food. The next 10 most widely cultivated crops include tomatoes (*Solanum lycopersicum*, Solanaceae), onions (*Allium cepa*, Alliaceae), and peanuts (*Arachis hypogaea*, Fabaceae). The latter is grown both as a food source and as an oilseed. Bananas/plantains (*Musa* × *paradisiaca*, Musaceae), grapes (*Vitis vinifera*, Vitaceae), sweet oranges (*Citrus sinensis*, Rutaceae), and apples (*Malus pumila*, Rosaceae) are the world's most popular fruits. About 70% of grape production is used to make wines.

Rank	Crop	Species	Family	2005 Production ¹	Notes
1	sugar cane	<i>Saccharum officinarum</i> L.	Poaceae	1328	most for sugar production
2	maize	<i>Zea mays</i> L.	Poaceae	725	Much used for animal fodder, increased production for ethanol
3	wheat	<i>Triticum aestivum</i> L.	Poaceae	630	
4	rice	<i>Oryza sativa</i> L.	Poaceae	608	
5	potatoes	<i>Solanum tuberosum</i> L.	Solanaceae	330	
6	sugar beets	<i>Beta vulgaris</i> L. subsp. <i>vulgaris</i>	Amaranthaceae	249	most for sugar production and fodder
7	soy beans	<i>Glycine max</i> (L.) Merr.	Fabaceae	206	most for oil and soy protein
8	cassava	<i>Manihot esculenta</i> Crantz	Euphorbiaceae	203	
9	barley	<i>Hordeum vulgare</i> L.	Poaceae	154	ca. 50% used for fodder, much used to in alcohol production
10	sweet potatoes	<i>Ipomoea batatas</i> (L.) Lam.	Convolvulaceae	127	
11	tomatoes	<i>Solanum esculentum</i> Dunal	Solanaceae	125	
12	bananas	<i>Musa ×paradisiaca</i> L.	Musaceae	73	
13	grapes	<i>Vitis vinifera</i> L.	Vitaceae	65	ca. 70% used for wine
14	onions	<i>Allium cepa</i> L.	Alliaceae	64	
15	oranges	<i>Citrus sinensis</i> (L.) Osbeck	Rutaceae	62	much for frozen orange concentrate
16	sorghum	<i>Sorghum bicolor</i> (L.) Moench	Poaceae	58	much for fodder and molasses
17	apples	<i>Malus pumila</i> Mill.	Rosaceae	55	
18	yams	<i>Dioscorea</i> spp.	Dioscoreaceae	40	
19	peanuts	<i>Arachis hypogaea</i> L.	Fabaceae	36	
20	millet	<i>Panicum miliaceum</i> L.	Poaceae	28	
21	oats	<i>Avena sativa</i> L.	Poaceae	26	

22	mangoes	<i>Mangifera indica</i> L.	Anacardiaceae	25	
23	common beans	<i>Phaseolus vulgaris</i> L.	Fabaceae	18	
24	rye	<i>Secale cereale</i> L.	Poaceae	18	
25	olives	<i>Olea europaea</i> L.	Oleaceae	17	most for oil

Table 1. Major food crops of the world and annual production values.

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Among the other top food 20 species are millet (*Panicum miliaceum*, Poaceae), oats (*Avena sativa*, Poaceae), mangoes (*Mangifera indica*, Anacardiaceae), common beans (*Phaseolus vulgaris*, Fabaceae), rye (*Secale cereale*, Poaceae), and olives (*Olea europaea*, Oleaceae). From a taxonomic perspective, Poaceae and Fabaceae are the most important plant families for humans. Rosaceae provides many edible fruits in the temperate zone. Anacardiaceae, Arecaceae, Myrtaceae, and Rutaceae are the tropical equivalents of Rosaceae. Tubers from Solanaceae, Dioscoreaceae, Araceae, and Euphorbiaceae provide staples for many cultures where members of Poaceae do not thrive. Many species of Apiaceae and Brassicaceae are major foods in temperate zones. Species of Cucurbitaceae are important in all regions. Appendix 1 provides a list of the major world food crops, providing common names, scientific name with author citation, family, and origin.

3. Value of Foods

Why do humans eat? The obvious answer is to obtain nutrients and energy. For all but a few modern cultures, plants provide the bulk of daily calories and around 65% of the protein. Growing archaeological evidence suggests that the diets of Paleolithic people were not as meat-oriented as often portrayed. Plant foods probably represented 50% or more of their diets. While the nutritional and energetic requirements for growth, development, and homeostasis are primary reasons for consuming foods, they are not the only reasons. In many cultures, the distinction between food and medicine is obscure. Foods provide calories and nutrients, but they also contain many chemical compounds that can prevent or alleviate disease. Food has another significant value—foods and meals have important ritualistic and symbolic values. Along with language and religion, foodways are one of the defining elements of a culture.

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Biographical Sketch

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